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Accounting (ACCT)

Courses primarily for undergraduates:

ACCT 215. Legal Environment of Business.

(3-0) Cr. 3. F.S.SS. *Prereq: Sophomore classification*

General history, structure, and principles of law. The legal system, as an agency of social control; good business practices, and tool for change. The court systems, Constitution, torts, contracts, administrative agencies, and agency law.

ACCT 284. Financial Accounting.

(3-0) Cr. 3. F.S.SS. *Prereq: not open to first term freshmen*

Introduction to the basic concepts and procedures of financial accounting from a user perspective. The course examines the accounting cycle, business terminology, basic control procedures, and the preparation and evaluation of financial reports, with an emphasis on financial statement analysis.

ACCT 285. Managerial Accounting.

(3-0) Cr. 3. F.S.SS. *Prereq: ACCT 284*

Understanding of fixed and variable costs and their role in planning, control and performance evaluation. Examination of alternative costing methods. Making decisions by identifying and developing relevant information. Development of spreadsheet skills.

ACCT 301. The Accounting Cycle.

(1-0) Cr. 1. F.S.SS. *Prereq: ACCT 284*

Interactive computer-based analysis of the accounting cycle including transactions and financial statements. Preparation of journal entries and adjusting entries and completion of the closing process.

ACCT 316. Business Law.

(3-0) Cr. 3. F.S. *Prereq: ACCT 215*

Continuation of 215. Sales under the Uniform Commercial Code, negotiable instruments, secured transactions, property transactions, partnerships, and wills and estates.

ACCT 383. Intermediate Managerial Accounting.

(3-0) Cr. 3. F.S. *Prereq: ACCT 285 or ACCT 501; and ACCT 301*

Generation, communication and use of information to assist management with planning, control, and decision making in manufacturing and service organizations. Includes cost concepts and relevance to decision situations, operational and capital budgeting, and performance evaluation. Emphasis on developing effective teamwork skills as well as spreadsheet capabilities.

ACCT 384. Accounting Information Systems.

(3-0) Cr. 3. *Prereq: ACCT 285 or ACCT 501; ACCT 301 and MIS 301*

Analysis of concepts and procedures underlying the automated accumulation and processing of accounting data. EDP internal control and audit techniques. Trends in accounting information systems.

ACCT 386. Intermediate Accounting I.

(3-0) Cr. 3. F.S. *Prereq: ACCT 285 or ACCT 501 and ACCT 301*

The conceptual framework of financial accounting. Communication of financial information on the income and retained earnings statements, statement of cash flows, and the balance sheet. Accounting concepts relating to current and operational assets of the firm. Identification of material differences between US GAAP and International Accounting Standards.

ACCT 387. Intermediate Accounting II.

(3-0) Cr. 3. F.S. *Prereq: ACCT 386*

Financial accounting and reporting practices for business entities. Generally accepted accounting principles (GAAP) relative to firm liabilities, equity, income, taxes, employee benefits, leases, accounting changes and cash flows. Identification of material differences between US GAAP and International Accounting Standards. Discussion of current issues in financial accounting. Focus on written communication.

ACCT 483. Advanced Managerial Accounting.

(Dual-listed with ACCT 583). Cr. 3. *Prereq: ACCT 383 or ACCT 581*

Business simulation focusing on generation and communication of information to assist management with financial decision-making. Emphasis on developing teamwork, written communication, and oral presentation skills.

ACCT 484. Advanced Accounting Information Systems.

(Dual-listed with ACCT 584). (3-0) Cr. 3. *Prereq: ACCT 384*

Advanced accounting information systems concepts; database design and information retrieval, internal controls within computerized accounting information systems, financial reporting in an electronic environment.

ACCT 485. Principles of Federal Income Tax.

(3-0) Cr. 3. F.S. *Prereq: ACCT 386 or ACCT 501*

Introduction to the fundamentals of federal income taxation and concepts applicable to all tax entities. Addresses issues related to the measurement and recognition of income, deductions, gains, and losses, taxation of property transactions, and basis / cost recovery concepts. Includes coverage of tax law policy objectives, tax implications of business and investment decisions, tax versus financial reporting treatment of common business transactions, and ethical issues related to tax compliance and planning.

ACCT 487. Volunteer Income Tax Assistance.

(Dual-listed with ACCT 587). (0-2) Cr. 1. Repeatable, maximum of 3 credits. S.

Prereq: ACCT 285 or ACCT 501

Introduction to and field work in the preparation of individual income tax returns (state and federal). Basic coverage of filing and residency status, taxable income, exemptions, deductions, and credits. Tax software usage and online filing.

ACCT 488. Governmental and Non-profit Institution Accounting.

(Dual-listed with ACCT 588). (3-0) Cr. 3. *Prereq: ACCT 387*

Accounting and financial reporting principles of local and state governments, including universities, schools, and hospitals. In addition, accounting and financial reporting of non-profit organizations will be addressed. Financial statements of local governmental units and the university are explored.

ACCT 490. Independent Study.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: ACCT 285, senior classification, permission of instructor*

ACCT 495. Advanced Accounting Problems.

(Dual-listed with ACCT 595). (3-0) Cr. 3. *Prereq: ACCT 387*

Accounting for business combinations and affiliated companies, intercompany transactions, and consolidated financial statements; Partnership accounting; Segment and Interim Reporting; Multinational accounting.

ACCT 496. International Accounting.

(Dual-listed with ACCT 596). (3-0) Cr. 3. *Prereq: ACCT 386 or ACCT 501*

Financial reporting issues in a global environment, including introduction to International Financial Reporting Standards (IFRS) and the potential for the use of IFRS in the U.S. Accounting and managerial issues faced by multinational corporations. Technical issues such as transfer pricing, inflation accounting and taxation will be discussed.

ACCT 497. Introduction to Auditing.

(3-0) Cr. 3. F.S. *Prereq: ACCT 384, ACCT 387 and STAT 326*

The conceptual framework of auditing. Professional ethics. External reporting concepts. Audit methodology including risk analysis, internal control, procedures for gathering evidence and the role of statistical sampling in auditing.

ACCT 498. Capstone in Accounting.

(2-0) Cr. 2. F. *Prereq: ACCT 383, ACCT 384, ACCT 387, and ACCT 485.*

Integrative studies in accounting. Development of critical thinking, ethical reasoning, professional research and teamwork skills. Written, visual, and oral communication with corporate stakeholders.

Courses primarily for graduate students, open to qualified undergraduates:

ACCT 501. Financial Accounting.

(3-0) Cr. 3. *Prereq: Enrollment in MBA program or departmental permission*

A general introduction to financial accounting information. Topics covered include the use and analysis of financial information, the regulatory environment, the role of International Financial Reporting Standards (IFRS), and the use of the internet and electronic spreadsheets as a means of accessing and analyzing financial data.

ACCT 581. Accounting for Decision Making.

(3-0) Cr. 3. *Prereq: ACCT 501 or equivalent*

Decision analysis applied to managerial accounting issues. Generation of information for management decision making and control. Responsibility accounting and non-recurring decisions.

ACCT 582. Corporate Governance and Top Management.

(Cross-listed with MGMT). (3-0) Cr. 3. *Prereq: MGMT 503 or permission*

Duties, structure, and functioning of top management teams and corporate boards of directors. CEO/board tenure and succession planning, top management compensation, board committee composition, assessment of CEO and board performance, theories of corporate governance, management of the corporate strategic agenda, governance codes, international governance, and chairman/CEO duality. Case studies and contemporary issues discussed.

ACCT 583. Advanced Managerial Accounting.

(Dual-listed with ACCT 483). Cr. 3. *Prereq: ACCT 383 or ACCT 581*

Business simulation focusing on generation and communication of information to assist management with financial decision-making. Emphasis on developing teamwork, written communication, and oral presentation skills.

ACCT 584. Advanced Accounting Information Systems.(Dual-listed with ACCT 484). (3-0) Cr. 3. *Prereq: ACCT 384*

Advanced accounting information systems concepts; database design and information retrieval, internal controls within computerized accounting information systems, financial reporting in an electronic environment.

ACCT 585. Taxes and Business Strategy.(3-0) Cr. 3. *Prereq: ACCT 485*

Integration of concepts from accounting, finance, and economics to determine how taxes affect business decisions. Provides students with a conceptual framework for thinking about business tax planning and applies it to various common business decisions.

ACCT 586. Advanced Federal Taxation.(3-0) Cr. 3. *Prereq: ACCT 485*

Advanced coverage of federal taxation including issues related to the taxation of corporations, partnerships, estates and trusts, and their owners. Includes coverage of rules, concepts, background, and planning opportunities related to a number of common transactions involving these entities.

ACCT 587. Volunteer Income Tax Assistance.

(Dual-listed with ACCT 487). (0-2) Cr. 1. Repeatable, maximum of 3 credits. S.

Prereq: ACCT 285 or ACCT 501

Introduction to and field work in the preparation of individual income tax returns (state and federal). Basic coverage of filing and residency status, taxable income, exemptions, deductions, and credits. Tax software usage and online filing.

ACCT 588. Governmental and Non-profit Institution Accounting.(Dual-listed with ACCT 488). (3-0) Cr. 3. *Prereq: ACCT 387*

Accounting and financial reporting principles of local and state governments, including universities, schools, and hospitals. In addition, accounting and financial reporting of non-profit organizations will be addressed. Financial statements of local governmental units and the university are explored.

ACCT 590. Special Topics.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

For students wishing to do individual research in a particular area of accounting.

ACCT 591. Fraud Examination and Prevention.(3-0) Cr. 3. *Prereq: ACCT 497 or ACCT 501*

Principles and methodology of fraud detection and deterrence. Addresses the causes and elements of fraud, asset theft, corruption, financial statement misrepresentation, internal controls for fraud prevention, investigative evidence gathering, and legal aspects of fraud.

ACCT 592. Financial Statement Analysis.(3-0) Cr. 3. *Prereq: ACCT 284 or ACCT 501*

Presentation and analysis of financial statement information from the point of view of the primary users of such data: owners and creditors. Topics include the financial reporting system, the primary financial statements, effects of accounting method choice on reported financial data, and firm valuation.

ACCT 594. Business Valuation.(3-0) Cr. 3. *Prereq: ACCT 387 or ACCT 592*

Using financial statement analysis to value the firm. Topics covered include assessing how well a firm's financial statements reflect the economic effects of its resource management strategies and constructing proforma financial information that will serve as inputs to valuation models.

ACCT 595. Advanced Accounting Problems.(Dual-listed with ACCT 495). (3-0) Cr. 3. *Prereq: ACCT 387*

Accounting for business combinations and affiliated companies, intercompany transactions, and consolidated financial statements; Partnership accounting; Segment and Interim Reporting; Multinational accounting.

ACCT 596. International Accounting.(Dual-listed with ACCT 496). (3-0) Cr. 3. *Prereq: ACCT 386 or ACCT 501*

Financial reporting issues in a global environment, including introduction to International Financial Reporting Standards (IFRS) and the potential for the use of IFRS in the U.S. Accounting and managerial issues faced by multinational corporations. Technical issues such as transfer pricing, inflation accounting and taxation will be discussed.

ACCT 597. Advanced Auditing and Assurance Services.(3-0) Cr. 3. *Prereq: ACCT 497*

A study of advanced auditing and assurance issues. Topics include risk analysis, internal control, fraud detection, analytical procedures, evaluating operational and strategic objectives, and reporting and implementing audit findings.

ACCT 598. Financial Accounting: Theory and Contemporary Issues.(3-0) Cr. 3. F. *Prereq: ACCT 386 or ACCT 501*

Theoretical discussion of the financial accounting and reporting environment. The usefulness of financial accounting information for decision making. Current financial accounting issues, the financial accounting standard setting process, FASB Standards Codification, and the role of the SEC in financial reporting.

ACCT 599. Creative Component.Cr. 2. *Prereq: Admission to the Master of Accounting Program*

This course prepares students to complete their creative component project option in the Master of Accounting degree.

Advertising (ADVRT)

Courses primarily for undergraduates:

ADVRT 230. Advertising Principles.

(3-0) Cr. 3. F.S.

Historical, social, economic and legal aspects of advertising. Evaluations of advertising research, media, strategy and appeals. Study of the creation of advertising.

ADVRT 301. Research and Strategic Planning for Advertising and Public Relations.

(Cross-listed with P R). (3-0) Cr. 3. F.S. *Prereq: ADVRT 230 or P R 220; Sophomore classification*

The use of primary and secondary research for situations, organizations and the public. Formation and development of strategic plans for public relations and advertising students.

ADVRT 334. Advertising Creativity.

(2-2) Cr. 3. *Prereq: Minimum of C+ in JL MC 201; ADVRT 301/P R 301*

Development and execution of creative advertising materials. Copywriting, art direction and computer applications. Creative strategy development, execution and evaluation.

ADVRT 335. Advertising Media Planning.

(3-0) Cr. 3. F.S. *Prereq: ADVRT/P R 301*

Concepts of media planning and selection in the development, execution and evaluation of advertising campaigns. Characteristics and capabilities of the advertising media. Utilization of market segmentation, consumer buying and media audience databases.

ADVRT 336. Advertising Account Management.

(3-0) Cr. 3. F.S. *Prereq: Minimum of C+ in JL MC 201; ADVRT/P R 301*

Fundamentals of account management with emphasis on leadership, sales techniques, relationship building, presentation skills, and strategic thinking. Includes aspects of agency communications, team building, client management, evaluating creative concepts and media plans, and developing strategic proposals and campaign recommendations.

ADVRT 390. Professional Skills Development.

(Cross-listed with JL MC, P R). Cr. 1-3. Repeatable, maximum of 6 credits. F.S. *Prereq: Minimum of C+ in JL MC 201; other vary by topic. Instructor permission for non-majors.*

Check with Greenlee School for course availability.

ADVRT 434. Advertising Campaigns.

(3-0) Cr. 3. F.S. *Prereq: Minimum of C+ in ADVRT 334 or ADVRT 336, and major status*

Development of advertising campaigns for business and social institutions. Projects involve budgeting, media selection, market analysis, campaign strategy and creative execution.

ADVRT 435. Advertising Competition.

Cr. 1-3. Repeatable, maximum of 3 credits. Alt. S., offered irregularly. *Prereq: Permission of instructor, Junior/senior standing strongly recommended*

Preparation of materials for regional and national competitions.

ADVRT 436. Advertising Portfolio Practicum.

(2-2) Cr. 3. S. *Prereq: Minimum of C+ in ADVRT 334, non-majors with instructor permission*

Advanced advertising writing and design. Emphasis on creative strategy, problem solving and execution of creative materials in print, broadcast and online media for a variety of clients.

ADVRT 497. Special Topics in Communication.

(Cross-listed with JL MC, P R). Cr. 1-3. Repeatable, maximum of 6 credits. F.S. Seminars or one-time classes on topics of relevance to students in communication.

ADVRT 499. Professional Media Internship.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: JL MC majors: minimum of C+ in JL MC 202 or JL MC 206 or P R 321; ADVRT majors: minimum of C+ in JL MC 201 and ADVRT 301; P R majors: minimum of C+ in P R 321. All students, junior classification, formal faculty adviser approval.*

Required of all Greenlee School majors. A 400-hour (for 3 credits) internship in the student's journalism and mass communication or advertising or public relations specialization. Assessment based on employer evaluations, student reports and faculty reviews. Available only to Greenlee School majors. Offered on a satisfactory-fail basis only.

Aerospace Engineering (AER E)

Courses primarily for undergraduates:

AER E 101H. Engineering Honors Orientation.

Cr. R. F. *Prereq: Membership in the Freshman Honors Program*
Introduction to the College of Engineering and the Aerospace Engineering profession. Information concerning university, college, and department policies, procedures and resources with emphasis on the Freshman Honors Program. Topics include experiential education study abroad opportunities, and department mentorships.

AER E 112. Orientation to Learning and Productive Team Membership.

(Cross-listed with CON E, FS HN, HORT, NREM). (2-0) Cr. 2. F.
Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

AER E 160. Aerospace Engineering Problems With Computer Applications Laboratory.

(2-2) Cr. 3. F.S. *Prereq: Satisfactory scores on mathematics placement assessments; credit or enrollment in MATH 142, MATH 165*
Solving aerospace engineering problems and presenting solutions through technical reports. Significant figures and estimation. SI units. Graphing and curve fitting. Introduction to aerospace engineering and engineering design. Spreadsheet programs. History of aerospace. Systems thinking. Team projects.

AER E 160H. Aerospace Engineering Problems With Computer Applications Laboratory: Honors.

(2-2) Cr. 3. F.S. *Prereq: Satisfactory scores on mathematics placement assessments; credit or enrollment in MATH 142, MATH 165*
Solving aerospace engineering problems and presenting solutions through technical reports. Significant figures. SI units and estimation. Graphing and curve fitting. Introduction to aerospace engineering and engineering design. Spreadsheet programs. History of aerospace. Systems thinking. Team projects.

AER E 161. Numerical, Graphical and Laboratory Techniques for Aerospace Engineering.

(2-2) Cr. 3. F.S. *Prereq: AER E 160 or equivalent course*
Computer solutions to aerospace engineering problems using the FORTRAN language and Matlab(R), with emphasis on numerical methods. Solid modeling with emphasis on aerospace design. Analysis of basic mathematical models and engineering problem solving. Written and oral technical reports, team projects.

AER E 161H. Numerical, Graphical and Laboratory Techniques for Aerospace Engineering: Honors.

(2-2) Cr. 3. F.S. *Prereq: AER E 160 or equivalent course*
Computer solutions to aerospace engineering problems using the FORTRAN language and Matlab(R), with emphasis on numerical methods. Solid modeling with emphasis on aerospace design. Analysis of basic mathematical models and engineering problem solving. Written and oral technical reports, team projects.

AER E 192. Aerospace Seminar.

Cr. R. S.
Experimental lab set-up, graphical skills. Academic program planning.

AER E 192H. Aerospace Seminar: Honors..

Cr. R. S.
Experimental lab set-up, graphical skills. Academic program planning.

AER E 261. Introduction to Performance and Design.

(3-0) Cr. 3. F.S. *Prereq: AER E 161, MATH 166, PHYS 221*
Introduction to aerospace disciplinary topics, including: aerodynamics, structures, propulsion, and flight dynamics with emphasis on performance. Written technical reports and team projects.

AER E 265. Scientific Balloon Engineering and Operations.

(Cross-listed with MTEOR). (0-2) Cr. 1. Repeatable. F.
Engineering aspects of scientific balloon flights. Integration of science mission objectives with engineering requirements. Operations team certification. FAA and FCC regulations, communications, and command systems. Flight path prediction and control.

AER E 290. Aerospace Engineering Independent Study: Independent Study.
Cr. 1-2. Repeatable. *Prereq: Sophomore classification, approval of the department*

AER E 290A. Aerospace Engineering Independent Study: Flight ground instruction.

Cr. 1-2. Repeatable. *Prereq: Sophomore classification, approval of the department*

AER E 290B. Aerospace Engineering Independent Study: In-flight training.
Cr. 1-2. Repeatable. *Prereq: AER E 301*

AER E 290C. Aerospace Engineering Independent Study: Other.
Cr. 1-2. Repeatable. *Prereq: AER E 301*

AER E 291. Aerospace Advising Seminar.

Cr. R. F.
Academic program planning. Offered on a satisfactory-fail basis only.

AER E 292. Aerospace Advising Seminar.

Cr. R. S.
Academic program planning. Offered on a satisfactory-fail basis only.

AER E 298. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services*
First professional work period in the cooperative education program. Students must register for this course prior to commencing work. Offered on a satisfactory-fail basis only.

AER E 301. Flight Experience.

Cr. R. F. *Prereq: Credit or enrollment in AER E 355*
Two hours of in-flight training and necessary ground instruction. Course content prescribed by the Aerospace Engineering Department. Ten hours of flight training certified in a pilot log book can be considered by the course instructor as evidence of satisfactory performance in the course. Offered on a satisfactory-fail basis only.

AER E 310. Aerodynamics I: Incompressible Flow.

(3-0) Cr. 3. F.S. *Prereq: Grade of C- or better in AER E 261 and MATH 265*
Introduction to fluid mechanics and aerodynamics. Fluid properties and kinematics. Conservation equations in differential and integral form. Bernoulli's equation. Basic potential flow concepts and solutions. Boundary layer concept. Incompressible flow over airfoils and wings. Examples of numerical methods. Applications of multi-variable calculus to fluid mechanics and aerodynamics.

AER E 311. Aerodynamics II: Compressible Flow.

(3-0) Cr. 3. F.S. *Prereq: AER E 310, ME 231*
Review of thermodynamics, energy equation, compressible flow, and isentropic flow. Normal and oblique shocks. Mach waves and expansion fans. Applications to ducts and nozzles. Compressible airfoil and wing theory. Introduction to advanced compressible flow topics.

AER E 321. Flight Structures Analysis.

(3-0) Cr. 3. F. *Prereq: EM 324, Credit or enrollment in MATH 266 or 267*
Introduction to elasticity, airworthiness, and flight loads. Introduction to fatigue. Materials selection for flight applications. Thin walled cross-sections under bending, torsion, and shear loads using classical methods. Shear center. Column buckling. Matrix methods of structural analysis.

AER E 322. Aerospace Structures Laboratory.

(1-2) Cr. 2. F. *Prereq: Credit or enrollment in AER E 321*
Design of experiments. Data analysis. Strain gage installation. Measurement of stiffness/strength of aluminum. Analysis/fabrication/testing of riveted joints. Shear/bending measurements in beam sections. Analysis/measurement of strains in frames. Buckling of columns. Stress concentration. Vibration testing of beams and plates. Fabrication/testing of composites.

AER E 331. Flight Control Systems I.

(3-0) Cr. 3. S. *Prereq: AER E 355*
Linear system analysis. Control system designs using root-locus and frequency response methods. Applications in flight control systems.

AER E 344. Aerodynamics and Propulsion Laboratory.

(2-2) Cr. 3. F.S. *Prereq: AER E 310; Coreq: AER E 311*
Similitude and dimensional analysis. Measurement uncertainty analysis. Pressure and velocity measurement methods and instruments. Pressure distribution around a circular cylinder. Aerodynamic performance of low-speed airfoils. Airfoil wake flow; Boundary layer flow. Flow visualization techniques for supersonic flows and de Laval nozzles.

AER E 351. Astrodynamic I.

(3-0) Cr. 3. F.S. *Prereq: EM 345, AER E 261, Credit or enrollment in AER E 310*
Introduction to astrodynamic. Two-body motion. Geocentric, lunar and interplanetary trajectories and applications. Launch and atmospheric re-entry trajectories.

AER E 355. Aircraft Flight Dynamics and Control.(3-0) Cr. 3. F. *Prereq:* AER E 261, MATH 267, E M 345

Aircraft rigid body equations of motion, linearization, and modal analysis. Longitudinal and lateral-directional static and dynamic stability analysis. Flight handling characteristics analysis. Longitudinal and lateral-directional open loop response to aircraft control inputs. Aircraft flight handling qualities.

AER E 361. Computational Techniques for Aerospace Design.(2-2) Cr. 3. F.S. *Prereq:* AER E 310, MATH 267, E M 324, E M 345

Advanced programming, workstation environment, and development of computational tools for aerospace analysis and design. Technical report writing.

AER E 362. Aerospace Systems Integration.(3-0) Cr. 3. F.S. *Prereq:* Junior standing in Aerospace Engineering or permission of instructor

Emphasis on impact of component interfaces in aerospace systems. Understand how changes in variables associated with individual components impact the performance of the aerospace system. Specific integration challenges include: capturing implicit disciplinary interactions (e.g. structures/aerodynamics, propulsion/aerodynamics, etc.), propagating tolerances through the system (i.e. uncertainty modeling), balancing component attributes in the system objective.

AER E 381. Introduction to Wind Energy.(3-0) Cr. 3. S. *Prereq:* MATH 166, PHYS 221

Basic introduction to the fundamentals of Wind Energy and Wind Energy conversion systems. Topics include but not limited to various types of wind energy conversion systems and the aerodynamics, blade and tower structural loads, kinematics of the blades and meteorology.

AER E 391. Aerospace Advising Seminar.

Cr. R. F.S.

Academic program planning. Offered on a satisfactory-fail basis only.

AER E 392. Aerospace Advising Seminar.

Cr. R. S.

Academic program planning. Offered on a satisfactory-fail basis only.

AER E 396. Summer Internship.Cr. R. Repeatable. SS. *Prereq:* Permission of department and Engineering Career Services

Summer professional work period. Students must register for this course prior to commencing work. Offered on a satisfactory-fail basis only.

AER E 397. Engineering Internship.Cr. R. Repeatable. F.S. *Prereq:* Permission of department and Engineering Career Services

Students must register for this course prior to commencing work. Offered on a satisfactory-fail basis only. Professional work period, one semester maximum per academic year.

AER E 398. Cooperative Education.Cr. R. F.S.SS. *Prereq:* AER E 298, permission of department and Engineering Career Services

Second professional work period in the cooperative education program. Students must register for this course prior to commencing work. Offered on a satisfactory-fail basis only.

AER E 411. Aerospace Vehicle Propulsion I.(3-0) Cr. 3. F.S. *Prereq:* AER E 311

Atmospheric propulsion system performance and cycle analysis. Momentum theorem, thrust and propulsive efficiency. Thermodynamics of compressible flow with heat and work addition. Components and principles of turbojets and turbofans. Rocket engines and ramjet principles.

AER E 412. Aerospace Vehicle Propulsion II.(3-0) Cr. 3. S. *Prereq:* AER E 311

Electricity and magnetism. Plasma physics. Ion engine performance. Introduction to advanced electromagnetic propulsion systems. Energy sources and nuclear propulsion. Space mission requirements.

AER E 417. Experimental Mechanics.(Cross-listed with E M). (2-2) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* E M 324

Introduction of different aspects of measuring deformation, strains, and stress for practical engineering problems. Strain gage theory and application. Selected laboratory experiments.

AER E 421. Advanced Flight Structures.(2-2) Cr. 3. S. *Prereq:* AER E 321, MATH 266 or MATH 267

Analysis of indeterminate flight structures including finite element laboratory. Static analysis of complex structural components subject to thermal and aerodynamic loads. Analytical and finite element solutions for stresses and displacements of membrane, plane stress, plate structures. Buckling of beams, frames, and plate structures. Introduction to vibration of flight structures. Steady state and transient structural response using normal modal analysis.

AER E 422. Vibrations and Aeroelasticity.(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* E M 324 or AER E 321

Vibration theory. Steady and unsteady flows. Mathematical foundations of aeroelasticity, static and dynamic aeroelasticity. Linear unsteady aerodynamics, non-steady aerodynamics of lifting surfaces. Stall flutter. Aeroelastic problems in civil engineering structures. Aeroelastic problems of rotorcraft. Experimental aeroelasticity. Selected wind tunnel laboratory experiments.

AER E 423. Composite Flight Structures.(2-2) Cr. 3. S. *Prereq:* E M 324; MAT E 273

Fabrication, testing and analysis of composite materials used in flight structures. Basic laminate theory of beams, plates and shells. Manufacturing and machining considerations of various types of composites. Testing of composites for material properties, strength and defects. Student projects required.

AER E 426. Design of Aerospace Structures.(1-6) Cr. 3. S. *Prereq:* E M 324

Detailed design and analysis of aerospace vehicle structures. Material selection, strength, durability and damage tolerance, and validation analysis. Design for manufacturability.

AER E 432. Flight Control Systems II.(3-0) Cr. 3. F. *Prereq:* AER E 331

Aircraft lateral directional stability augmentation. Launch vehicle pitch control system design. Control of flexible vehicles. Satellite attitude control. Flight control designs based on state-space methods. Introduction to sample-data systems.

AER E 442. V/STOL Aerodynamics and Performance.(3-0) Cr. 3. F. *Prereq:* AER E 261

Introduction to the aerodynamics, performance, stability, control and critical maneuvering characteristics of V/STOL vehicles. Topics include hovercrafts, jet flaps, ducted fans and thrust vectored engines.

AER E 446. Computational Fluid Dynamics.(3-0) Cr. 3. F. *Prereq:* AER E 311, AER E 361

Introduction to computational fluid dynamics. Discretization, consistency, and stability. Explicit and implicit methods for ordinary and partial differential equations. Linearization techniques. Iterative and direct solution algorithms. Numerical methods for parabolic, elliptic and hyperbolic equations. Curvilinear coordinates and numerical grid generation. Applications to Euler, boundary-layer and Navier-Stokes equations.

AER E 448. Fluid Dynamics of Turbomachinery.(Cross-listed with M E). (3-0) Cr. 3. S. *Prereq:* AER E 311 or M E 335

Applications of principles of fluid mechanics and thermodynamics in performance analysis and design of turbomachines. Conceptual and preliminary design of axial and radial flow compressors and turbines using velocity triangles and through-flow approaches.

AER E 451. Astrodynamics II.(3-0) Cr. 3. F.S. *Prereq:* AER E 351

Orbit determination and prediction using Gibb's and Gauss' methods. Advanced orbit maneuvers, triple-, and fixed-impulse; universal variables; Kepler's problem. Earth gravity field models and gravity harmonics, orbit perturbations, advanced dynamics, variational methods, relative orbital mechanics, and Clohessy-Wiltshire equations.

AER E 461. Modern Design Methodology with Aerospace Applications.(2-2) Cr. 3. F.S. *Prereq:* AER E 361, AER E 311, AER E 321, AER E 351, AER E 355

Introduction to modern engineering design methodology. Computational constrained optimal design approach including selection of objective function, characterization of constraint system, materials and strength considerations, and sensitivity analyses.

AER E 462. Design of Aerospace Systems.(1-4) Cr. 3. F.S. *Prereq:* AER E 461

Fundamental principles used in engineering design of aircraft, missile, and space systems. Preliminary design of aerospace vehicles. Engineering Ethics.

AER E 464. Spacecraft Systems.

(3-0) Cr. 3. S. Prereq: AER E 351

An examination of spacecraft systems including attitude determination and control, power, thermal control, communications, propulsion, guidance, navigation, command and data handling, and mechanisms. Explanation of space and operational environments as they impact spacecraft design. Includes discussion of safety, reliability, quality, maintainability, testing, cost, legal, and logistics issues.

AER E 466. Multidisciplinary Engineering Design.

(Cross-listed with A B E, CPR E, E E, ENGR, I E, M E, MAT E). (1-4) Cr. 3. Repeatable. F.S. Prereq: Student must be within two semesters of graduation and permission of instructor.

Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

AER E 467. Multidisciplinary Engineering Design II.

(Cross-listed with CPR E, E E, ENGR, I E, M E, MAT E). (1-4) Cr. 3. Repeatable, maximum of 2 times. F.S. Prereq: Student must be within two semesters of graduation or receive permission of instructor.

Build and test of a conceptual design. Detail design, manufacturability, test criteria and procedures. Application of design tools such as CAD and CAM and manufacturing techniques such as rapid prototyping. Development and testing of a full-scale prototype with appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

AER E 480. Introduction to Nondestructive Evaluation Engineering.

(Cross-listed with E M). (3-0) Cr. 3. S. Prereq: E M 324, MATH 266 or MATH 267, PHYS 222

Introduction to stress/strain, Hooke's law, and elastic wave propagation in two dimensions in isotropic media. Ultrasonic plane-wave reflection and transmission; and simple straight-crested guided waves. Transducer construction, behavior, and performance. Simple signal analysis and discrete signal processing. The last few weeks of the course are devoted to case studies.

AER E 481. Advanced Wind Energy: Technology and Design.

(3-0) Cr. 3. F. Prereq: AER E 381 or senior classification in engineering or junior in engineering with a course in fluid mechanics

Advanced topics in wind energy, emphasis on current practices. Theoretical foundations for horizontal and vertical axis wind turbine. Design codes for energy conversion systems design, aerodynamic and structural load estimation, wind resource characterization wind farm design, optimization.

AER E 490. Aerospace Engineering Independent Study.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490A. Aerospace Engineering Independent Study: Aero and/or Gas Dynamics.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490B. Aerospace Engineering Independent Study: Propulsion.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490C. Aerospace Engineering Independent Study: Aerospace Structures.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490D. Aerospace Engineering Independent Study: Flight Dynamics.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490E. Aerospace Engineering Independent Study: Spacecraft Systems.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490F. Aerospace Engineering Independent Study: Flight Control Systems.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490G. Aerospace Engineering Independent Study: Aeroelasticity.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490H. Aerospace Engineering Independent Study: Independent Study, Honors.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490I. Aerospace Engineering Independent Study: Design.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490J. Aerospace Engineering Independent Study: Non-destructive Evaluation.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490K. Aerospace Engineering Independent Study: Wind Engineering.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490L. Aerospace Engineering Independent Study: Multi-functional Ultra-light Structures.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 490O. Aerospace Engineering Independent Study: Other.

Cr. 1-6. Repeatable. Prereq: Junior or senior classification, approval of the department

AER E 491. Aerospace Advising Seminar.

Cr. R. F.S.

Academic program planning.

AER E 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. Prereq: AER E 398, permission of department and Engineering Career Services

Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

AER E 499. Senior Project.

Cr. 1-2. Repeatable. F.S. Prereq: Senior classification, credit or enrollment in AER E 491

Development of aerospace principles and concepts through individual research and projects. Written report.

Courses primarily for graduate students, open to qualified undergraduates:**AER E 514. Advanced Mechanics of Materials.**

(Cross-listed with E M). (3-0) Cr. 3. F. Prereq: E M 324

Theory of stress and strain, stress-strain relationships. Unsymmetrical bending, curved beams, shear center. Torsion of thin-walled noncircular sections. Equilibrium, compatibility equations. Airy stress functions. Membrane stresses in shells, thick-walled cylinders.

AER E 517. Experimental Mechanics.

(Cross-listed with E M). (3-2) Cr. 4. Alt. S., offered even-numbered years. Prereq: E M 510 or E M 514 or E M 516

Fundamental concepts for force, displacement, stress, and strain measurements. Strain gages. Full field deformation measurements with laser interferometry and digital image processing. Advanced experimental concepts at the micro and nano scale regimes.

AER E 521. Airframe Analysis.

(3-0) Cr. 3. F. Prereq: AER E 421 or E M 424

Analysis of static stresses and deformation in continuous aircraft structures. Various analytical and approximate methods of analysis of isotropic and anisotropic plates and shells.

AER E 522. Design and Analysis of Composite Materials.

(3-0) Cr. 3. F. Prereq: E M 324

Composite constituent materials, micro-mechanics, laminate analysis, hygro-thermal analysis, composite failure, joining of composites, design of composite beams and plates, honeycomb core, manufacturing of composites, short fiber composites, and demonstration laboratory.

AER E 524. Numerical Mesh Generation.

(3-0) Cr. 3. F. Prereq: MATH 385, proficiency in programming

Introduction to modern mesh generation techniques. Structured and unstructured mesh methods, algebraic and PDE methods, elliptic and hyperbolic methods, variational methods, error analysis, Delaunay triangulation, data structures, geometric modeling with B-spline and NURBS surfaces, surface meshing.

AER E 525. Finite Element Analysis.

(Cross-listed with E M). (3-0) Cr. 3. S. *Prereq: E M 425, MATH 385*
Variational and weighted residual approach to finite element equations. Emphasis on two- and three-dimensional problems in solid mechanics. Isoparametric element formulation, higher order elements, numerical integration, imposition of constraints and penalty, convergence, and other more advanced topics. Use of two- and three-dimensional computer programs. Dynamic and vibrational problems, eigenvalues, and time integration. Introduction to geometric and material nonlinearities.

AER E 531. Automatic Control of Flight Vehicles.

(3-0) Cr. 3. S. *Prereq: AER E 331*
Applications of classical and modern linear control theory to automatic control of flight vehicles. Spacecraft attitude control. Control of flexible vehicles. Linear-quadratic regulator design applications.

AER E 532. Compressible Fluid Flow.

(Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: AER E 310, 311 or equivalent*
Thermodynamics of compressible flow. Viscous and inviscid compressible flow equations. One dimensional steady flow; isentropic flow, shocks, expansions. Multidimensional compressible flow aspects. Linear and nonlinear wave analysis and method of characteristics. Subsonic, transonic, supersonic and hypersonic flows.

AER E 541. Incompressible Flow Aerodynamics.

(3-0) Cr. 3. F. *Prereq: AER E 310 or M E 335 or equivalent*
Kinematics and dynamics of fluid flow. Derivation of the Navier-Stokes, Euler and potential flow equations. Introduction to generalized curvilinear coordinates. Ideal fluids. Two-dimensional and three-dimensional potential flow. Complex variable methods.

AER E 545. Experimental Flow Mechanics and Heat Transfer.

(3-0) Cr. 3. F. *Prereq: AER E 310 or M E 335 or E M 378*
Similitude and dimensional analysis. Measurement uncertainty analysis; Fluid mechanical apparatus: wind tunnel and water tunnels. Various experimental techniques widely used for fluid mechanics, aerodynamics, heat transfer, and combustion studies: Pressure gauge and transducers; Pitot tube; hot wire anemometry; Shadowgraph and Schlieren Photography; laser Doppler velocimetry; particle image velocimetry (PIV); advanced PIV techniques (stereo PIV, 3-D PIV, Tomographic PIV, Holograph PIV and microscopic PIV); laser induced fluorescence; pressure sensitive painting, temperature sensitive painting; molecular tagging velocimetry; molecular tagging thermometry. Extensive applications and laboratory experiments will be included.

AER E 546. Computational Fluid Mechanics and Heat Transfer I.

(Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: AER E 310 or M E 335, and programming experience*
Basic concepts of discretization, consistency, and stability. Explicit and implicit methods for ordinary differential equations. Methods for each type of partial differential equation. Iterative solution methods; curvilinear grids. Students will program basic algorithms.

AER E 547. Computational Fluid Mechanics and Heat Transfer II.

(Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: AER E 546 or equivalent*
Application of computational methods to current problems in fluid mechanics and heat transfer. Methods for solving the Navier-Stokes and reduced equation sets such as the Euler, boundary layer, and parabolized forms of the conservation equations. Introduction to relevant aspects of grid generation and turbulence modeling.

AER E 551. Orbital Mechanics.

(3-0) Cr. 3. F. *Prereq: AER E 351*
Review of 2-body problem. Orbital maneuvers. Relative motion in orbit. Orbit perturbation analysis. Gravity field expansions and effects on orbiters. 3-body problem with applications.

AER E 556. Guidance and Navigation of Aerospace Vehicles.

(3-0) Cr. 3. F. *Prereq: AER E 331*
Principles of guidance systems for spacecraft, launch vehicles, homing and ballistic missiles. Optimal guidance. Interplanetary transfer guidance with low thrust. Principles of inertial navigation. Theory and applications of the Global Positioning System. Celestial navigation procedures. Application of Kalman filtering to recursive navigation theory.

AER E 564. Fracture and Fatigue.

(Cross-listed with E M, M E, M S E). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: E M 324 and either MAT E 216 or MAT E 273 or MAT E 392. Undergraduates: Permission of instructor*
Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

AER E 565. Systems Engineering and Analysis.

(Cross-listed with E E, I E). (3-0) Cr. 3. *Prereq: Coursework in basic statistics*
Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated systems. Life cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test and evaluation, and systems engineering planning and organization. Not available for degrees in industrial engineering.

AER E 566. Avionics Systems Engineering.

(Cross-listed with E E). (3-0) Cr. 3. S. *Prereq: E E 565*
Avionics functions. Applications of systems engineering principles to avionics. Top down design of avionics systems. Automated design tools.

AER E 569. Mechanics of Composite and Combined Materials.

(Cross-listed with E M, M S E). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: E M 324*
Mechanics of fiber-reinforced materials. Micromechanics of lamina. Macromechanical behavior of lamina and laminates. Strength and interlaminar stresses of laminates. Failure criteria. Stress analysis of laminates. Thermal moisture and residual stresses. Joints in composites.

AER E 570. Wind Engineering.

(Cross-listed with E M). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: E M 378, E M 345*
Atmospheric circulations, atmospheric boundary layer wind, bluff-body aerodynamics, aeroelastic phenomena, wind-tunnel and full-scale testing, wind-load code and standards, effect of tornado and thunderstorm winds, design applications.

AER E 572. Turbulence.

(Cross-listed with CH E). (3-0) Cr. 3. *Prereq: AER E 541 or M E 538*
Qualitative features of turbulence. Statistical representation of turbulent velocity fields: averages, moments, correlations, length and time scales and the energy cascade. Averaged equations of motion, closure requirements, Reynolds averaged models. Homogeneous shear flows, free shear flows, boundary layers. Numerical simulation of turbulence: DNS, LES, DES.

AER E 573. Random Signal Analysis and Kalman Filtering.

(Cross-listed with E E, M E). (3-0) Cr. 3. F. *Prereq: E E 324 or AER E 331 or M E 370 or M E 411 or MATH 341*
Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

AER E 574. Optimal Control.

(Cross-listed with E E, M E). (3-0) Cr. 3. S. *Prereq: E E 577*
The optimal control problem. Variational approach. Pontryagin's principle, Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

AER E 575. Introduction to Robust Control.

(Cross-listed with E E, M E). (3-0) Cr. 3. *Prereq: E E 577*
Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H₂, H_∞, and I₁ control problems. Tools for robustness analysis and synthesis.

AER E 576. Digital Feedback Control Systems.

(Cross-listed with E E, M E). (3-0) Cr. 3. F. *Prereq: E E 475 or AER E 432 or M E 411 or MATH 415; and MATH 267*
Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods: root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

AER E 577. Linear Systems.

(Cross-listed with E E, M E, MATH). (3-0) Cr. 3. F. *Prereq: E E 324 or AER E 331 or MATH 415; and MATH 207*
Linear algebra review. Least square method and singular value decomposition. State space modeling of linear continuous-time systems. Solution of linear systems. Controllability and observability. Canonical description of linear equations. Stability of linear systems. State feedback and pole placements. Observer design for linear systems.

AER E 578. Nonlinear Systems.

(Cross-listed with E E, M E, MATH). (3-0) Cr. 3. S. *Prereq: E E 577*
Linear vs nonlinear systems. Phase plane analysis. Bifurcation and center manifold theory. Lyapunov stability. Absolute stability of feedback systems. Input-output stability. Passivity theory and feedback linearization. Nonlinear control design techniques.

AER E 581. Perturbation Methods.

(3-0) Cr. 3. F. *Prereq: MATH 267*
Mathematical perturbation methods with applications to ordinary and partial differential equations. Perturbation expansions. Order of magnitude and gauge functions. Matched asymptotic expansions. Boundary layer problems. Multiple scales. Resonance and mode coupling. Solvability conditions for differential equations. Physical and engineering applications.

AER E 590. Aerospace Engineering Independent Study: Special Topics.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590A. Aerospace Engineering Independent Study: Aero and/or Gas Dynamics.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590B. Aerospace Engineering Independent Study: Propulsion.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590C. Aerospace Engineering Independent Study: Aerospace Structures.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590D. Aerospace Engineering Independent Study: Flight Dynamics.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590E. Aerospace Engineering Independent Study: Spacecraft Systems.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590F. Aerospace Engineering Independent Study: Flight Control Systems.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590G. Aerospace Engineering Independent Study: Aeroelasticity.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590H. Aerospace Engineering Independent Study: Viscous Aerodynamics.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590I. Aerospace Engineering Independent Study: Design.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590J. Aerospace Engineering Independent Study: Hypersonics.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590K. Aerospace Engineering Independent Study: Computational Aerodynamics.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590L. Aerospace Engineering Independent Study: Optimization.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590M. Aerospace Engineering Independent Study: Non Destructive Evaluation.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 590N. Aerospace Engineering Independent Study: Wind Engineering.

Cr. 1-5. Repeatable, maximum of 3 times.

AER E 591. Graduate Student Seminar Series.

Cr. R. Repeatable.

Presentation of professional topics by department graduate students. Development of presentation skills used in a professional conference setting involving question and answer format.

AER E 599. Creative Component.

Cr. 1-5. Repeatable.

Courses for graduate students:**AER E 640. Stability of Fluid Flow.**

(3-0) Cr. 3. *Prereq: AerE 541*

Theoretical methods of stability analysis; linear analysis of exchange of stability and over stability; bifurcation of equilibria; most dangerous modes and pattern formation; shear flow stability theorems. Physical mechanisms. Tollmein-Schlichting waves, disintegration of capillary jets, Benard convection, Taylor-Couette flow, centrifugal instability, double diffusion.

AER E 647. Advanced Computational Fluid Dynamics.

(Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: AER E 547*
An examination of current methods in computational fluid dynamics. Differencing strategies. Advanced solution algorithms for unstructured meshes. Grid generation. Construction of higher-order CFD algorithms. Parallel computing. Current applications. Use of state of the art CFD codes.

AER E 690. Aerospace Engineering Independent Study: Advanced Topics.

Cr. 1-5. Repeatable.

AER E 690A. Aerospace Engineering Independent Study: Aero and/or Gas Dynamics.

Cr. 1-5. Repeatable.

AER E 690B. Aerospace Engineering Independent Study: Propulsion.

Cr. 1-5. Repeatable.

AER E 690C. Aerospace Engineering Independent Study: Aerospace Structures.

Cr. 1-5. Repeatable.

AER E 690D. Aerospace Engineering Independent Study: Flight Dynamics.

Cr. 1-5. Repeatable.

AER E 690E. Aerospace Engineering Independent Study: Spacecraft Systems.

Cr. 1-5. Repeatable.

AER E 690F. Aerospace Engineering Independent Study: Flight Control Systems.

Cr. 1-5. Repeatable.

AER E 690G. Aerospace Engineering Independent Study: Aeroelasticity.

Cr. 1-5. Repeatable.

AER E 690H. Aerospace Engineering Independent Study: Viscous Aerodynamics.

Cr. 1-5. Repeatable.

AER E 690I. Aerospace Engineering Independent Study: Design.

Cr. 1-5. Repeatable.

AER E 690J. Aerospace Engineering Independent Study: Hypersonics.

Cr. 1-5. Repeatable.

AER E 690K. Aerospace Engineering Independent Study: Computational Aerodynamics.

Cr. 1-5. Repeatable.

AER E 690L. Aerospace Engineering Independent Study: Non Destructive Evaluation.

Cr. 1-5. Repeatable.

AER E 690M. Aerospace Engineering Independent Study: Wind Engineering.

Cr. 1-5. Repeatable.

AER E 697. Engineering Internship.

Cr. R. Repeatable. *Prereq: Permission of DOGE (Director of Graduate Education), graduate classification*

One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

AER E 699. Research.

Cr. arr. Repeatable.

African American Studies (AF AM)

Courses primarily for undergraduates:

AF AM 201. Introduction to African American Studies.

(3-0) Cr. 3. F.S.

An interdisciplinary introduction to the study of African American culture. Includes history, the social sciences, literature, religion, and the arts, as well as conceptual frameworks for investigation and analysis of the African American experience.

Meets U.S. Diversity Requirement

AF AM 330. Ethnic and Race Relations.

(Cross-listed with SOC). (3-0) Cr. 3. F.S.SS. *Prereq: SOC 134*

Analysis of ethnic and race relations, particularly in America; emphasis on the sociology and psychology of race and ethnic relations.

Meets U.S. Diversity Requirement

AF AM 334. African American Religious Experience.

(Cross-listed with RELIG). (3-0) Cr. 3. F. *Prereq: Prior course work in Religious Studies or African American Studies recommended*

Examination of African-American experience from the perspective of black religion with attention to political, economic, social, theological and artistic expressions, including music, that serve the life of African-American communities."

Meets U.S. Diversity Requirement

AF AM 347. Studies in African American Literature.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250*

Literature by African Americans, which may include study of individual authors, movements, themes, genres.

Meets U.S. Diversity Requirement

AF AM 350. Women of Color in the U.S.

(Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: 3 credits in Women's Studies or African American Studies*

Economic, social, political and cultural roles of Women of Color in the U.S. Includes literary, philosophical, and artistic expressions. Myths and realities explored.

Meets U.S. Diversity Requirement

AF AM 353. History of African Americans I.

(Cross-listed with HIST). (3-0) Cr. 3. *Prereq: Sophomore classification*

Examines African roots of black culture and the African American experience in the United States from the colonial period through the Civil War. Topics include Atlantic Slave Trade, slavery and American identity, abolition, the emergence of Black Nationalism, and black participation in the Civil War.

Meets U.S. Diversity Requirement

AF AM 354. History of African Americans II.

(Cross-listed with HIST). (3-0) Cr. 3. *Prereq: Sophomore classification*

Explores African American political thought and political action from Reconstruction to the present. Topics include rise of Jim Crow segregation, urban migration, Garvey movement, Harlem Renaissance, Depression and world wars, Pan-Africanism, civil rights, Black Power, and black feminism.

Meets U.S. Diversity Requirement

AF AM 460. Seminar in African American Culture.

(3-0) Cr. 3. S.

Intensive study of a selected topic in African-American Studies in one or more disciplines. Selected readings of various authors, movements, eras, or genres. Primary and secondary source materials.

Meets U.S. Diversity Requirement

AF AM 473. Civil Rights and Ethnic Power.

(Cross-listed with HIST, US LS). (3-0) Cr. 3. *Prereq: Sophomore classification*

Comparative history of the civil rights and ethnic power movements (African American, Chicano, American Indian, Puerto Rican, among others) in the U.S. from World War II to the present. Topics include institutional foundations, leadership, gender and racial dynamics, and the convergences and divergences of these differing ethnic struggles for rights.

Meets U.S. Diversity Requirement

AF AM 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 3 times.

Agricultural Education and Studies (AGEDS)

Courses primarily for undergraduates:

AGEDS 110. Orientation.

(1-0) Cr. 1. F.S.

Orientation to the department. Careers in agriculture.

AGEDS 110A. Agriculture and Life Sciences Education (Fall only).

(1-0) Cr. 1. F.S.

Orientation to the department. Careers in agriculture.

AGEDS 110B. Agricultural Studies (Fall only).

(1-0) Cr. 1. F.S.

Orientation to the department. Careers in agriculture.

AGEDS 110C. Agricultural and Life Sciences exploration.

(1-0) Cr. 1. F.S.

Orientation to the department. Careers in agriculture.

AGEDS 111. Dean s Leadership Seminar.

(1-0) Cr. 1. F. *Prereq: Permission of the Associate Dean for Academic Programs, College of Agriculture and Life Sciences*

Introduction to leadership in agriculture and the life sciences, problem solving applied to current case studies, global perspective required by leaders, and designing programs to respond to societal needs in the agricultural and life sciences.

AGEDS 112. Agriculture Biotechnology Colloquium.

(1-0) Cr. 1. S. *Prereq: Enrollment as an agricultural excellence scholar*

The scientific basis of biological and social sciences in agriculture.

AGEDS 113. Access to Success Seminar I.

(1-0) Cr. 1. Repeatable. F.S.

Course provides career skills, learning strategies and social and academic integration techniques to student members of Step Forward Learning Community. Utilization of campus resources, encouragement of self-exploration, and development of academic skills. Offered on a satisfactory-fail basis only.

AGEDS 116. Initial Field Experience in Agricultural Education.

(1-2) Cr. 1. F. *Prereq: AGEDS majors only.*

Field experience in a formal education setting designed to explore teaching as a career through guided observation and interviews, reflection, and on-campus dialogue.

AGEDS 211. Early Field Based Experience.

(1-0) Cr. 1. Repeatable, maximum of 3 credits. F.S.SS. *Prereq: AGEDS 110*

Forty hours on-site in an agricultural setting. Students will have an opportunity outside the classroom for career guidance, role modeling, and reflection on their observations that they can apply to their courses and other educational experiences.

AGEDS 211A. High School Agriculture Programs.

(1-0) Cr. 1. Repeatable, maximum of 3 credits. F.S.SS. *Prereq: AGEDS 110*

Forty hours on-site in an agricultural setting. Students will have an opportunity outside the classroom for career guidance, role modeling, and reflection on their observations that they can apply to their courses and other educational experiences.

AGEDS 211C. Agricultural Industries and Agencies.

(1-0) Cr. 1. Repeatable, maximum of 3 credits. F.S.SS. *Prereq: AGEDS 110*

Forty hours on-site in an agricultural setting. Students will have an opportunity outside the classroom for career guidance, role modeling, and reflection on their observations that they can apply to their courses and other educational experiences.

AGEDS 215. Career Seminar.

(1-0) Cr. 1. F.S. *Prereq: Sophomore classification*

Overview of career opportunities. Evaluation of interests and accomplishments and setting career goals. Development of job search and interviewing skills. Establishing networks of job contacts.

AGEDS 310. Foundations of Agricultural Education Programs.

(3-0) Cr. 3. F.S.

Historical development of agricultural education programs. Philosophic premises, program goals and objectives. Educational and social issues impacting the implementation of agricultural education programs.

AGEDS 311. Presentation and Sales Strategies for Agricultural Audiences.

(3-0) Cr. 3. F.S.

Utilizing instructional methods, techniques, and problem solving, presentation and sales strategies with agricultural audiences.

AGEDS 312. Science With Practice.

(1-6) Cr. 3. Repeatable. F.S. *Prereq: College of Agriculture and Life Sciences majors only*

A planned learning experience wherein each student and faculty mentor develops a learning agreement that encompasses specific activities and expectations. Students are engaged in reflective activities that include journals, micro-reflections, formal presentations, and a comprehensive portfolio.

AGEDS 315. Personal, Professional, and Entrepreneurial Leadership in Agriculture.

(3-0) Cr. 3. F.S.

Leadership principles and strategies to influence and motivate team members to achieve personal, professional, and entrepreneurial goals in production agriculture, agricultural education, and agricultural organizations.

AGEDS 327. Advanced Communications for Agriculture and Life Sciences.

(2-2) Cr. 3. F.S. *Prereq: ENGL 250 or equivalent.*

Development of written, oral, visual and electronic communications relevant to agriculture and life sciences. Students develop skills and perspectives consistent ethical and democratic principles applicable to agriculture, natural resource, and life science issues. Provide explanations of scientific and technical concepts to rural, industry, and urban audiences. Field trips.

AGEDS 388. Agricultural Mechanics Applications.

(2-3) Cr. 3. Repeatable, maximum of 2 times. F.S.SS.

Introduction to SMAW (Arc), GMAW (Mig), GTAW (Tig), Oxy-Fuel welding, Oxy-Fuel cutting, and Plasma cutting theories and applications. Emphasis will be on theoretical foundation of welding, safety, welding skill development, and management of equipment, and materials. Introduction to small engines and applications. Emphasis will be on theory of operating systems, maintenance, troubleshooting, failure analysis, and safety.

AGEDS 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AGEDS 401. Planning Agriculture and Life Sciences Education Programs.

(Dual-listed with AGEDS 501). (3-0) Cr. 3. F. *Prereq: AGEDS 310*

Responsibilities of an agricultural education teacher, curriculum development, experiential learning opportunities including FFA and SAE, and assessment and maintenance of program quality.

AGEDS 402. Methods of Teaching in Agriculture and Life Sciences.

(Dual-listed with AGEDS 502). (3-0) Cr. 3. F. *Prereq: Concurrent enrollment in AGEDS 401*

Topics include: principles of teaching and learning, individualized and group methods, application of learning, instructional management, special populations, and evaluation.

AGEDS 412. Internship in Agricultural Education and Studies.

Cr. 2-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior classification in AGEDS and permission of instructor*

A supervised two to twelve week learning experience in an approved learning setting with application to educational, agricultural, communications and/or environmental practices and principles.

AGEDS 414. Developing Agricultural Education Programs in Non-Formal Settings.

(2-0) Cr. 2. S. *Prereq: Permission of instructor*

Basic concepts in planning, conducting, and evaluating educational programs in non-formal settings. Includes programming for youth and adults in Extension, agricultural industry, and related agencies.

AGEDS 416. Pre-Student Teaching Experience in Agricultural Education.

Cr. 1. F.S. *Prereq: AGEDS 211, AGEDS 402 and admission to teacher education program*

A forty hour field-based experience in an approved secondary agricultural education program. Concurrent enrollment in 417 is required.

AGEDS 417. Supervised Teaching in Agriculture and Life Sciences.

Cr. 1-16. Repeatable. F.S. *Prereq: AGEDS 211, AGEDS 402 and admission to teacher education program*

Supervised teaching in public schools.

AGEDS 450. Farm Management and Operation.

(2-4) Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Econ 235, Econ 230, junior classification*

Participation in the management and operation of a diversified Iowa farm. The class is responsible for the plans, records, and decisions for buying and selling the farm's livestock, crops, and equipment. Special speakers on current topics. May be taken for credit 3 times at different times of the year with permission of the instructor.

AGEDS 451. Agricultural Law.

(3-2) Cr. 4. S. *Prereq: Senior classification*

The legal framework impinging upon decision-making by firms, families, and individuals, real and personal property, contracts, secured transactions, negotiable instruments, debtor-creditor relations, bankruptcy, farm income tax organization of firms, intergenerational property transfers, trusts and farm estate planning, civil and criminal liabilities, environmental law, federal and state regulatory powers.

AGEDS 461. Technology Transfer and the Role of Agricultural and Extension Education.

(Dual-listed with AGEDS 561). (3-0) Cr. 3. S.

Impact of agricultural and extension education processes on development and their role in the transfer of agricultural technology. Utilizing situational analysis techniques to analyze and solve problems in international agricultural education programs.

Meets International Perspectives Requirement.

AGEDS 465. Horticulture Enterprise Management.

(Cross-listed with HORT). (1-6) Cr. 3. F. *Prereq: Junior or senior classification.*

Participation in the management and operation of fruit and vegetable enterprises for local markets. The class is responsible for the plans, records, and decision for planting, operating, harvesting, and marketing fruit and vegetables.

AGEDS 465A. Horticulture Enterprise Management - Planting.

(Cross-listed with HORT). (1-6) Cr. 3. S. *Prereq: Junior or senior classification.*

Participation in the management and operation of fruit and vegetable enterprises for local markets. Principles and practices of researching and developing a commercial business plan that will meet industry standards and that will be linked to the operations and production associated with the Hort 465 class. Laboratory work includes development of a horticulture enterprise business plan, high tunnel site preparation and planting, development of summer crop protocols, seedling production for the summer crop (if applicable) and land preparation and planting of a portion of the summer crop.

AGEDS 465B. Horticulture Enterprise Management: Harvesting.

(Cross-listed with HORT). (1-6) Cr. 3. SS. *Prereq: Junior or senior classification.*

Participation in the management and operation of fruit and vegetable enterprises for local markets. Principles and practices of harvesting and marketing high tunnel crops and the planting and growing of a variety of summer vegetables in the field. Laboratory work includes all operation and production aspects involved with the day-to-day running of a horticultural enterprise. The class will be responsible for crop selection and crop protocols for the fall high tunnel crop and seedling production for this crop (if applicable). Additionally, the class will be responsible for all crop maintenance decisions and record keeping during the season.

AGEDS 465C. Horticulture Enterprise Management: Marketing.

(Cross-listed with HORT). (1-6) Cr. 3. F. *Prereq: Junior or senior classification.*

Participation in the management and operation of fruit and vegetable enterprises for local markets. Principles and practices of researching and developing a commercial horticulture enterprise market plan that could be used by a startup business and that will be linked directly to the operations and production associated with the Hort 465 class. Laboratory work includes completing the summer crop harvest, development of a horticulture marketing plan, high tunnel site preparation and planting, development of spring high tunnel crop protocols and all crop maintenance decisions and the record keeping for the fall high tunnel crop.

AGEDS 475. Agri-Marketing and Communications Competition.

(2-0) Cr. 1-2. Repeatable, maximum of 6 credits. F.S. *Prereq: Admission by invitation.*

Specialized training in communication and agricultural marketing knowledge and skills in preparation for intercollegiate competition. Maximum of 6 credits can be applied toward graduation.

AGEDS 488. Methods of Teaching Agricultural Mechanics.

(2-3) Cr. 3. F.S.

Methods and management techniques in agricultural mechanics laboratories. Emphasis will be on safety, mechanical skills development and management of students, facilities, equipment, and materials.

AGEDS 490. Independent Study in Agricultural Education and Studies.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior or senior classification, permission of instructor*

AGEDS 490A. Philosophy, Curriculum, and Methods.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior or senior classification, permission of instructor*

AGEDS 490B. Leadership, Evaluation, and Administration.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior or senior classification, permission of instructor*

AGEDS 490C. Business, Industry, and Production Agriculture.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior or senior classification, permission of instructor*

AGEDS 490D. Extension and International Agriculture.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior or senior classification, permission of instructor*

AGEDS 490E. Instructional Technology.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior or senior classification, permission of instructor*

AGEDS 490F. Environmental Issues.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior or senior classification, permission of instructor*

AGEDS 490G. Entrepreneurship.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior or senior classification, permission of instructor*

AGEDS 490H. Independent Study in Agricultural Education and Studies, Honors.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior or senior classification, permission of instructor*

AGEDS 490I. Communications.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Junior or senior classification, permission of instructor*

AGEDS 496. Agricultural Travel Course.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*
Limited enrollment. Extended field trips to study agriculture and education related topics. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

AGEDS 496A. International.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*
Limited enrollment. Extended field trips to study agriculture and education related topics. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.
Meets International Perspectives Requirement.

AGEDS 496B. Domestic.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*
Limited enrollment. Extended field trips to study agriculture and education related topics. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

AGEDS 499. Undergraduate Research.

Cr. arr. F.S.SS. *Prereq: Permission of instructor, adviser, and departmental chair*
Research experience in agricultural education and studies with application to selected problems.

Courses primarily for graduate students, open to qualified undergraduates:**AGEDS 501. Planning Agriculture and Life Sciences Education Programs.**

(Dual-listed with AGEDS 401). (3-0) Cr. 3. F. *Prereq: AGEDS 310*
Responsibilities of an agricultural education teacher, curriculum development, experiential learning opportunities including FFA and SAE, and assessment and maintenance of program quality.

AGEDS 502. Methods of Teaching in Agriculture and Life Sciences.

(Dual-listed with AGEDS 402). (3-0) Cr. 3. F. *Prereq: Concurrent enrollment in AGEDS 401*
Topics include: principles of teaching and learning, individualized and group methods, application of learning, instructional management, special populations, and evaluation.

AGEDS 510. Introduction to Research in Agricultural Education.

(3-0) Cr. 3. S. *Prereq: Graduate classification*
Determining your research focus; developing research problems and objectives; reviewing the literature and establishing a theoretical framework; establishing procedures for data collection and analysis; ethical issues.

AGEDS 511. Professional Agricultural Presentation Practices.(3-0) Cr. 3. F.SS. *Prereq: Graduate Classification*

The identification and use of key planning, delivery and evaluation of presentations using audience engagement techniques focused on research-based principles and field-based practices of professional presenters in agriculture and the life sciences.

AGEDS 514. Organizing Agricultural Information for Professional and Scientific Meetings.(1-2) Cr. 2. F. *Prereq: Graduate classification in agriculture*

Concepts and practices in planning, preparing, and presenting materials used in professional meetings and scientific papers by agriculturalists with special emphasis on computerized delivery methods.

AGEDS 520. Instructional Methods for Adult and Higher Education in Agriculture and Natural Resources.(3-0) Cr. 3. S. *Prereq: Graduate classification*

Theory and practice of adult education. Teaching and learning in formal and non-formal instructional programs for adult learners.

AGEDS 524. Program Development and Evaluation in Agricultural and Extension Education.(3-0) Cr. 3. F. *Prereq: Graduate classification*

Theories and practice of program planning for nonformal education. Addresses use of program logic modeling and considers critical theories of planning to address power and interests in program development, needs assessment, and evaluation.

AGEDS 533. Introduction to Learning Theory in Agricultural Education.(3-0) Cr. 3. S. *Prereq: Graduate classification*

Introduction to a variety of theoretical perspectives of learning and how they may be used within the context of agricultural education. Emphasis will be on the major domains of learning, developmental considerations, basic assumptions, concepts, and principles of various learning theories; understanding how each theoretical perspective may be used in both formal and non-formal educational settings.

AGEDS 550. Foundations of Agricultural Education.(3-0) Cr. 3. F. *Prereq: Graduate classification*

Philosophical premises, ethical principles, historical development, contextual applications, and knowledge bases for agricultural education.

AGEDS 561. Technology Transfer and the Role of Agricultural and Extension Education.

(Dual-listed with AGEDS 461). (3-0) Cr. 3. S.

Impact of agricultural and extension education processes on development and their role in the transfer of agricultural technology. Utilizing situational analysis techniques to analyze and solve problems in international agricultural education programs.

Meets International Perspectives Requirement.

AGEDS 590. Special Topics in Agricultural Education.Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590A. Curriculum.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590B. Methods.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590C. Philosophy.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590D. Evaluation.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590E. Administration.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590F. Leadership.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590G. Guidance.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590I. Instructional Technology.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590J. Extension.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590K. International Agriculture.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 590L. Program Planning.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 593. Workshop in Agricultural Education.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 593A. Curriculum.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 593B. Methods.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 593C. Evaluation.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 593D. Administration.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 593E. Leadership.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 593F. Extension.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 593G. Program Planning.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 593H. Instructional Technology.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 593M. Biotechnology Workshop.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: 12 credits in agricultural education***AGEDS 599. Creative Component.**

Cr. arr. Repeatable. F.S.SS.

For nonthesis masters degree programs.

Courses for graduate students:**AGEDS 615. Seminar in Agricultural Education.**

(1-0) Cr. 1. Repeatable. F.S.SS.

Offered on a satisfactory-fail basis only.

AGEDS 615A. Writing for publication.

(1-0) Cr. 1. Repeatable. F.S.SS.

Offered on a satisfactory-fail basis only.

AGEDS 615B. Ethics.

(1-0) Cr. 1. Repeatable. F.S.SS.

Offered on a satisfactory-fail basis only.

AGEDS 615C. Grant writing.

(1-0) Cr. 1. Repeatable. F.S.SS.

Offered on a satisfactory-fail basis only.

AGEDS 615D. Career planning.

(1-0) Cr. 1. Repeatable. F.S.SS.

Offered on a satisfactory-fail basis only.

AGEDS 615E. Contemporary issues.

(1-0) Cr. 1. Repeatable. F.S.SS.

Offered on a satisfactory-fail basis only.

AGEDS 617. Professional Internship for Agricultural Educators.Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of instructor*

Analysis of the roles and activities of professionals in agricultural education.

Supervised professional field-based experience in public and private settings.

Offered on a satisfactory-fail basis only.

AGEDS 625. Leadership, Administration, Supervision and Management of Agricultural Education Programs.(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: Graduate classification*

Principles and best practices for leading, administering, supervising, and managing agricultural education programs. Analyzing selected case studies that apply theory to practice in agricultural situations.

AGEDS 699. Research.

Cr. arr. Repeatable.

Agricultural and Biosystems Engineering (A B E)

Courses primarily for undergraduates:

A B E 110. Experiencing Agricultural and Biosystems Engineering.

(0-2) Cr. 1. S.

Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of agricultural and biosystems engineering. Report writing, co-ops, internships, careers, registration planning.

A B E 160. Systematic Problem Solving and Computer Programming.

(2-2) Cr. 3. S. Prereq: MATH 165 or enrollment in MATH 142

Engineering approach to problem solution and presentation in the context of real world problems. Introduction to basic principles from statics, projectile motion, conservation of mass and energy and electricity and magnetism. Use of spreadsheet programs and computer programming language(s) to solve and present engineering problems. Introduction to interfacing computers to sensor systems for data collection.

A B E 170. Engineering Graphics and Introductory Design.

(2-2) Cr. 3. Prereq: Satisfactory scores in math placement assessments; credit or enrollment in MATH 142.

Applications of multi-view drawings and dimensioning. Techniques for visualizing, analyzing, and communicating 3-D geometries. Application of the design process including written and oral reports.

A B E 201. Preparing for Workplace Seminar.

(Cross-listed with TSM). (1-0) Cr. 1. F.S. Prereq: Prereq: Sophomore classification in AE, AST, BSE, or I TEC

8 week course. Professionalism in the context of the engineering/technical workplace. Development and demonstration of key workplace competencies: teamwork, initiative, communication, and engineering/technical knowledge. Resumes; Cover Letters; Behavioral Based Interviewing; Industry Speakers; Preparation for internships experiences.

A B E 216. Fundamentals of Agricultural and Biosystems Engineering.

(2-2) Cr. 3. F. Prereq: A B E 160 or permission of the instructor

Application of mathematics and engineering sciences to mass and energy balances in agricultural and biological systems. Emphasis is on solving engineering problems in the areas of heat and mass transfer, air and water vapor systems; animal production systems, grain systems; food systems, hydrologic systems, and bioprocessing.

A B E 218. Project Management & Design in Agricultural and Biosystems Engineering.

(1-2) Cr. 2. S. Prereq: A B E 216

Project management - critical path, Gantt charts, resource allocations, basic project budgeting, and project management software. Engineering design approaches. Open-ended design projects to demonstrate the preceding principles through application of technical concepts taught in prerequisite coursework.

A B E 271. Engineering Applications of Parametric Solid Modeling.

(1-2) Cr. 1. F.S. Prereq: A B E 170 or TSM 116 or equivalent

8 week-course. Creating, editing, and documenting part and assembly models using Solidworks.

A B E 272. Parametric Solid Models, Drawings, and Assemblies Using Pro/ENGINEER.

(1-2) Cr. 1. F.S. Prereq: A B E 170 or TSM 116 or equivalent

8 week-course. Applications of Pro/ENGINEER software. Create solid models of parts and assemblies. Utilize the solid models to create design documentation: standard drawing views, dimensions, and notes.

A B E 273. CAD for Process Facilities and Land Use Planning.

(1-2) Cr. 1. Prereq: ENGR 170 or TSM 116 or equivalent. 8-week course.

Application of 2-D AutoCAD software to create and interpret 3-D drawings of plant layouts and soil water conservation structures. Use drawings to evaluate options and to create design documentation: stand drawing views, dimension, and notes.

A B E 298. Cooperative Education.

Cr. R. F.S.SS. Prereq: Permission of department and Engineering Career Services

First professional work period in the cooperative education program. Students must register for this course before commencing work.

A B E 316. Applied Numerical Methods for Agricultural and Biosystems Engineering.

(2-2) Cr. 3. F. Prereq: A B E 160, Math 266

Computer aided solution of agricultural engineering problems by use of numerical techniques and mathematical models. Systems analysis and optimization applicable to agricultural and biological systems.

A B E 325. Biorenewable Systems.

(Cross-listed with TSM). (3-0) Cr. 3. F. Prereq: ECON 101, CHEM 163 or higher, MATH 140 or higher

Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, and transportation/logistics.

A B E 340. Functional Analysis and Design of Agricultural Field Machinery.

(2-2) Cr. 3. F. Prereq: A B E 110, A B E 216

Principles of operation, design, selection, testing and evaluation of agricultural field machinery and systems. Functional and mechanical performances. Crop and soil interaction with machines. Machine systems, including land preparation, crop establishment, crop protection, harvesting and post-harvest, materials handling systems.

A B E 342. Agricultural Tractor Power.

(2-3) Cr. 3. S. Prereq: Ch E 381 or M E 231

Thermodynamic principles and construction of tractor engines. Fuels, combustion, and lubrication. Kinematics and dynamics of tractor power applications; drawbar, power take-off and traction mechanisms.

A B E 363. Agri-Industrial Applications of Electric Power and Electronics.

(3-2) Cr. 4. F. Prereq: PHYS 222

Single phase and three phase circuit design. Electrical safety. Electric motors and controls. Programmable logic controllers. Digital logic, instrumentation and sensors.

A B E 380. Principles of Biological Systems Engineering.

(3-0) Cr. 3. S. Prereq: A B E 216 (or equivalent) and MATH 266 or 267

Unit-operation analysis of biological systems, through the study of mass, energy, and information transport in bioresource production and conversion systems. Quantification and modeling of biomass production, ecological interactions, and bioreactor operations.

A B E 388. Sustainable Engineering and International Development.

(Cross-listed with C E, E E). (2-2) Cr. 3. F. Prereq: Junior classification in engineering

Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernment organizations (NGOs). Course readings, final project/design report. Meets International Perspectives Requirement.

A B E 396. Summer Internship.

Cr. R. Repeatable. SS. Prereq: Permission of department and Engineering Career Services

Summer professional work period.

A B E 397. Engineering Internship.

Cr. R. Repeatable. F.S. Prereq: A B E 218 and permission of department and Engineering Career Services

One semester maximum per academic year professional work period.

A B E 398. Cooperative Education.

Cr. R. F.S.SS. Prereq: A B E 298, permission of department and Engineering Career Services

Second professional work period in the cooperative education program. Students must register for this course before commencing work.

A B E 403. Modeling and Controls for Agricultural Systems.

(Dual-listed with A B E 503). (2-2) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: A B E 363, MATH 266

Modeling dynamic systems with ordinary differential equations. Introduction to state variable methods of system analysis. Analysis of mechanical, electrical, and fluid power systems. Analytical and numerical solutions of differential equations. Introduction to classical control theory. Feedback and stability examined in the s domain. Frequency response as an analytical and experimental tool. MATLAB will be used throughout the course for modeling. Individual and/or group projects required for graduate credit.

A B E 404. Instrumentation for Agricultural and Biosystems Engineering. (Dual-listed with A B E 504). (2-2) Cr. 3. F. *Prereq:* A B E 363 or CPR E 281
Interfacing techniques for computer-based data acquisition and control systems. Basic interfacing components including A/D and D/A conversion, signal filtering, multiplexing, and process control. Sensors and theory of operation applied to practical monitoring and control problems. Individual and group projects required for graduate credit.

A B E 408. GIS and Natural Resources Management. (Dual-listed with A B E 508). (Cross-listed with ENSCI). (2-2) Cr. 3. F. *Prereq:* Working knowledge of computers and Windows environment
Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS.

A B E 410. Electronic Systems Integration for Agricultural Machinery & Production Systems. (Dual-listed with A B E 510). Cr. 3. Alt. S., offered odd-numbered years.
System architecture and design of electronics used in agricultural machinery and production systems. Emphasis on information technology and systems integration for automated agriculture processes. Design of Controller Area Network (CAN BUS) communication systems and discussion of relevant standards (ISO 11783 and SAE J1939). Application of technologies for sensing, distribution control, and automation of agricultural machinery will be emphasized.

A B E 413. Fluid Power Engineering. (Cross-listed with M E). (2-2) Cr. 3. F. *Prereq:* Credit or enrollment in E M 378 or M E 335, A B E 216 or M E 270
Properties of hydraulic fluids. Performance parameters of fixed and variable displacement pumps and motors. Hydraulic circuits and systems. Hydrostatic transmissions. Characteristics of control valves. Analysis and design of hydraulic systems for power and control functions.

A B E 415. Agricultural & Biosystems Engineering Design I. (1-2) Cr. 2. F.S. *Prereq:* A B E 271 or A B E 272, E M 324 (majors only)
Identification of current design problems in ag & biosystems engineering. Development of alternate solutions using creativity and engineering analysis and synthesis techniques.

A B E 416. Agricultural & Biosystems Engineering Design II. (1-2) Cr. 2. F.S. *Prereq:* A B E 415 (majors only)
Selection of promising solutions to design problems identified in 415 for development by design teams. Presentation of designs through oral and written reports and prototypes.

A B E 418. Fundamentals of Engineering Review. (1-0) Cr. 1. *Prereq:* senior classification.
8 week course. Review of core concepts covered in the Fundamentals of Engineering examination with emphasis on statics, dynamics, fluid mechanics, heat transfer, electric circuits, and engineering economics. Open to all College of Engineering seniors, however focus is on the general exam, not discipline specific exams.

A B E 424. Air Pollution. (Dual-listed with A B E 524). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq:* Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

A B E 424A. Air Pollution: Air quality and effects of pollutants. (Dual-listed with A B E 524A). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq:* Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

A B E 424B. Air Pollution: Climate change and causes. (Dual-listed with A B E 524B). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq:* Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

A B E 424C. Air Pollution: Transportation Air Quality. (Dual-listed with A B E 524C). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq:* C E 524A; PHYS 221 or CHEM 178; MATH 166 or 3 credits in statistics. Senior classification or above.

A B E 424D. Air Pollution: Off-gas treatment technology. (Dual-listed with A B E 524D). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq:* Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

A B E 424E. Air Pollution: Agricultural sources of pollution. (Dual-listed with A B E 524E). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq:* Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

A B E 431. Design and Evaluation of Soil and Water Conservation Systems. (Dual-listed with A B E 531). (Cross-listed with ENSCI). (2-2) Cr. 3. F. *Prereq:* E M 378 or CH E 356
Hydrology and hydraulics in agricultural and urbanizing watersheds. Design and evaluation of systems for the conservation and quality preservation of soil and water resources. Use and analysis of hydrologic data in engineering design; relationship of topography, soils, crops, climate, and cultural practices in conservation and quality preservation of soil and water for agriculture. Small watershed hydrology, water movement and utilization in the soil-plant-atmosphere system, agricultural water management, best management practices, and agricultural water quality.

A B E 432. Nonpoint Source Pollution and Control. (Dual-listed with A B E 532). (3-0) Cr. 3. *Prereq:* A B E 431 or C E 372
Characteristics and courses of non-point source (NPS) pollution in agricultural and urban watersheds, computer modeling and NPS pollution for terrestrial and aquatic systems, strategies to control and manage NPS pollution of water bodies, total maximum daily loads (TMDLs) and integrated watershed management. Graduate students are required to review research papers and develop/deliver lecture models on assigned topics.

A B E 436. Design and Evaluation of Soil and Water Monitoring Systems. (Dual-listed with A B E 536). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* A B E 431/A B E 531

Development of monitoring systems that support effective planning, performance evaluation, modeling, or environmental impact assessment of soil-, water-, and waste-management systems. Typical soil and water pollutants and physical, chemical, and biological characteristics that affect sample location and timing. Sample collection, documentation, chain-of-custody, and quality assurance procedures. In addition to other assignments, graduate students will prepare several research literature reviews on topics covered in the class and develop monitoring plans.

A B E 451. Food and Bioprocess Engineering. (Dual-listed with A B E 551). (3-0) Cr. 3. F. *Prereq:* A B E 216 and M E 436 or CH E 357, or FS HN 351 and MATH 266 or MATH 267
Application of engineering principles and mathematical modeling to the quantitative analysis of food and bioprocessing systems. Physical/chemical characteristics of foods and biological systems, flow processes, thermal processes and separation processes. Term paper required for graduate credit.

A B E 466. Multidisciplinary Engineering Design. (Cross-listed with AER E, CPR E, E E, ENGR, I E, M E, MAT E). (1-4) Cr. 3. Repeatable. F.S. *Prereq:* Student must be within two semesters of graduation and permission of instructor.
Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

A B E 469. Grain Processing and Handling. (Dual-listed with A B E 569). (2-3) Cr. 3. S. *Prereq:* A B E 216
Cereal grain and oilseed properties, quality measurement, processing, and end-use value. Design of drying systems using computer simulation. Corn wet and dry milling. Soybean oil extraction. Grain handling systems.

A B E 472. Design of Environmental Modification Systems for Animal Housing. (Dual-listed with A B E 572). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* A B E 216, M E 231
Principles and design of animal environmental control systems. Insulation, heat and mass transfer, fans, ventilation, air distribution, heating and cooling equipment, and controls. Individual and group projects required for graduate credit.

A B E 475. Design in Animal Production Systems Engineering. (2-0) Cr. 2. F.S. *Prereq:* A B E 271 or A B E 272, E M 324
Application of engineering fundamentals to the independent solution of an animal production systems engineering problem with well defined criteria and constraints in either environmental control, structural design, manure management, or air quality/mitigation.

A B E 478. Wood Frame Structural Design.

(Dual-listed with A B E 578). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: A B E 216, E M 324

Design of light-framed wood structures using LRFD and ASD design procedures. Includes analysis of wind, snow, dead, and live loads. Applications include animal housing and machine storage. Fasteners, laminated posts, truss design and use of National Design Specifications.

A B E 480. Engineering Analysis of Biological Systems.

(Cross-listed with ENSCI). (2-2) Cr. 3. F. *Prereq: A B E 380 or permission of the instructor*

Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues.

A B E 490. A B E Independent Study.

Cr. 1-4. Repeatable.

Independent Study.

A B E 490A. A B E Independent Study: Animal Production Systems Engineering.

Cr. 1-4. Repeatable.

Independent Study.

A B E 490B. A B E Independent Study: Biorenewable Resources.

Cr. 1-4. Repeatable. F.S.SS.

Independent study.

A B E 490E. A B E Independent Study: Environmental Bioprocessing Engineering.

Cr. 1-4. Repeatable. F.S.SS.

Independent study in environmental bioprocessing engineering.

A B E 490F. A B E Independent Study: Food Engineering.

Cr. 1-4. Repeatable. F.S.SS.

Independent study in food engineering.

A B E 490G. A B E Independent Study: General Topics in A B E.

Cr. 1-4. Repeatable. F.S.SS.

Independent study in general A B E topics.

A B E 490H. A B E Independent Study: Honors.

Cr. 1-4. Repeatable.

Guided instructing in agricultural and biosystems engineering for honors students.

A B E 490L. A B E Independent Study: Land & Water Resources Engineering.

Cr. 1-4. Repeatable.

Guided instruction in land and water resources engineering.

A B E 490M. A B E Independent Study: Advanced Machinery Systems Engineering.

Cr. 1-4. Repeatable.

Guided instruction in advance machinery systems engineering.

A B E 495. Agricultural and Biosystems Engineering Department Study Abroad Preparation or Follow-up.

(Cross-listed with TSM). Cr. 1-2. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Preparation for, or follow-up of, study abroad experience (496). For preparation, course focuses on understanding the tour destination through readings, discussions, and research on topics such as the regional industries, climate, crops, culture, economics, food, geography, government, history, natural resources, and public policies. For follow-up, course focuses on presentations by students, report writing, and reflection. Students enrolled in this course intend to register for 496 the following term or have had taken 496 the previous term. Meets International Perspectives Requirement.

A B E 496. Agricultural and Biosystems Engineering Department Study Abroad.

(Cross-listed with TSM). Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Tour and study at international sites relevant to disciplines of industrial technology, biological systems engineering, agricultural systems technology, and agricultural engineering. Location and duration of tours will vary. Trip expenses paid by students. Pre-trip preparation and/or post-trip reflection and reports arranged through 495.

Meets International Perspectives Requirement.

A B E 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. *Prereq: A B E 398, permission of department and Engineering Career Services*

Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduates:

A B E 501. Fundamentals of Biorenewable Resources.

(3-0) Cr. 3. S. *Prereq: Undergraduate training in an engineering or physical or biological discipline or degrees in agriculture or economics*

Introduction to the science and engineering of converting biorenewable resources into bioenergy and biobased products. Survey of biorenewable resource base and properties; description of biobased products; methods of biorenewable resource production; processing technologies for fuels, chemicals, materials, and energy; environmental impacts; economics of biobased products and bioenergy.

A B E 503. Modeling and Controls for Agricultural Systems.

(Dual-listed with A B E 403). (2-2) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: A B E 363, MATH 266

Modeling dynamic systems with ordinary differential equations. Introduction to state variable methods of system analysis. Analysis of mechanical, electrical, and fluid power systems. Analytical and numerical solutions of differential equations. Introduction to classical control theory. Feedback and stability examined in the s domain. Frequency response as an analytical and experimental tool. MATLAB will be used throughout the course for modeling. Individual and/or group projects required for graduate credit.

A B E 504. Instrumentation for Agricultural and Biosystems Engineering.

(Dual-listed with A B E 404). (2-2) Cr. 3. F. *Prereq: A B E 363 or CPR E 281*

Interfacing techniques for computer-based data acquisition and control systems. Basic interfacing components including A/D and D/A conversion, signal filtering, multiplexing, and process control. Sensors and theory of operation applied to practical monitoring and control problems. Individual and group projects required for graduate credit.

A B E 506. Applied Computational Intelligence.

(2-2) Cr. 3. Alt. F., offered even-numbered years. *Prereq: A B E 316 or equivalent, MATH 166, STAT 305*

Applications of biologically inspired computational intelligence tools for data mining, system modeling, and optimization for agricultural, biological and other engineered systems. Introduction to Artificial Neural Networks, Support Vector Machines, Fuzzy Logic, Genetic Algorithms, Bayesian and Decision Tree learning. Fundamental Machine Vision techniques will be introduced in the first part of course and be integrated into the lab exercises for learning different computational intelligence techniques. MATLAB will be used throughout the course for algorithm implementation.

A B E 508. GIS and Natural Resources Management.

(Dual-listed with A B E 408). (Cross-listed with ENSCI). (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment*

Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS.

A B E 510. Electronic Systems Integration for Agricultural Machinery & Production Systems.

(Dual-listed with A B E 410). Cr. 3. Alt. S., offered odd-numbered years.

System architecture and design of electronics used in agricultural machinery and production systems. Emphasis on information technology and systems integration for automated agriculture processes. Design of Controller Area Network (CAN BUS) communication systems and discussion of relevant standards (ISO 11783 and SAE J1939). Application of technologies for sensing, distribution control, and automation of agricultural machinery will be emphasized.

A B E 515. Integrated Crop and Livestock Production Systems.

(Cross-listed with AGRON, AN S, SUSAG). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: SUSAG 509*

Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

A B E 524. Air Pollution.

(Dual-listed with A B E 424). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.*

Senior classification or above

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

A B E 524A. Air Pollution: Air quality and effects of pollutants.

(Dual-listed with A B E 424A). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.*

Senior classification or above

A B E 524B. Air Pollution: Climate change and causes.

(Dual-listed with A B E 424B). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq:* C E 524A; *Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

A B E 524C. Air Pollution: Transportation Air Quality.

(Dual-listed with A B E 424C). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq:* C E 524A; *PHYS 221 or CHEM 178; MATH 166 or 3 credits in statistics. Senior classification or above.*

A B E 524D. Air Pollution: Off-gas treatment technology.

(Dual-listed with A B E 424D). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq:* C E 524A, C E 524B; *Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

A B E 524E. Air Pollution: Agricultural sources of pollution.

(Dual-listed with A B E 424E). (Cross-listed with C E, ENSCI). (1-0) Cr. 1. *Prereq:* C E 524A, C E 524B; *Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

A B E 531. Design and Evaluation of Soil and Water Conservation Systems.

(Dual-listed with A B E 431). (Cross-listed with ENSCI). (2-2) Cr. 3. F. *Prereq:* E M 378 or CH E 356

Hydrology and hydraulics in agricultural and urbanizing watersheds. Design and evaluation of systems for the conservation and quality preservation of soil and water resources. Use and analysis of hydrologic data in engineering design; relationship of topography, soils, crops, climate, and cultural practices in conservation and quality preservation of soil and water for agriculture. Small watershed hydrology, water movement and utilization in the soil-plant-atmosphere system, agricultural water management, best management practices, and agricultural water quality.

A B E 532. Nonpoint Source Pollution and Control.

(Dual-listed with A B E 432). (3-0) Cr. 3. *Prereq:* A B E 431 or C E 372
Characteristics and courses of non-point source (NPS) pollution in agricultural and urban watersheds, computer modeling and NPS pollution for terrestrial and aquatic systems, strategies to control and manage NPS pollution of water bodies, total maximum daily loads (TMDLs) and integrated watershed management. Graduate students are required to review research papers and develop/deliver lecture models on assigned topics.

A B E 533. Erosion and Sediment Transport.

(Cross-listed with ENSCI). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* C E 372, MATH 266
Soil erosion processes, modified universal soil loss equation and its application to conservation planning, sediment properties, initiation of sediment motion and over land flow, flow in alluvial channels and theory of sediment transport, channel stability, reserves sedimentation, wind erosion, BMPs for controlling erosion.

A B E 536. Design and Evaluation of Soil and Water Monitoring Systems.

(Dual-listed with A B E 436). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* A B E 431/A B E 531
Development of monitoring systems that support effective planning, performance evaluation, modeling, or environmental impact assessment of soil-, water-, and waste-management systems. Typical soil and water pollutants and physical, chemical, and biological characteristics that affect sample location and timing. Sample collection, documentation, chain-of-custody, and quality assurance procedures. In addition to other assignments, graduate students will prepare several research literature reviews on topics covered in the class and develop monitoring plans.

A B E 537. Total Maximum Daily Load (TMDL) Development and Implementation.

(2-2) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* CE 372 or equivalent
A project-based course to develop a water quality improvement plan. The legislative and judicial basis of the Total Maximum Daily Load (TMDL) program, different approaches for TMDL development, data needs and sources, SWAT modeling, and principles and techniques for implementation of water quality improvement plans.

A B E 551. Food and Bioprocess Engineering.

(Dual-listed with A B E 451). (3-0) Cr. 3. F. *Prereq:* A B E 216 and M E 436 or CH E 357, or FS HN 351 and MATH 266 or MATH 267
Application of engineering principles and mathematical modeling to the quantitative analysis of food and bioprocessing systems. Physical/chemical characteristics of foods and biological systems, flow processes, thermal processes and separation processes. Term paper required for graduate credit.

A B E 569. Grain Processing and Handling.

(Dual-listed with A B E 469). (2-3) Cr. 3. S. *Prereq:* A B E 216
Cereal grain and oilseed preservation, quality measurement, and end-use value. Design of drying systems using computer simulation. Corn wet and dry milling. Soybean oil extraction. Grain handling systems. Individual and group projects required for graduate credit.

A B E 572. Design of Environmental Modification Systems for Animal Housing.

(Dual-listed with A B E 472). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* A B E 216, M E 231
Principles and design of animal environmental control systems. Insulation, heat and mass transfer, fans, ventilation, air distribution, heating and cooling equipment, and controls. Individual and group projects required for graduate credit.

A B E 578. Wood Frame Structural Design.

(Dual-listed with A B E 478). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* A B E 216, E M 324
Design of light-framed wood structures using LRFD and ASD design procedures. Includes analysis of wind, snow, dead, and live loads. Applications include animal housing and machine storage. Fasteners, laminated posts, truss design and use of National Design Specifications.

A B E 580. Engineering Analysis of Biological Systems.

(2-2) Cr. 3. F. *Prereq:* A B E 216; MATH 266; BIOL 211 or BIOL 212; M E 231
Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues. Students enrolled in ABE 580 will be required to answer additional exam questions and report on two journal articles.

A B E 590. Special Topics in Agricultural & Biosystems Engineering.

Cr. 1-3. Repeatable.
Guided instruction and self-study on special topics relevant to agricultural and biosystems engineering.

A B E 598. Technical Communications for a Master's Degree.

(Cross-listed with TSM). Cr. 1. F.S.SS.
A technical paper draft based on the M.S. thesis or creative component is required of all master's students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on M.S. thesis or creative component is required of all master's students. This presentation must be in a form that satisfies the normal presentation requirements of a professional society. The presentation itself (oral or poster) may be made at a professional society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Offered on a satisfactory-fail basis only.

A B E 599. Creative Component.

Cr. arr. Repeatable.
Creative Component.

Courses for graduate students:**A B E 601. Graduate Seminar.**

(Cross-listed with TSM). (1-0) Cr. 1. F.
Keys to writing a good MS thesis or PhD dissertation. How to begin formulating research problems. Discussion of research problems and broader impacts, review of literature, identifying knowledge gaps and needs, long-term goals, research hypotheses, objectives, rationale and significance, methods, procedures, data analysis, and reporting results. Presentation of research proposal in different formats. Using peer review and responding to feedback.

A B E 610. Foundations of Sustainable Agriculture.

(Cross-listed with AGRON, ANTHR, SOC, SUSAG). (3-0) Cr. 3. F. *Prereq:* Graduate classification, permission of instructor
Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging agricultural systems in terms of the core concepts of sustainability and their theoretical contexts.

A B E 690. Advanced Topics.

Cr. arr. Repeatable.
Advanced topics.

A B E 694. Teaching Practicum.

(Cross-listed with TSM). Cr. 1-3. Repeatable. F.S.SS. *Prereq:* Graduate classification and permission of instructor
Graduate student experience in the agricultural and biosystems engineering departmental teaching program.

A B E 697. Engineering Internship.

Cr. R. Repeatable. *Prereq: Permission of department chair, graduate classification*
One semester and one summer maximum per academic year professional work period.

A B E 698. Technical Communications for a Doctoral Degree.

(Cross-listed with TSM). Cr. 1. F.S.SS.

A technical paper draft based on the dissertation is required of all Ph.D. students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on the dissertation is required of all Ph.D. students. This presentation must be in a form that satisfies the normal presentation requirements of a professional society. The presentation itself (oral or poster) may be made at a professional society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Offered on a satisfactory-fail basis only.

A B E 699. Research.

Cr. arr. Repeatable.

Research.

A B E 699B. Research: Biosystems Engineering.

Cr. arr. Repeatable.

Guided graduate research in biosystems engineering.

A B E 699C. Research: Computer Aided Design.

Cr. arr. Repeatable.

Guided graduate research in computer-aided design.

A B E 699E. Research: Environmental Systems.

Cr. arr. Repeatable.

Guided graduate research in environmental systems.

A B E 699F. Research: Food Engineering.

Cr. arr. Repeatable.

Guided graduate research in food engineering.

A B E 699O. Research: Occupational Safety.

Cr. arr. Repeatable.

Guided graduate research in occupational safety.

A B E 699P. Research: Power and Machinery Engineering.

Cr. arr. Repeatable.

Guided graduate research in power and machinery engineering.

A B E 699Q. Research: Structures.

Cr. arr. Repeatable.

Guided graduate research in structures.

A B E 699R. Research: Process Engineering.

Cr. arr. Repeatable.

Guided graduate research in process engineering.

A B E 699S. Research: Environment and Natural Resources.

Cr. arr. Repeatable.

Guided graduate research in environment and natural resources.

A B E 699U. Research: Waste Management.

Cr. arr. Repeatable.

Guided graduate research in waste management.

Agronomy (AGRON)

Courses primarily for undergraduates:

AGRON 105. Leadership Experience.

Cr. R. F.S.SS.

A participatory experience in activities or completion of a course that enhances the development of leadership and group-dynamic skills. See adviser for departmental requirements.

AGRON 110. Professional Development in Agronomy: Orientation.

Cr. 0.5-1. F.

Orientation to college life, the profession of agronomy, and the agronomy curriculum.

AGRON 114. Principles of Agronomy.

(2-3) Cr. 3. F.S.

A foundation course in agronomy applying crop, soil, and environmental sciences in understanding agricultural systems in the world. Includes introductory concepts of plant, soil, tillage, pest, environmental, and sustainable aspects of crop production. Off-campus version offered through internet by interactive computer courseware.

AGRON 120. Introduction to Renewable Resources.

(Cross-listed with ENV S, NREM). (3-0) Cr. 3. F.S.

Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

AGRON 154. Fundamentals of Soil Science.

(2-2) Cr. 3. F.S. *Prereq: CHEM 163*

Introduction to physical, chemical, and biological properties of soils, their formation, classification, and distribution. Use of soil survey and computer databank information in balancing agronomic, economic, and environmental concerns in soil management. Credit for only one of Agron 154, 155, or 156 may be applied toward graduation.

AGRON 155. Soils for Horticultural Scientists.

(2-2) Cr. 3. F.S. *Prereq: CHEM 163, enrollment in horticulture major*

Physical, chemical and biological properties of natural and manufactured soils. Use of soil information when producing plants on natural and manufactured soils. Credit for only one of Agron 154, 155, or 156 may be applied toward graduation.

AGRON 156. Soils for Urban Use.

(2-2) Cr. 3. F.S.

Restricted to students outside the College of Agriculture. Fundamental properties of soils and their application to urban settings. Development of a site plan for area of land using data from soil survey and computerized data bank information. Field trip. Credit for only one of Agron 154, 155 or 156 may be applied toward graduation.

AGRON 160. Water Resources of the World.

(Cross-listed with ENV S, GEOL, MTEOR). (3-0) Cr. 3. S.

Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in society and the environment.

AGRON 206. Introduction to Weather and Climate.

(Cross-listed with MTEOR). (3-0) Cr. 3. F.S.

Basic concepts in weather and climate, including atmospheric measurements, radiation, stability, precipitation, winds, fronts, forecasting, and severe weather. Applied topics include global warming, ozone depletion, world climates and weather safety.

AGRON 210. Professional Development in Agronomy: Career Planning.

(1-0) Cr. 1. F. *Prereq: Sophomore classification*

Career planning, résumé and cover letter preparation, and interviewing techniques. Career orientation through invited speakers.

AGRON 212. Crop Growth, Productivity and Management.

(3-0) Cr. 3. F.S. *Prereq: AGRON 114*

Production and management practices for corn, soybean, small grain, and forage crops common to Midwestern U.S. agriculture. Emphasis on growth and development, plant characteristics, management practices, crop use, quality, and problem-solving.

AGRON 212L. Field Application and Problem Solving in Crop Production.

(0-2) Cr. 1. F.S. *Prereq: AGRON 154, credit or enrollment in AGRON 212*

Problem solving in crop production. Integration and application of concepts introduced in Agron 212. Agronomic field skills such as crop and pest identification, integrated management strategies, staging crop growth, agricultural math and site specific management related to crop production will be emphasized.

AGRON 217. Weed Identification.

(0-3) Cr. 1. F.S. *Prereq: BIOL 101 or equivalent*

Identification of important weeds of agricultural, horticultural and native ecosystems. Principles of plant taxonomy and classification. Field trips.

AGRON 259. Organic Compounds in Plant and Soils.

(3-0) Cr. 3. S. *Prereq: CHEM 163, 167, or 177; BIOL 211; AGRON 154 or AGRON 260; Math 140*

Structure, function, and transformations of organic compounds significant in plant and soil environments.

AGRON 260. Soils and Environmental Quality.

(Cross-listed with ENV S). (3-0) Cr. 3. F.S.

Role of soils in environmental quality and natural resources management. Emphasis on soil erosion and conservation, water quality, and environmental planning. Saturday field trip.

AGRON 283. Pesticide Application Certification.

(Cross-listed with ENT, FOR, HORT). (2-0) Cr. 2. S.

Core background and specialty topics in agricultural, and horticultural pesticide applicator certification. Students can select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

AGRON 298. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator, sophomore classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AGRON 310. Professional Development in Agronomy: Work Experience.

Cr. R. F.S.SS.

Professional work experience in agronomy. See adviser for departmental requirements. Offered on a satisfactory-fail basis only.

AGRON 311. Professional Internship in Agronomy.

(1-0) Cr. 1. Repeatable. F.S. *Prereq: AGRON 110, agronomy majors only, permission of instructor before internship begins*

A supervised learning experience in a professional setting related to crop production, plant breeding, soil science or environmental science.

AGRON 316. Crop Structure-Function Relationships.

(3-0) Cr. 3. F.S. *Prereq: BIOL 212 Recommended*

Basic principles concerning the growth, development, and production of crop communities in relation to their environment.

AGRON 317. Principles of Weed Science.

(2-2) Cr. 3. F.

Biology and ecology of weeds. Interactions between weeds and crops. Principles and practices of integrated weed management systems. Herbicide mechanisms, classification, and fate in plants and soils.

AGRON 320. Genetics, Agriculture and Biotechnology.

(Cross-listed with GEN). (3-0) Cr. 3. F.S. *Prereq: BIOL 212*

Transmission genetics with an emphasis on applications in agriculture, the structure and expression of the gene, how genes behave in populations and how recombinant DNA technology can be used to improve agriculture. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320 and Biol 313 and 313L.

AGRON 330. Crop and Seed Identification Laboratory.

(0-4) Cr. 2. S. *Prereq: AGRON 114*

Identification, agronomic and binomial classification of crops, weeds, and diseases. Analysis of crop seed samples for contaminants of weed and other crop seeds.

AGRON 331. Intercollegiate Crops Team.

(0-6) Cr. 2. Repeatable. F.S. *Prereq: Permission of instructor*

Intensive training in preparation for intercollegiate competition in national crops contests.

AGRON 334. Forage Crop Management.

(3-0) Cr. 3. F.S. *Prereq: AGRON 114*

Production and management of forage crops; concepts applied to yield, quality, and stand persistence; systems of forage utilization including grazing, hay, and silage. Students enrolling for graduate credit will be expected to complete an additional class project.

AGRON 338. Seed Science and Technology.

(Cross-listed with HORT). (2-3) Cr. 3. F. *Prereq:* AGRON 114 or HORT 221, BIOL 211

Seed production, maturation, dormancy, vigor, deterioration, and related aspects of enhancement, conditioning, storage, and quality evaluation. Aspects of the seed industry and regulation of seed marketing.

AGRON 342. World Food Issues: Past and Present.

(Cross-listed with ENV S, FS HN, T SC). (3-0) Cr. 3. F.S. *Prereq:* Junior classification

Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects.

Meets International Perspectives Requirement.

AGRON 342H. World Food Issues: Past and Present, Honors.

(Cross-listed with ENV S, T SC). (3-0) Cr. 3. F.S. *Prereq:* Junior classification

Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects.

Meets International Perspectives Requirement.

AGRON 351. Turfgrass Establishment and Management.

(Cross-listed with HORT). (3-0) Cr. 3. F. *Prereq:* HORT 221 or AGRON 114 or BIOL 211

Principles and practices of turfgrass propagation, establishment, and management. Specialized practices relative to professional lawn care, golf courses, athletic fields, highway roadsides, and seed and sod production. The biology and control of turfgrass pests.

AGRON 351L. Turfgrass Establishment and Management Laboratory.

(Cross-listed with HORT). (0-3) Cr. 1. F. *Prereq:* Credit or enrollment in HORT 351 Those enrolled in the horticulture curriculum are required to take 351L in conjunction with 351 except by permission of the instructor.

AGRON 354. Soils and Plant Growth.

(Cross-listed with HORT). (3-0) Cr. 3. F.S. *Prereq:* AGRON 154 and BIOL 101 or BIOL 211

Effects of chemical, physical, and biological properties of soils on plant growth, with emphasis on nutritive elements, pH, organic matter maintenance, and rooting development.

AGRON 354L. Soils and Plant Growth Laboratory.

(Cross-listed with HORT). (0-3) Cr. 1. F.S. *Prereq:* Agron or Hort major with credit or enrollment in AGRON 354

Laboratory exercises in soil testing that assess a soil's ability to support nutritive requirements for plant growth.

AGRON 356. Site-Specific Crop and Soil Management.

(3-3) Cr. 4. F. *Prereq:* AGRON 114 and AGRON 354

Development of solutions to crop and soil management problems in consultation with a producer-client. Identification of client needs, gathering technical information, and use of geographic information systems as a tool for making crop and soil management decisions. Development and presentation of solutions for crop and soil management issues confronting the client. Emphasis will be placed on identifying and solving complex problems that require integration of biological, physical, chemical, and economic components within a crop and soil management system.

AGRON 360. Environmental Soil Science.

(Cross-listed with ENSCI). (2-3) Cr. 3. S. *Prereq:* AGRON 154 or ENSCI 250 or GEOL 201

Application of soil science to contemporary environmental problems; comparison of the impacts that different management strategies have on short- and long-term environmental quality and land development. Emphasis on participatory learning activities.

AGRON 370. Field Experience in Soil Description and Interpretation.

(0-3) Cr. 1. Repeatable, maximum of 4 times. F.S. *Prereq:* AGRON 154 and permission of instructor

Description and interpretation of soils in the field and laboratory, emphasizing hands-on experience. Evaluation of soil information for land use. Students may participate in intercollegiate judging contests.

AGRON 388. Agronomic Sciences in Theory and Practice..

(1-0) Cr. 1. F. *Prereq:* Junior or senior classification

Scientific methodologies and ethics. Preparation for writing an optional undergraduate thesis.

AGRON 392. Systems Analysis in Crop and Soil Management.

(2-3) Cr. 3. F.S. *Prereq:* AGRON 316 and AGRON 354

Management strategies at the level of the farm field. Emphasis will be on participatory learning activities.

AGRON 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq:* Permission of department cooperative education coordinator; junior classification

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AGRON 402I. Watershed Hydrology and Surficial Processes.

(Cross-listed with ENSCI, IA LL). Cr. 4. SS. *Prereq:* Four courses in physical or biological sciences or engineering

Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminants) in watersheds. Fieldwork will emphasize investigations of the Iowa Great Lakes watershed.

AGRON 404. Global Change.

(Dual-listed with AGRON 504). (Cross-listed with ENSCI, ENV S, MTEOR). (3-0) Cr. 3. S. *Prereq:* Four courses in physical or biological sciences or engineering;

junior standing
Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Also offered online Alt. F, even-numbered years.

AGRON 405. Environmental Biophysics.

(Dual-listed with AGRON 505). (Cross-listed with ENSCI, MTEOR). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* MATH 165 or MATH 182 or equivalent and some computer programming experience (any language)

A description of the physical microenvironment in which organisms live. Emphasis on the movement of energy (heat and radiation) and mass (water and carbon) among organisms, the soil, and atmosphere. Applications to humans, other animals, plants, and plant communities.

AGRON 406. World Climates.

(Cross-listed with ENSCI, MTEOR). (3-0) Cr. 3. S. *Prereq:* AGRON 206/MTEOR 206

Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required.

Meets International Perspectives Requirement.

AGRON 407. Mesoscale Meteorology.

(Dual-listed with AGRON 507). (Cross-listed with MTEOR). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* Math 166 and Mteor 443

Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

AGRON 410. Professional Development in Agronomy: Senior Forum.

(1-0) Cr. 1. F.S. *Prereq:* Senior classification

Development of an appropriate content for professionalism. Topics include professional certification, ethics, and maintaining an active network of information sources and professional contacts in support of lifelong learning. Student interpretation, writings, presentations, and discussions.

AGRON 421. Introduction to Plant Breeding.

(Cross-listed with HORT). (3-0) Cr. 3. F. *Prereq:* GEN 320 or BIOL 313

Breeding methods used in the genetic improvement of self-pollinated, cross-pollinated and asexually reproducing agronomic and horticultural crops. Applications of biotechnology techniques in the development of improved cultivars.

AGRON 446. International Issues and Challenges in Sustainable Development.

(Cross-listed with GLOBE, INTST). Cr. 4. S. *Prereq:* 3-credit biology course, Sophomore or higher classification, permission of Instructor

Interdisciplinary study and analysis of agricultural, biophysical, environmental, sociological, economical, political, and historical factors affecting sustainable development of communities and countries from art and science perspectives. International field experience with foreign language training required. A program fee is charged to students for international study abroad.

Meets International Perspectives Requirement.

AGRON 450. Issues in Sustainable Agriculture.

(Cross-listed with ENV S). (3-0) Cr. 3. F.
Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices. Meets International Perspectives Requirement.

AGRON 452. GIS for Geoscientists.

(Dual-listed with AGRON 552). (Cross-listed with ENSCI, GEOL). (2-2) Cr. 3. F. *Prereq: GEOL 100, GEOL 201 or equivalent*
Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

AGRON 459. Environmental Soil and Water Chemistry.

(Dual-listed with AGRON 559). (Cross-listed with ENSCI). (3-3) Cr. 4. F. *Prereq: Two semesters of college-level chemistry, MATH 140, AGRON 154 or AGRON 360; GEOL 100 and AGRON 354 recommended.*
An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, and applications to contemporary environmental issues.

AGRON 463. Soil Formation and Landscape Relationships.

(Dual-listed with AGRON 563). (Cross-listed with ENSCI). (2-4) Cr. 4. S. *Prereq: AGRON 154 or AGRON 260*
Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of AGRON 463 or AGRON 463I may be applied for graduation.

AGRON 463I. Soil Formation and Landscape Relationships.

(Dual-listed with AGRON 563I). (Cross-listed with ENSCI, IA LL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: AGRON 154 or AGRON 260*
Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only Agron 563 or 563I may be applied for graduation.

AGRON 477. Soil Physics.

(Dual-listed with AGRON 577). (Cross-listed with ENSCI). (3-0) Cr. 3. S. *Prereq: Recommended: AGRON 154 MATH 166*
The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

AGRON 484. Organic Agricultural Theory and Practice.

(Dual-listed with AGRON 584). (Cross-listed with HORT). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 9 cr. in biological or physical sciences*
Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

AGRON 485. Soil and Environmental Microbiology.

(Dual-listed with AGRON 585). (Cross-listed with ENSCI, MICRO). (2-3) Cr. 3. F. *Prereq: AGRON 154 or AGRON 402, MICRO 201 (MICRO 201L recommended)*
The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

AGRON 488. GIS for Geoscientists II.

(Dual-listed with AGRON 588). (Cross-listed with ENSCI, GEOL). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: GIS course, such as GEOL 452, CRP 451, CRP 452, NREM 345, NREM 446, AE 408 or equivalent*
GIS course with focus on the spatial analysis and modeling of raster data and triangulated irregular network (TIN) data. Uses ArcGIS and various extensions, such as Spatial Analyst, 3D Analyst, and ArcScene. Includes practical exercises during lectures, lab exercises, homework assignments, and (for GEOL 588) a class project.

AGRON 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation*
Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.

AGRON 490E. Entrepreneurship.

Cr. 1-3. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation*
Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.

AGRON 490G. General.

Cr. 1-3. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation*
Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.

AGRON 490H. Independent Study, Honors.

Cr. 1-3. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation*
Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.

AGRON 490Z. Service Learning.

Cr. 1-3. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation*
Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.

AGRON 491. Seed Science Internship Experience.

(Cross-listed with HORT). Cr. 1-2. Repeatable, maximum of 1 times. F.S.SS. *Prereq: Agron 338, advanced approval and participation of employer and instructor*
A professional work experience and creative project for seed science secondary majors. The project requires the prior approval and participation of the employer and instructor. The student must submit a written report.

AGRON 493. Workshop in Agronomy.

Cr. arr. Repeatable, maximum of 4 times. *Prereq: Permission of instructor*
Workshop experience in crops, soils, or agricultural meteorology.

AGRON 495. Agricultural Travel Course Preparation.

Cr. R. Repeatable. F.S. *Prereq: Permission of instructor*
Limited enrollment. Students enrolled in this course intend to register for Agron 496 the following term. Topics will include the agricultural industries, climate, crops, culture, economics, geography, history, livestock, marketing, soils, and preparation for travel to locations to be visited.

AGRON 496. Agricultural Travel Course.

Cr. arr. Repeatable. *Prereq: Permission of instructor*
Limited enrollment. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on crop and livestock production. Location and duration of tours will vary. Tour expenses paid by students. Check with department for current offerings.

AGRON 496A. International Tour.

Cr. arr. Repeatable. *Prereq: Permission of instructor*
Limited enrollment. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on crop and livestock production. Location and duration of tours will vary. Tour expenses paid by students. Check with department for current offerings.
Meets International Perspectives Requirement.

AGRON 496B. Domestic Tour.

Cr. arr. Repeatable. *Prereq: Permission of instructor*
Limited enrollment. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on crop and livestock production. Location and duration of tours will vary. Tour expenses paid by students. Check with department for current offerings.

AGRON 497. Agroecology Field Course.

(3-0) Cr. 3. F. *Prereq: Jr. or Sr. classification with at least 8 credits in Agronomy*
A one-week intensive class, offered off-campus. Student will visit farms within the Midwest and analyze the sustainability of each farm.

AGRON 498. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification*
Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduates:

AGRON 500. Orientation Seminar.

(2-0) Cr. 1. F. *Prereq:* International agronomy graduate students only
An introduction to Iowa and U.S. agriculture for international scholars in agronomic majors. Field trips when possible. Departmental role in the functioning of research, teaching, and extension in fulfilling the charge given the land-grant university.

AGRON 501. Crop Growth and Development.

(3-0) Cr. 3. F.S. *Prereq:* AGRON 114, MATH 140, CHEM 163, BIOL 101
Physiological processes in crop growth, development and yield: photosynthesis, respiration, water relations, mineral nutrition, assimilate partitioning, seedling vigor, light interception and canopy growth, root growth, reproduction and yield. Required course for the Master of Science in Agronomy degree program.

AGRON 502. Chemistry, Physics, and Biology of Soils.

(3-0) Cr. 3. F. *Prereq:* AGRON 114, AGRON 154, BIOL 101, CHEM 163, and MATH 140
Soil chemical, physical, and biological properties that control processes within the soil, their influence on plant/soil interactions, and soil classification. Basic concepts in soil science and their applications. Required course for the Master of Science in Agronomy degree program.

AGRON 503. Climate and Crop Growth.

(3-0) Cr. 3. F.S.S. *Prereq:* AGRON 114 and MATH 140
Applied concepts in climate and agricultural meteorology with emphasis on the climate-agriculture relationship and the microclimate-agriculture interaction. Basic meteorological principles are also presented to support these applied concepts. Required course for the Master of Science in Agronomy degree program.

AGRON 504. Global Change.

(Dual-listed with AGRON 404). (Cross-listed with ENSCI, MTEOR). (3-0) Cr. 3. S. *Prereq:* Four courses in physical or biological sciences or engineering; junior standing
Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Also offered online Alt. F, even-numbered years.

AGRON 505. Environmental Biophysics.

(Dual-listed with AGRON 405). (Cross-listed with ENSCI, MTEOR). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* MATH 165 or MATH 182 or equivalent and some computer programming experience (any language)
A description of the physical microenvironment in which organisms live. Emphasis on the movement of energy (heat and radiation) and mass (water and carbon) among organisms, the soil, and atmosphere. Applications to humans, other animals, plants, and plant communities.

AGRON 506. Crop Genetics.

(Cross-listed with HORT). Cr. 3. F.
Introduction to genetics of reproductive systems, recombination, segregation and linkage analysis, inbreeding, quantitative inheritance, fertility regulation, and polyploidy to prepare students for subsequent courses in crop improvement. Enrollment is restricted to off-campus MS in Plant Breeding students.

AGRON 507. Mesoscale Meteorology.

(Dual-listed with AGRON 407). (Cross-listed with MTEOR). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* Math 166 and Mteor 443
Gallus. The physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure. Semester project and in-class presentation required.

AGRON 508. Biophysical Crop Ecology.

(3-0) Cr. 3. F. *Prereq:* AGRON 505
Physical modeling of bio-response and crop adaptation to climate. Principles of resource capture (light and water) applied to growth and development. Ecological implications of radiation, temperature, moisture, and the biological properties of size, shape, resistance to water vapor loss, and absorptivity to solar and thermal radiation. Physiological stress in the soil, plant, atmosphere continuum.

AGRON 509. Agroecosystems Analysis.

(Cross-listed with SOC, SUSAG). (3-4) Cr. 4. F. *Prereq:* Senior or above classification
Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecological, social, etc), and scales of operation.

AGRON 510. Crop Improvement.

(Cross-listed with STB). (3-0) Cr. 3. *Prereq:* Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor
A study of the basic principles and methods in the genetic improvement of crop plants. Methods used in manipulating genomes through the use of biotechnology. Methods of cultivar development. Quantitative procedures for describing response to selection. Analysis of the relationship of reproductive characters and growth characteristics to response to selection.

AGRON 511. Crop Improvement.

(3-0) Cr. 3. S. *Prereq:* AGRON 114, MATH 140, CHEM 163, BIOL 101
Basic principles in the genetic improvement of crop plants. Methods of cultivar development in self-pollinated and cross-pollinated crop species. Required course for the Master of Science in Agronomy degree program.

AGRON 512. Soil-Plant Environment.

(3-0) Cr. 3. S. *Prereq:* AGRON 502. *Recommended* AGRON 501
Soil properties and their impact on soil/plant relationships. Soil structure, aeration, moisture, and nutrients will be discussed in the context of soil fertility and environmental quality management. Required course for the Master of Science in Agronomy degree program.

AGRON 513. Quantitative Methods for Agronomy.

(3-0) Cr. 3. F.S. *Prereq:* AGRON 114, MATH 140, STAT 104
Quantitative methods for analyzing and interpreting agronomic information. Principles of experimental design, hypothesis testing, analysis of variance, regression, correlation, and graphical representation of data. Use of SAS and Excel for organization, analyzing, and presenting data. Required course for the Master of Science in Agronomy degree program.

AGRON 514. Integrated Pest Management.

(3-0) Cr. 3. SS. *Prereq:* AGRON 114, 501, MATH 140, CHEM 163, BIOL 101. *Recommended:* AGRON 502, AGRON 503
Principles and practices of weed science, entomology, and plant pathology applied to crop production systems. Biology, ecology and principles of integrated crop pest management. Required course for the Master of Science in Agronomy degree program.

AGRON 515. Integrated Crop and Livestock Production Systems.

(Cross-listed with A B E, AN S, SUSAG). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* SUSAG 509
Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

AGRON 516. Crop Physiology.

(3-0) Cr. 3. S.
Investigation of Molecular, whole plant, and plant community processes essential to biomass production and seed formation, and analysis of molecular approaches to overcome the limitations imposed on these processes by the environment.

AGRON 518. Microwave Remote Sensing.

(Cross-listed with E E, MTEOR). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* Math 265 or equivalent
Microwave remote sensing of Earth's surface and atmosphere using satellite-based or ground-based instruments. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, ocean salinity, and soil moisture.

AGRON 519. Herbicide Physiology and Biochemistry.

(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq:* AGRON 317; BIOL 330
Herbicide mechanisms of action, selectivity, uptake, and translocation. Specific sites of herbicide action as they affect plant physiology. Herbicide resistance in weeds and crops. Implications of herbicides on weed management.

AGRON 520. Plant Breeding Methods.

Cr. 3. S. *Prereq:* Agron 527 or Agron 506
Breeding methods used in the genetic improvement of self-pollinated, cross-pollinated and asexually reproducing agronomic and horticultural crops. Application of biotechnology techniques in the development of improved cultivars.

AGRON 521. Principles of Cultivar Development.

(3-0) Cr. 3. F. *Prereq:* AGRON 421; STAT 401
Theoretical and practical analysis of alternative breeding methods to improve crop plants. Strategies to incorporate germplasm resources, develop populations, maximize genetic gain, and use marker-assisted selection. Relationship of breeding methods to commercial seed production.

AGRON 522. Field Methods in Plant Breeding.

(0-6) Cr. 1-2. Alt. SS., offered even-numbered years. *Prereq:* AGRON 521
Field experience in planning and conducting plant breeding research for germplasm and cultivar development. Offered on a satisfactory-fail basis only.

AGRON 523. Molecular Plant Breeding.

(2-2) Cr. 3. S. *Prereq:* AGRON 421 or AGRON 521, GDCB 542A
Plant breeding in the era of sequenced genomes and transformation. High throughput genomic technologies will be presented in relation to various applications in plant breeding.

AGRON 524. Applied Plant Molecular Genetics & Biotechnology.

Cr. 3. F. *Prereq:* Agron 527 or Agron 506
Basic principles and applied techniques used in the genetic improvement of crop plants. Discussion of structure and function of genes that control traits of value. Types of molecular markers, analysis of quantitatively inherited traits, genome mapping, analyses of databases.

AGRON 525. Crop and Soil Modeling.

(3-0) Cr. 3. F. *Prereq:* Math 181 or 165 or equivalent, Agron 316 or Agron 354 or equivalent.

Understanding basic crop physiology and soil processes through the use of mathematical and statistical approaches. Structure of crop models, dynamics and relationship among components such as leaf-level photosynthesis, canopy architecture, root dynamics and soil carbon and nitrogen pools.

AGRON 526. Field Plot Technique.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* STAT 401
Planning experiments for agricultural research, analysis of data, and concepts in data interpretation.

AGRON 527. Plant Genetics.

(3-0) Cr. 3. S. *Prereq:* GEN 410
Fundamental genetic and cytogenetic concepts from plant perspective including recombination, linkage analysis, genetic and molecular mapping, male sterility, self incompatibility, apomixis, and polyploid evolution.

AGRON 530. Ecologically Based Pest Management Strategies.

(Cross-listed with ENT, PL P, SUSAG). (3-0) Cr. 3. Alt. F., offered even-numbered years.
Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

AGRON 531. Crop Ecology and Management.

(3-0) Cr. 3. F. *Prereq:* AGRON 501, AGRON 502, AGRON 503. *Recommended:* AGRON 512, AGRON 514
Ecological principles underlying crop production systems. Crop production in the context of management approaches, system resources and constraints, and interactions. Emphasis on the ecology of row and forage crops common to the Midwest. Required course for the Master of Science in Agronomy degree program.

AGRON 532. Soil Management.

(3-0) Cr. 3. F. *Prereq:* AGRON 501, AGRON 503, AGRON 512. *Recommended:* AGRON 513
Evaluates the impact of various soil management practices on soil and water resources. Combines and applies basic information gained in Agron 502 and Agron 512. Emphasizes the agronomic, economic, and environmental effects of soil management strategies. Required course for the Master of Science in Agronomy degree program.

AGRON 533. Crop Protection.

(3-0) Cr. 3. F. *Prereq:* AGRON 514
Integrated management systems for important crop pests. Cultural, biological and chemical management strategies applicable to major crops grown in the Midwest. Required course for the Master of Science in Agronomy degree program.

AGRON 534. Seed and Variety, Testing and Technology.

(Cross-listed with STB). (2-0) Cr. 2. *Prereq:* Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor
The components of seed quality and how they are assessed in the laboratory, including traits derived from modern biotechnology. The impact of new technologies on seed quality testing. Variety maintenance procedures and breeder seed. Variety identification: phenotype and grow-out trials, isozyme testing, and DNA marker testing. Procedures for evaluating varieties. The variance tests appropriate for fixed effects analysis of variance. Statistical inference and stratification for yield trials. Use of strip plot testing.

AGRON 535. Introduction to the Seed Industry.

(Cross-listed with STB). Cr. 1. *Prereq:* Admission to MS in Seed Technology and Business program or by special arrangement with the instructor
An analysis of the defining characteristics of the seed industry and introduction to the Master in Seed Technology and Business curriculum. The tasks of crop improvement and seed production will be analytically related to basic management functions and classifications of management activities that are used in the study of business administration. Management tasks and roles will be analyzed in relation to the public policy issues that shape the seed industry, including ethical and economical approaches to biotechnology, intellectual property, and corporate responsibility.

AGRON 536. Quantitative Methods for Seed.

(Cross-listed with STB). (1-0) Cr. 1. F. *Prereq:* Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor
Quantitative Methods for analyzing and interpreting agronomic and business information for the seed industry. Principles of experimental design and hypothesis testing, regression, correlation and graphical representation of data. Use of spreadsheets for manipulating, analyzing and presenting data.

AGRON 538. Seed Physiology.

(2-0) Cr. 2. Alt. F., offered even-numbered years. *Prereq:* AGRON 316, CHEM 231 or CHEM 331
Physiological aspects of seed development, maturation, longevity, dormancy, and germination. Emphasis on current literature and advanced methodology.

AGRON 539. Seed Conditioning and Storage.

(Cross-listed with STB). (2-0) Cr. 2. *Prereq:* Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor
The technical operations which may be carried out on a seed lot from harvest until it is ready for marketing and use. The opportunities for quality improvement and the risks of deterioration which are present during that time. Analysis of the costs of and benefits of operations. Evaluation of equipment based on benefits to the customer and producer. Interpretation of the role of the conditioning plant and store as a focal points within the overall operations of a seed company.

AGRON 541. Applied Agricultural Meteorology.

Cr. 2-3. F.S.SS. *Prereq:* AGRON 206 or upper division Biological Science
Applied concepts in agricultural meteorology. Basic concepts of weather and of crop/climate relationships influencing production, protection, yield and associated production risk factors. Self study sections are available to resident and to distant education students all semesters. Credit for only one of Agron 503 or 541 may be applied toward graduation.

AGRON 544. Host-Pest Interactions.

Cr. 3. F.
Incorporation of the principles of integrated pest management and crop protection. Management systems (biological, cultural, chemical) and strategies which practice principles of weed science, plant pathology, and entomology. Enrollment is restricted to off-campus students in Agronomy MS in Plant Breeding.

AGRON 546. Strategies for Diversified Food and Farming Systems.

(Cross-listed with HORT, SUSAG). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* SUSAG 509
Project-focused engagement in food and farming systems using tools and perspectives drawn from multiple disciplines. Includes a field component.

AGRON 547. Seed Production.

(Cross-listed with STB). (2-0) Cr. 2. *Prereq:* Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor
Survey of crop production; including management of soil fertility, planting dates, populations, weed control, and insect control. Analysis of the principles of seed multiplication and the key practices which are used to ensure high quality in the products. Field inspection procedures and production aspects that differ from other crop production. Foundation seed production. Analysis of the typical organization of field production tasks. Resources and capabilities required. Survey of differences in seed production strategies between crops and impact of differences on management of seed production.

AGRON 551. Growth and Development of Perennial Grasses.

(Cross-listed with HORT). (2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq:* Junior or senior or graduate classification or permission of instructor
Selected topics on anatomy, morphology, and physiology relative to growth and development of perennial grasses. Emphasis on growth and development characteristics peculiar to grasses and variations of such characteristics under natural and managed conditions.

AGRON 552. GIS for Geoscientists.

(Dual-listed with AGRON 452). (Cross-listed with ENSCI, GEOL). (2-2) Cr. 3. F. *Prereq: GEOL 100, GEOL 201 or equivalent*
Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

AGRON 553. Soil-Plant Relationships.

(Cross-listed with ENSCI). (3-0) Cr. 3. F. *Prereq: AGRON 354*
Composition and properties of soils in relation to the nutrition and growth of plants.

AGRON 554. Advanced Soil Management.

(2-0) Cr. 2. Alt. F., offered odd-numbered years. *Prereq: AGRON 354; MATH 165*
Implications of soil management on the soil environment and root activity. Effect of soil physical properties on soil erosion.

AGRON 555. Environmental Soil Mineralogy.

(Cross-listed with GEOL). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: AGRON 473, CHEM 178. Recommend: GEOL 311*
Structure and behavior of clay minerals, humic substances and biochar in soil environments, with emphasis on reactions and environmental implications.

AGRON 555L. Soil Clay Mineralogy Laboratory.

(Cross-listed with GEOL). (0-3) Cr. 1. Alt. S., offered odd-numbered years. *Prereq: Credit or enrollment in AGRON 555*
Application of X-ray diffraction, thermal analysis, infrared spectroscopy, and chemical analyses to identification and behavior of clay minerals in soils.

AGRON 556. Agroecosystem Nutrient Cycles.

(3-0) Cr. 3. F. *Prereq: 3 credits in chemistry, 6 credits in biology. Recommended: ENSCI 382, 553, EEB 484/584 or upper-level coursework in nutrient cycles.*
Major, biologically important agroecosystem nutrient cycles as linked to energy (carbon) and water. Effects of agricultural production and management on cycling within systems and transfer among system at local, regional and global scales will be emphasized.

AGRON 558. Laboratory Methods in Soil Chemistry.

(Cross-listed with ENSCI). (2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq: AGRON 354 and CHEM 211*
Experimental and descriptive inorganic and organic analyses. Operational theory and principles of applicable instruments, including spectrophotometry, atomic and molecular absorption and emission spectroscopy, mass spectrometry, X-ray diffraction and fluorescence, gas and ion chromatography, and ion-selective electrodes.

AGRON 559. Environmental Soil and Water Chemistry.

(Dual-listed with AGRON 459). (Cross-listed with ENSCI). (3-3) Cr. 4. F. *Prereq: Two semesters of college-level chemistry, MATH 140, AGRON 154 or AGRON 360; GEOL 100 and AGRON 354 recommended.*
An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, and applications to contemporary environmental issues.

AGRON 561. Population and Quantitative Genetics for Breeding.

(Cross-listed with AN S). (4-0) Cr. 4. F. *Prereq: STAT 401*
Population and quantitative genetics for plant and animal genetics. Study of the genetic basis and analysis of variation in quantitative traits in domestic or experimental populations using phenotypic and molecular marker data, including estimation of heritability and other genetic parameters, linkage analysis and mapping of quantitative trait loci, and the impact of inbreeding, heterosis, and genotype-by-environment interaction.

AGRON 563. Soil Formation and Landscape Relationships.

(Dual-listed with AGRON 463). (Cross-listed with ENSCI). (2-4) Cr. 4. S. *Prereq: AGRON 154 or AGRON 260*
Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of AGRON 463 or AGRON 463I may be applied for graduation.

AGRON 563L. Soil Formation and Landscape Relationships.

(Dual-listed with AGRON 463I). (Cross-listed with ENSCI, IA LL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: AGRON 154 or AGRON 260*
Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only Agron 563 or 563I may be applied for graduation.

AGRON 570. Risk Assessment for Food, Agriculture and Veterinary Medicine.

(Cross-listed with TOX, VDPAM). (3-0) Cr. 3. F. *Prereq: STAT 104 or consent of instructor*
Risk assessment principles as applied to biological systems. Exposure and effects characterization in human and animal health and ecological risk assessment. Risk analysis frameworks and regulatory decision-making. Introduction to quantitative methods for risk assessment using epidemiological and distributional analysis. Uncertainty analysis. This course is available only by distance.

AGRON 575. Soil Formation and Transformation.

(Cross-listed with ENSCI). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: AGRON 463 or equivalent*
Advanced study of soil formation, emphasizing relationships among soils, landscapes, environment, humans, and land use.

AGRON 577. Soil Physics.

(Dual-listed with AGRON 477). (Cross-listed with ENSCI). (3-0) Cr. 3. S. *Prereq: Recommended: AGRON 154 MATH 166*
The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

AGRON 578. Laboratory Methods in Soil Physics.

(Cross-listed with ENSCI). (0-3) Cr. 1. S. *Prereq: concurrent enrollment in AGRON 477 or 577*
Methods of measuring soil physical properties such as texture, density, and water content, and transport of heat, water, and gases.

AGRON 584. Organic Agricultural Theory and Practice.

(Dual-listed with AGRON 484). (Cross-listed with HORT, SUSAG). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 9 cr. in biological or physical sciences*
Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

AGRON 585. Soil and Environmental Microbiology.

(Dual-listed with AGRON 485). (Cross-listed with ENSCI, MICRO). (2-3) Cr. 3. F. *Prereq: AGRON 154 or AGRON 402, MICRO 201 (MICRO 201L recommended)*
The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

AGRON 588. GIS for Geoscientists II.

(Dual-listed with AGRON 488). (Cross-listed with ENSCI, GEOL). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: GIS course, such as GEOL 452, CRP 451, CRP 452, NREM 345, NREM 446, AE 408 or equivalent*
GIS course with focus on the spatial analysis and modeling of raster data and triangulated irregular network (TIN) data. Uses ArcGIS and various extensions, such as Spatial Analyst, 3D Analyst, and ArcScene. Includes practical exercises during lectures, lab exercises, homework assignments, and (for GEOL 588) a class project.

AGRON 590. Special Topics.

Cr. arr. Repeatable. *Prereq: 15 credits in agronomy*
Literature reviews and conferences on selected topics in crops, soils, or agricultural meteorology according to needs and interest of student.

AGRON 591. Agronomic Systems Analysis.

(3-0) Cr. 3. S. *Prereq: AGRON 511, AGRON 513, AGRON 531, AGRON 532, AGRON 533*
Analysis of cropping systems from a problem-solving perspective. Case studies will be used to develop the students' ability to solve agronomic problems. Required course for the Master of Science in Agronomy degree program.

AGRON 592. Current Issues in Agronomy.

(3-0) Cr. 3. S. *Prereq: AGRON 501, AGRON 503, AGRON 511, AGRON 512, AGRON 513, AGRON 514*
Study and discussion of topics of current interest to the field of agronomy. While Agron 591 deals with agronomics at the farm and landscape level, Agron 592 seeks to address issues on a broader scale including off-farm agricultural impacts. Required course for the Master of Science in Agronomy degree program.

AGRON 593. Workshop in Agronomy.

Cr. arr. Repeatable. *Prereq: Graduate classification*

AGRON 593A. Crops.

Cr. arr. Repeatable. *Prereq: Graduate classification*

AGRON 593B. Soils.

Cr. arr. Repeatable. *Prereq: Graduate classification*

AGRON 593C. Agricultural Meteorology.

Cr. arr. Repeatable. *Prereq: Graduate classification*

AGRON 593D. Seed Science.

Cr. arr. Repeatable. *Prereq: Graduate classification*

AGRON 593E. Weed Science.

Cr. arr. Repeatable. *Prereq: Graduate classification*

AGRON 594. Agronomy MS Practicum.

(1-0) Cr. 1. SS. *Prereq: AGRON 501, AGRON 502, AGRON 503, AGRON 514 (or current enrollment. Recommended: AGRON 511, AGRON 512, AGRON 513*

Practical field and laboratory experiences integrating coursework in climatology, crops, and soils. Includes lectures, labs and local agri-business tours.

AGRON 595. Seed Quality, Production, and Research Management.

(Cross-listed with STB). (3-0) Cr. 3. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor*

Advanced survey of the organization, staff capabilities and management characteristics typical in seed production and crop improvement in seed enterprises. Analysis of the use of quality information in the management of seed operations and sales. Process management applications for seed. Production planning for existing capacity. Analysis of the manager's tasks in the annual cycle and how the tasks of these managers relate to the general categories of business management roles. Difference in management strategies used with different situations and groups of employees.

AGRON 599. Creative Component.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599A. Agricultural Meteorology.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599B. Crop Production and Physiology.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599C. Plant Breeding.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599D. Soil Chemistry.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599E. Soil Fertility.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599F. Soil Management.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599G. Soil Microbiology and Biochemistry.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599H. Soil Morphology and Genesis.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599I. Soil Physics.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599K. Seed Science.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599L. Weed Science.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599M. Agronomy.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

Courses for graduate students:**AGRON 600. Seminar.**

(1-0) Cr. 1. Repeatable, maximum of 6 times. F.S.

Reports and discussion of recent literature and research.

AGRON 600A. Seminar: Plant Breeding.

(1-0) Cr. 1. Repeatable, maximum of 6 times. F.S.

Reports and discussion of recent literature and research.

AGRON 600B. Seminar: Soils.

(1-0) Cr. 1. Repeatable, maximum of 6 times. F.S.

Reports and discussion of recent literature and research.

AGRON 600C. Seminar: Crop Production and Physiology.

(1-0) Cr. 1. Repeatable, maximum of 6 times. F.S.

Reports and discussion of recent literature and research.

AGRON 601. Agronomic Science Presentations.

(3-0) Cr. 2. S. *Prereq: graduate status in agronomic science, permission of instructor.*

Experience in critical communications in exchange of ideas through oral and poster presentations and scientific questioning/evaluation.

AGRON 610. Foundations of Sustainable Agriculture.

(Cross-listed with A B E, ANTHR, SOC, SUSAG). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor*

Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging agricultural systems in terms of the core concepts of sustainability and their theoretical contexts.

AGRON 621. Advanced Plant Breeding.

(3-0) Cr. 3. F. *Prereq: AGRON 521, AGRON 526, AGRON 561; GEN 410*

Estimation and interpretation of genetic effects and variances of plant breeding populations, analysis of mating designs, estimation of combining ability and heritability, best linear unbiased prediction, selection indices with and without molecular information, inbreeding and heterosis.

AGRON 625. Genetic Strategies in Plant Breeding.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: AGRON 521, GEN 510*

Evaluation of genetic, molecular, and cellular approaches to crop improvement; gene transfer methods. Application and role of basic plant biology in breeding programs and processes; genome structure and function, gene isolation, expression, regulation, and modification. Integration of molecular and cellular methods in breeding strategies; analysis of alternative breeding methods, regulatory and ethical issues.

AGRON 655. Advanced Soil Fertility.

(2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq: AGRON 553*

Evaluation of soil fertility and fertilizers; theory and applications.

AGRON 677. Advanced Soil Physics.

(2-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: AGRON 577; MATH 266, MATH 267. Recommended: COM S 207*

The flow and distribution of water, chemicals, and heat in soils. Physical principles and applications.

AGRON 685. Advanced Soil Biochemistry.

(Cross-listed with ENSCI, MICRO). (2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: AGRON 585*

Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

AGRON 696. Research Seminar.

(Cross-listed with BBMB, FOR, GDCB, HORT, PLBIO). Cr. 1. Repeatable. F.S.

Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

AGRON 698. Agronomy Teaching Practicum.

Cr. 1-2. Repeatable. F.S.SS. *Prereq: Graduate classification in agronomy and permission of instructor*

Graduate student experience in the agronomy teaching program. Offered on a satisfactory-fail basis only.

AGRON 699. Research.

Cr. arr. Repeatable.

AGRON 699A. Agricultural Meteorology.

Cr. arr. Repeatable.

AGRON 699B. Crop Production and Physiology.

Cr. arr. Repeatable.

AGRON 699C. Plant Breeding.

Cr. arr. Repeatable.

AGRON 699D. Soil Chemistry.

Cr. arr. Repeatable.

AGRON 699E. Soil Fertility.

Cr. arr. Repeatable.

AGRON 699F. Soil Management.

Cr. arr. Repeatable.

AGRON 699G. Soil Microbiology and Biochemistry.

Cr. arr. Repeatable.

AGRON 699H. Soil Morphology and Genesis.

Cr. arr. Repeatable.

AGRON 699I. Soil Physics.

Cr. arr. Repeatable.

AGRON 699J. Plant Physiology.

Cr. arr. Repeatable.

AGRON 699K. Seed Science.

Cr. arr. Repeatable.

AGRON 699L. Weed Science.

Cr. arr. Repeatable.

Air Force Aerospace Studies (AFAS)

Courses primarily for undergraduates:

AFAS 101. Introductory Leadership Laboratory I.

(0-2) Cr. 1. F. *Prereq: Membership as a cadet in AFROTC*

Instruction on Air Force customs and courtesies; drill and ceremonies, issuing military commands, physical training, studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Offered on a satisfactory-fail basis only.

AFAS 102. Introductory Leadership Laboratory II.

(0-2) Cr. 1. S. *Prereq: Membership as a cadet in AFROTC*

A continuation of AFAS 101. Air Force customs and courtesies; drill and ceremonies, issuing military commands, physical training, studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Offered on a satisfactory-fail basis only.

AFAS 141. Foundations of the United States Air Force.

(1-0) Cr. 1. F.

Basic introduction to the United States Air Force and Air Force Reserve Officer Training Corps. Mission and organization of the Air Force, officership and professionalism, military customs and courtesies, Air Force officer opportunities, and communication skills.

AFAS 142. Foundations of the United States Air Force.

(1-0) Cr. 1. S.

A continuation of 141. Topics include Air Force installations, Air Force core values, leadership and team building, further study of interpersonal communication, the Oath of Office and Commissioning.

AFAS 151. Air Force Physical Training.

(0-2) Cr. 1. Repeatable. F.S. *Prereq: Membership as a cadet in AFROTC*

Use of basic military training skills and instruction to develop confidence, leadership, communication skills and physical fitness. The team approach is utilized in the instruction and application of Air Force physical fitness requirements. Students will learn various Air Force physical fitness techniques as well as how to conduct physical fitness sessions. Full participation in all events will be determined based on student's physical and medical eligibility. Offered on a satisfactory-fail basis only.

AFAS 201. Basic Leadership Laboratory I.

(0-2) Cr. 1. F. *Prereq: Membership as a cadet in AFROTC*

Instructs and critiques freshmen cadets on Air Force customs and courtesies, drill and ceremonies, issuing military commands and physical training. Offered on a satisfactory-fail basis only.

AFAS 202. Basic Leadership Laboratory II.

(0-2) Cr. 1. S. *Prereq: Membership as a cadet in AFROTC*

A continuation of AFAS 201, instructing and critiquing freshmen cadets on Air Force customs and courtesies, drill and ceremonies, issuing military commands and physical training. Offered on a satisfactory-fail basis only.

AFAS 241. The Evolution of USAF Air & Space Power I.

(1-0) Cr. 1. F.

Examines the general aspects of air and space power through a historical perspective. Utilizing this perspective, the course covers a time period from the first balloons and dirigibles to the Korean War. Historical examples are provided to illustrate the development of airpower capabilities and missions to demonstrate the evolution of what has become today's USAF air and space power.

AFAS 242. The Evolution of USAF Air & Space Power II.

(1-0) Cr. 1. S.

A continuation of AFAS 241 that examines the general aspects of air and space power through a historical perspective. Utilizing this perspective, the course covers a time period from the Korean War to the space-age global positioning systems of the Persian Gulf War. Historical examples are provided to illustrate the development of airpower capabilities and missions to demonstrate the evolution of what has become today's USAF air and space power.

AFAS 301. Intermediate Leadership Laboratory I.

(0-3) Cr. 1. F. *Prereq: Membership as a cadet in AFROTC*

Mid-level management of leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. Offered on a satisfactory-fail basis only.

AFAS 302. Intermediate Leadership Laboratory II.

(0-3) Cr. 1. S. *Prereq: Membership as a cadet in AFROTC*

A continuation of AFAS 301, mid-level management of leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. Offered on a satisfactory-fail basis only.

AFAS 341. Air Force Leadership Studies I.

(3-0) Cr. 3. F.

A look at the fundamental issues of leadership and management in the U.S. Air Force; a large and diverse organization. It examines the theoretical aspects of leadership, management, communications, motivation and problem-solving while studying them against the backdrop of the U.S. Air Force. The course also conducts hands-on exercises to apply principles learned. While the curriculum is focused on the Air Force as an organization, the principles studied are applicable to most organizations.

AFAS 342. Air Force Leadership Studies II.

(3-0) Cr. 3. S. *Prereq: AFAS 341*

A continuation of AFAS 341, that looks at the advanced issues of leadership and management in the U.S. Air Force; a large and diverse organization. It examines the theoretical aspects of leadership, management, communications, motivation and problem-solving while studying them against the backdrop of the U.S. Air Force. The course also conducts hands-on exercises to apply principles learned. While the curriculum is focused on the Air Force as an organization, the principles studied are applicable to most organizations.

AFAS 401. Advanced Leadership Laboratory I.

(0-3) Cr. 1. F. *Prereq: Membership as a cadet in AFROTC*

Advanced leadership experiences involving the planning and controlling of the upper level management of military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. Offered on a satisfactory-fail basis only.

AFAS 402. Advanced Leadership Laboratory II.

(0-3) Cr. 1. S. *Prereq: Membership as a cadet in AFROTC*

A continuation of AFAS 401, advanced leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, physical training, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. Offered on a satisfactory-fail basis only.

AFAS 441. Preparation for Active Duty.

(3-0) Cr. 3. F.

Traces the source of military authority and responsibilities from the U.S. Constitution through the DoD to an Air Force officer. Examines the structure and capabilities of the other services and joint structures. Addresses the supervisory duties of an Air Force officer associated with administrative actions and military law as force management tools. Builds upon leadership and management skill learned in AFAS 341/342 and includes demonstrations of written and verbal communications processes.

AFAS 442. National Security Affairs.

(3-0) Cr. 3. S.

Examines the national security process through review of the Department of Defense's statutory administrative and operational relationships as context for this course's regional studies component. Reviews functions of air and space power as outlined in Air Force doctrine and introduces the concept of joint operations. Integrates these concepts with regional studies to survey issues of interest to professional military officers and governmental leaders. Selectively reviews and discusses Africa, Latin America, South Asia, East Asia, Europe, Russia and the Middle East.

Meets International Perspectives Requirement.

American Indian Studies (AM IN)

Courses primarily for undergraduates:

AM IN 210. Introduction to American Indian Studies.

(3-0) Cr. 3. F.S.SS.

Introduction to the multidisciplinary aspects of American Indian studies. Topics include literature, the arts, history, anthropology, sociology, education, and contemporary Indian politics. Guest lectures, media presentations, and discussion of assigned readings.

Meets U.S. Diversity Requirement

AM IN 240. Introduction to American Indian Literature.

(Cross-listed with ENGL). (3-0) Cr. 3. F. *Prereq: Credit in or exemption from ENGL 150*

Appreciation of oral and written forms of American Indian literatures. Tropes and techniques in oral, visual and written texts. Focus on the role of American Indians in interdisciplinary approaches to modern social and environmental issues as expressed in literary works.

Meets U.S. Diversity Requirement

AM IN 310. Topics in American Indian Studies.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. F.S.

Issues within specific topical areas of American Indian society and culture, such as social work with Indian families, tribal government, and environmental policy.

Meets U.S. Diversity Requirement

AM IN 315. Archaeology of North America.

(Cross-listed with ANTHR). (3-0) Cr. 3. S. *Prereq: ANTHR 202*

Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture- historical sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Meets U.S. Diversity Requirement

AM IN 320. Great Plains Archaeology.

(Cross-listed with ANTHR). (3-0) Cr. 3. F. *Prereq: ANTHR 202*

Prehistoric societies of the Great Plains region of North America, from initial occupation to European contact; emphasis on sociocultural changes, continuities, and adaptations to changing environments using archaeological, ecological, ethnographic information.

Meets U.S. Diversity Requirement

AM IN 322. Peoples and Cultures of Native North America.

(Cross-listed with ANTHR). (3-0) Cr. 3. *Prereq: ANTHR 201 or AM IN 210*

Origin, distribution, and pre-contact life of the indigenous peoples of North America. Survey of culture areas; language families, social and political systems, ecological and economic adaptations, religion and spirituality; impact of European contact; cultural resilience and revitalization in contemporary American Indian life.

Meets U.S. Diversity Requirement

AM IN 323. Topics in Latin American Anthropology.

(Cross-listed with ANTHR). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S.

Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

AM IN 323A. Latin American Anthropology: Violence and Memory.

(Cross-listed with ANTHR). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S.

Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

AM IN 323B. Latin American Anthropology: Social movements and Democracy.

(Cross-listed with ANTHR). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S.

Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

Meets International Perspectives Requirement.

AM IN 323C. Latin American Anthropology: Race, Class and Gender.

(Cross-listed with ANTHR). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S.

Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

Meets International Perspectives Requirement.

AM IN 323D. Latin American Anthropology: Regional Focus.

(Cross-listed with ANTHR). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S.

Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

Meets International Perspectives Requirement.

AM IN 328. American Indian Religions.

(Cross-listed with RELIG). (3-0) Cr. 3.

An introduction to the beliefs and rituals of Native American religious traditions, with attention to cultural and historical contexts and implications.

Meets U.S. Diversity Requirement

AM IN 332. Current Issues in Native North America.

(Cross-listed with ANTHR). (3-0) Cr. 3. S. *Prereq: ANTHR 201 or ANTHR 306;*

ANTHR 322 or AM IN 210 recommended

Conditions and issues of contemporary American Indian peoples, historical background of contemporary life; federal policies, treaty rights, and sovereignty. Economic development and politics on reservations, family and gender roles, cultural innovation and revitalization, urbanization, recent social movements, and other current concerns.

Meets U.S. Diversity Requirement

AM IN 342. American Indian Women Writers.

(Cross-listed with ENGL, W S). (3-0) Cr. 3. *Prereq: ENGL 250*

Literature of American Indian women writers which examines their social, political, and cultural roles in the United States. Exploration of American Indian women's literary, philosophical, and artistic works aimed at recovering elements of identity, redescribing stereotypes, resisting colonization, and constructing femininity.

Meets U.S. Diversity Requirement

AM IN 346. American Indian Literature.

(Cross-listed with ENGL). (3-0) Cr. 3. *Prereq: ENGL 250*

Survey of literature by Native Americans from pre-Columbian tales and songs to contemporary novels and poetry.

Meets U.S. Diversity Requirement

AM IN 426. Topics in Native American Architecture.

(Cross-listed with ARCH, DSN S). (3-0) Cr. 3. Repeatable, maximum of 6 credits.

Prereq: Junior classification

History, theory, and principles of Native American/American Indian architecture, landscape architecture and planning considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture. A maximum of 6 credits of ARCH 426 may be applied to degree program.

Meets U.S. Diversity Requirement

AM IN 490. Independent Study.

Cr. arr. Repeatable, maximum of 9 credits. *Prereq: 6 credits in American Indian studies; permission of instructor*

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits in Am In 490 may be counted toward graduation.

American Sign Language (ASL)

Courses primarily for undergraduates:

ASL 105. American Sign Language I.

(4-0) Cr. 4. F.S.

Introduction to American Sign Language (ASL). Development of expressive and receptive skills including vocabulary, grammar, usage, and cultural information. Note: Distinct from "Signed English". ASL is a natural language with its own rules of grammar and usage.

Meets U.S. Diversity Requirement

ASL 106. American Sign Language II.

(4-0) Cr. 4. S. *Prereq: ASL 101*

Introduction to American Sign Language (ASL) II continues development of expressive and receptive skills introduced in American Sign Language I, including vocabulary, grammar, usage, and cultural information. Distinct from "Signed English". ASL is a natural language with its own rules of grammar and usage.

Meets U.S. Diversity Requirement

ASL 205. Intermediate American Sign Language I.

(4-0) Cr. 4. F. *Prereq: ASL 102 or equivalent.*

Development of fluency for intermediate conversational skills. Review of grammar and varying grammatical forms for both structured and unstructured social situations such as sharing opinions, discussing weekend activities, and exchanging views on current topics.

ASL 206. Intermediate American Sign Language II.

(4-0) Cr. 4. S. *Prereq: ASL 201 or equivalent.*

A continuation and further application of language principles learned in WLC 205X, to deepen ability to actively engage in dialogue both in structured and unstructured social situations. Further fluency in intermediate conversational skills will be developed, particularly in the areas of sematic equivalence and dialogic/monologic register.

ASL 275. Topics in Deaf Culture.

(3-0) Cr. 3.

Focus on contemporary topics in Deaf Culture, Communities, and History. Readings and discussion from a wide range of sources. Topics vary according to faculty interest.

Meets U.S. Diversity Requirement

ASL 490. Independent Study.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: 6 credits in ASL and permission of department chair*

Designed to meet the needs of students in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 6 credits of ASL 490 may be counted towards graduation.

Animal Ecology (A ECL)

Courses primarily for undergraduates:

A ECL 312. Ecology.

(Cross-listed with BIOL, ENSCI). (3-3) Cr. 4. F.SS. *Prereq: BIOL 211, BIOL 211L, BIOL 212, and BIOL 212L*

Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

A ECL 312I. Ecology.

(Cross-listed with ENSCI, IA LL). Cr. 4. SS.

An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

A ECL 321. Fish Biology.

(2-3) Cr. 3. S. *Prereq: A ECL 365*

Biology, ecology, and evolution of fishes. Emphasis on structure, physiology, and behavior, including a focus on the conservation and management of fishes and their habitats. Laboratory focus on fish morphology, survey methods, identification, distribution, habits, and habitats of fishes.

A ECL 326I. Ornithology.

(Cross-listed with IA LL). Cr. 4. SS.

The biology, ecology, and behavior of birds with emphasis on field studies of local avifauna. Group projects stress techniques of population analysis and methodology for population studies.

A ECL 365. Vertebrate Biology.

(Cross-listed with BIOL). (3-2) Cr. 4. F. *Prereq: BIOL 212, BIOL 212L*

Evolution, biology, and classification of fish, amphibians, reptiles, birds, and mammals. Emphasis on a comparative analysis of the structure and function of organ systems. Laboratory exercises concentrate on morphology and identification of orders of vertebrates.

A ECL 366. Natural History of Iowa Vertebrates.

(2-3) Cr. 3. S. *Prereq: BIOL 211, BIOL 211L, BIOL 212, BIOL 212L*

Vertebrate fauna of Iowa, including fishes, amphibians, reptiles, birds, and mammals. Species identification, habitat requirements, community structure and assessment, conservation issues that include historical population changes and value of wild animals to the region's ecological and economic health.

A ECL 371. Ecological Methods.

(Cross-listed with BIOL). (2-3) Cr. 3. S. *Prereq: A ECL 312; STAT 101 or STAT 104*

Quantitative techniques used in management of natural resources with emphasis on inventory and manipulation of habitat and animal populations.

A ECL 401. Intro to Aquatic Animal Medicine.

(Cross-listed with B M S). (1-2) Cr. 1. S.

8 week course. Introductory course with focus on fin fish production, health and medicine. Course content will help define future roles for veterinarians, producers, and service providers. Emphasis will be placed on anatomy, pathology, infectious diseases, nutrition, regulatory constraints in production, food safety, and current research. Field trip to aquaculture facility.

A ECL 404I. Behavioral Ecology.

(Cross-listed with IA LL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: Two semesters of biology*

Animal coloniality, courtship, territoriality, predator defense, habitat selection, foraging, mating systems, and parental care will be examined in the field in order to evaluate various ecological and evolutionary theories of animal behavior.

A ECL 415. Ecology of Freshwater Invertebrates, Plants, and Algae.

(Dual-listed with A ECL 515). (2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq: A ECL 312*

Identification, biology, and ecological requirements of freshwater invertebrates, plants and algae. Additional emphases on community sampling methods and analysis, and use of organisms as tools for aquatic ecosystem health assessment.

A ECL 418. Stream Ecology.

(Dual-listed with A ECL 518). (Cross-listed with ENSCI). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: A ECL 486*

Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

A ECL 419I. Vertebrate Ecology and Evolution.

(Cross-listed with IA LL). Cr. 4. SS.

Field and laboratory study of representative vertebrates of northwestern Iowa. Observations and experimentation emphasize ecological histories by integrating concepts of functional morphology, behavioral ecology, and evolutionary biology.

A ECL 420I. Amphibians and Reptiles.

(Cross-listed with IA LL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: Two semesters of biology*

Ecology, behavior, and conservation biology of amphibians and reptiles with emphasis on their anatomy and morphology; temperature and water regulation; locomotion; life history; reproduction; population and community ecology; and conservation.

A ECL 425. Aquatic Insects.

(Dual-listed with A ECL 525). (Cross-listed with ENT). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: BIOL 312 or equivalent*

Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

A ECL 440. Fishery Management.

(Dual-listed with A ECL 540). (2-3) Cr. 3. F. *Prereq: A ECL 312, A ECL 321, STAT 101 or STAT 104; credit or enrollment in A ECL 486*

Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries.

A ECL 442. Aquaculture.

(Dual-listed with A ECL 542). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: credit or enrollment in A ECL 321

Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, diseases, and marketing.

A ECL 451. Wildlife Ecology and Management.

(2-3) Cr. 3. F. *Prereq: A ECL 371*

Ecological theory and practice of wildlife management, including, population ecology, habitat management, and current issues in the field. Course involves a series of case studies addressing actual wildlife issues using field and quantitative methods.

A ECL 454. Principles of Wildlife Disease.

(Dual-listed with A ECL 554). (3-0) Cr. 3. S. *Prereq: Junior standing and at least 10 credits in biological sciences at the 300+ level*

Ecological and epidemiological aspects of diseases as they relate to wildlife populations. Topics to be covered include: major classes of disease; detection, description, monitoring, and management of disease; characteristics and interactions between disease agents and wildlife hosts; relationships among wildlife, domestic animal, and human health.

A ECL 455. International Wildlife Issues.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: A ECL 365, A ECL 312 or graduate standing; NREM 120*

Biological, political, social, and economic factors affecting the management of international wildlife resources.

Meets International Perspectives Requirement.

A ECL 457. Herpetology.

(Cross-listed with BIOL). (2-0) Cr. 2. F. *Prereq: BIOL 351 or BIOL 365*

Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodylians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

A ECL 457L. Herpetology Laboratory.

(Cross-listed with BIOL). (0-3) Cr. 1. F. *Prereq: BIOL 351 or BIOL/A ECL 365; concurrent registration in BIOL 457 or A ECL 457*

Laboratory to accompany Biology/Animal Ecology 457. Focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

A ECL 458. Ornithology.

(Cross-listed with BIOL). (2-0) Cr. 2. S. *Prereq: A ECL 365 or BIOL 351*

Biology, evolution, ecology and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation.

A ECL 458L. Ornithology Laboratory.

(Cross-listed with BIOL). (0-3) Cr. 1. S. *Prereq: BIOL 351 or AECL/BIOL 365. Concurrent enrollment in AECL/BIOL 458 is required.*

Laboratory complements lecture topics with emphasis on external anatomy, identification and distribution of Midwest birds, and field trips.

A ECL 459. Mammalogy.

(Cross-listed with BIOL). (2-0) Cr. 2. S. *Prereq: BIOL 351 or A ECL 365*
Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation.

A ECL 459L. Mammalogy Laboratory.

(Cross-listed with BIOL). (0-3) Cr. 1. S. *Prereq: BIOL 351 or BIOL/AECL 365; concurrent enrollment in AECL 459 or BIOL 459 required.*

Laboratory focus on identification, survey methods, distribution, habits, and habitats of mammals. Several field trips.

A ECL 480. Studies in Marine Biology.

Cr. 1-8. Repeatable. SS.

Courses taken at Gulf Coast Research Laboratory and other marine biological stations are transferred to Iowa State University under this number.

A ECL 486. Aquatic Ecology.

(Cross-listed with BIOL, ENSCI). (3-0) Cr. 3. F. *Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301*

Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology.

A ECL 486L. Aquatic Ecology Laboratory.

(Cross-listed with BIOL, ENSCI). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in BIOL 486*

Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts.

Courses primarily for graduate students, open to qualified undergraduates:**A ECL 515. Ecology of Freshwater Invertebrates, Plants, and Algae.**

(Dual-listed with A ECL 415). (2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq: A ECL 312*

Identification, biology, and ecological requirements of freshwater invertebrates, plants and algae. Additional emphases on community sampling methods and analysis, and use of organisms as tools for aquatic ecosystem health assessment.

A ECL 516. Avian Ecology.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: A ECL 365, A ECL 312, or graduate standing*

Current topics and theories including avian breeding and foraging ecology, population biology, community structure, habitat selection, field methodologies, and data interpretation.

A ECL 518. Stream Ecology.

(Dual-listed with A ECL 418). (Cross-listed with ENSCI). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: A ECL 486*

Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

A ECL 520. Fisheries Science.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: A ECL 312, A ECL 321*

Concepts, approaches, and techniques for assessment of recreational and commercial fisheries. Scope will range from individual fish to entire ecosystems, both freshwater and marine.

A ECL 523I. Fish Ecology.

(Cross-listed with IA LL). Cr. 4. Alt. SS., offered even-numbered years.

Basic principles of fish interaction with the biotic and abiotic environment. Field methods, taxonomy, and biology of fish with emphasis on the fish fauna of northwestern Iowa.

A ECL 525. Aquatic Insects.

(Dual-listed with A ECL 425). (Cross-listed with ENT). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: BIOL 312 or equivalent*

Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

A ECL 526I. Advanced Field Ornithology.

(Cross-listed with IA LL). Cr. 2. SS. *Prereq: Concurrent registration in IA LL 326I*

Field study of birds of the upper Midwest; extended field trip to Minnesota and Wisconsin; individual or group project.

A ECL 531. Conservation Biology.

(Cross-listed with EEOB). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: BIOL 312; BIOL 313 or graduate standing*

Examination of conservation issues from a population and a community perspective. Population-level analysis will focus on the role of genetics, demography, and environment in determining population viability. Community perspectives will focus on topics such as habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology.

A ECL 531I. Conservation Biology.

(Cross-listed with EEOB, IA LL). Cr. 4. Alt. SS., offered even-numbered years.

Prereq: IA LL 312I

Population-and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

A ECL 535I. Restoration Ecology.

(Cross-listed with EEOB, ENSCI, IA LL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: A course in ecology*

Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

A ECL 540. Fishery Management.

(Dual-listed with A ECL 440). (2-3) Cr. 3. F. *Prereq: A ECL 312, A ECL 321, STAT 101 or STAT 104; credit or enrollment in A ECL 486*

Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries.

A ECL 542. Aquaculture.

(Dual-listed with A ECL 442). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: credit or enrollment in A ECL 321

Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, diseases, and marketing.

A ECL 551. Behavioral Ecology.

(2-2) Cr. 3. Alt. S., offered even-numbered years. *Prereq: a course in ecology or animal behavior*

The study of how an animal's behavior affects its ability to survive and reproduce in its environment. Course topics, such as foraging behavior, sexual selection, parental care, etc., represent the interface of ecology, evolution, and behavior.

A ECL 554. Principles of Wildlife Disease.

(Dual-listed with A ECL 454). (3-0) Cr. 3. S. *Prereq: Graduate classification*

Ecological and epidemiological aspects of disease as they relate to wildlife populations. Topics to be covered include: major classes of disease; detection, description, monitoring, and management of disease; characteristics and interactions between disease agents and wildlife hosts; relationship among wildlife, domestic animal, and human health.

A ECL 570. Landscape Ecology.

(Cross-listed with EEOB). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: Permission of instructor; EEOB 588; a course in calculus

The study of ecological and evolutionary processes within a spatial context with emphasis on behavior, population, and community dynamics.

A ECL 573. Techniques for Biology Teaching.

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 573A. Techniques for Biology Teaching : Animal Biology.

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 573G. Techniques for Biology Teaching: Limnology.

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 573H. Animal Behavior (Same as IA LL 573H).

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 573I. Techniques for Biology Teaching: Insect Ecology.

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 573W. Techniques for Biology Teaching: Project WET.

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 589. Population Ecology.

(Cross-listed with EEOB). (2-2) Cr. 3. F. *Prereq: BIOL 312, STAT 101 or STAT 104, a course in calculus, or graduate standing*

Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

A ECL 590. Graduate Independent Study.

(Cross-listed with ANTHR, EEOB, IA LL). Cr. 1-4. Repeatable. SS. *Prereq: Graduate classification and permission of instructor*

A ECL 590I. Special Topics: Graduate Independent Study.

(Cross-listed with ANTHR, EEOB, IA LL). Cr. 1-4. Repeatable. SS. *Prereq: Graduate classification and permission of instructor*

A ECL 599. Creative Component.

Cr. arr. *Prereq: Nonthesis M.S. option only*

Courses for graduate students:**A ECL 611. Analysis of Populations.**

(Cross-listed with EEOB). (2-2) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: BIOL 312; STAT 401; a course in calculus*

Quantitative techniques for analyzing vertebrate population data to estimate parameters such as density and survival. Emphasis on statistical inference and computing.

A ECL 698. Animal Ecology Teaching Practicum.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification in animal ecology and permission of instructor*

Graduate student experience in the animal ecology teaching program. Offered on a satisfactory-fail basis only.

A ECL 699. Research.

Cr. arr. Repeatable.

A ECL 699I. Research.

(Cross-listed with ANTHR, EEOB, GDCB, IA LL). Cr. 1-4. Repeatable.

Animal Science (AN S)

Courses primarily for undergraduates:

AN S 101. Working with Animals.

(1-2) Cr. 2. F.S.

A hands-on introductory course in skills for proper care and management of domestic animals. Husbandry skills including health observation, animal movement, identification, management procedures, and environmental assessment are covered.

AN S 110. Orientation in Animal Science and ISU.

(2-0) Cr. 1. F.S.

Orientation to the university and Department of Animal Science. Challenges and opportunities available to the professional animal agriculturalist. Professional goal setting, portfolio development, and development of interpersonal skills in the context of pursuing a career in animal science.

AN S 114. Survey of the Animal Industry.

(2-0) Cr. 2. F.S.

Ways domestic animals serve the basic needs of humans for food, shelter, protection, fuel, and emotional well-being. Terminology, basic structures of the industries surrounding the production, care, and marketing of domestic animals in the U.S.

AN S 116. Practicum in Safe Equine Handling and Welfare.

(0-3) Cr. 1. F.S.S.

Development of best practices for safe horse handling and practical equine health care tasks. Course will focus on equine welfare and human safety as well as provide training in necessary every day skills needed to own a horse or to work at a horse farm. Certificate of Safe Equine Handling and Welfare available upon course completion. Offered on satisfactory - fail grading basis only. Offered on a satisfactory-fail basis only.

AN S 190. Livestock Handling, Safety and Welfare.

Cr. 2. Prereq: AN S 101

Understanding of animal perception to develop best care practices involved in handling of livestock species (beef, sheep, swine, dairy, equine, poultry). Intensive development of skills associated with handling and moving healthy and compromised livestock in respect to human and animal welfare. Integration of scientific and theoretical knowledge of biosecurity and animal-human interactions as it related to livestock handling and movement.

AN S 199. Marketing and Management of Livestock Events.

(0-2) Cr. 1. Repeatable. F.S. Prereq: Credit or enrollment in AN S 101 or AN S 114

Management and coordination of livestock shows, sales and events, including program planning, staff and volunteer management, time management, publicity and promotion for fairs, shows, clinics, expos, and other events. For section E students are expected to take the fall and spring courses consecutively. Offered on a satisfactory-fail basis only. A maximum of two credits of AnS 199 may be applied toward the total credits required for graduation.

AN S 199A. Marketing and Management of Livestock Events: Beef.

(0-2) Cr. 1. Repeatable. F.S. Prereq: Credit or enrollment in AN S 101 or AN S 114

Management and coordination of livestock shows, sales and events, including program planning, staff and volunteer management, time management, publicity and promotion for fairs, shows, clinics, expos, and other events. For section E students are expected to take the fall and spring courses consecutively. Offered on a satisfactory-fail basis only. A maximum of two credits of AnS 199 may be applied toward the total credits required for graduation.

AN S 199E. Marketing and Management of Livestock Events: Horses.

(0-2) Cr. 1. Repeatable. F.S. Prereq: Credit or enrollment in AN S 101 or AN S 114

Management and coordination of livestock shows, sales and events, including program planning, staff and volunteer management, time management, publicity and promotion for fairs, shows, clinics, expos, and other events. For section E students are expected to take the fall and spring courses consecutively. Offered on a satisfactory-fail basis only. A maximum of two credits of AnS 199 may be applied toward the total credits required for graduation.

AN S 207. The Art and Heritage of Livestock.

(3-0) Cr. 3.

Using art as a venue to understand the legacy and heritage of livestock production and livestock's contribution to civilization and society; livestock's contributions to warfare, social class, industry, economies, etc.; history of the impact of livestock on painting, poetry, music, sculpture, advertising, pop culture, movies, religion and sports in society.

AN S 210. Career Preparation in Animal Science.

(0-2) Cr. 1. F.S. Prereq: Sophomore classification in An S

Life skill development emphasized in the context of career preparation. Assist students with career goal clarification, interview skills, resume and cover letter preparation. Internship development, job shadowing, and exploration of career option.

AN S 211. Issues Facing Animal Science.

(0-2) Cr. 1. F.S. Prereq: AN S 114, sophomore classification

Overview of the factors that define contemporary ethical and scientifically based issues facing animal agriculture. Life skill development (including interactive skills, communication ability, organization, information gathering, and leadership skills) emphasized in the context of issues study. Offered on a satisfactory-fail basis only.

AN S 214. Domestic Animal Physiology.

(3-0) Cr. 3. F.S. Prereq: BIOL 212, CHEM 163 or CHEM 177

Introduction to anatomy and physiology of the muscular, renal, skeletal, neural, mammary, cardiovascular, respiratory, immune, endocrine, reproductive, and digestive systems of domestic animals.

AN S 214L. Domestic Animal Anatomy and Physiology Lab.

(0-2) Cr. 1. F.S. Prereq: Concurrent enrollment in AN S 214

Basic anatomy of domestic animals.

AN S 216. Equine Science.

(2-2) Cr. 3. F.S.SS. Prereq: AN S 101 or AN S 114; one course in biology

Introduction to contemporary concepts, and basic practices and decisions necessary when managing horses through stages of their lives.

AN S 217. Equine Farm Practicum.

(1-2) Cr. 2. F. Prereq: Student majoring in Animal Science, riding experience An S, credit or concurrent enrollment in AN S 216

Intensified management of the equine farm. Provide students with experiential learning in all phases of horse production and management. Students assist with general farm management, preparing horses for sale, marketing techniques and web design.

AN S 223. Poultry Science.

(2-2) Cr. 3. F. Prereq: AN S 101, AN S 114

Introduction to principles, practices and decisions necessary when raising poultry through their production cycle.

AN S 224. Companion Animal Science.

(2-2) Cr. 3. S. Prereq: Course in biology

Introduction of students to contemporary concepts, and basic practices and decisions necessary when caring for the companion animal through stages of its life.

AN S 225. Swine Science.

(2-2) Cr. 3. F.S. Prereq: AN S 101, AN S 114

Introduction to principles, practices and decisions necessary when raising swine through the vertically integrated production cycle. Only AN S 280 and AN S 280L or AN S 225 may count toward graduation.

AN S 226. Beef Cattle Science.

(2-2) Cr. 3. F.S. Prereq: AN S 101, AN S 114

Introduction to principles, practices and decisions necessary when raising beef cattle through the vertically integrated production cycle.

AN S 229. Sheep Science.

(2-2) Cr. 3. S. Prereq: AN S 101, AN S 114

Introduction to principles, practices and decisions necessary when raising sheep through their production cycle.

AN S 235. Dairy Cattle Science.

(2-2) Cr. 3. F. Prereq: AN S 101, AN S 114

Introduction to principles, practices and decisions necessary when raising dairy cattle through the vertically integrated production cycle.

AN S 270. Foods of Animal Origin.

(2-0) Cr. 2. F.S.SS. Prereq: BIOL 212, CHEM 163 or CHEM 177

Principles, practices and issues impacting the production, processing and preservation of safe, wholesome, nutritious, and palatable meat, dairy, and egg products. Product evaluation, classification, value, and utilization.

AN S 270L. Foods of Animal Origin Laboratory.

(0-2) Cr. 1. F.S. Prereq: Credit or current enrollment in AN S 270

Determination of composition and quality of meat, eggs and milk based on industry and USDA standards. Fundamentals of processing foods of animal origin to add value, maintain quality and ensure safety.

AN S 280. Basic Swine Science.(2-0) Cr. 2. *Prereq:* AN S 101 AN S 114

Basic disciplines and concepts involved in swine production including; industry structure, trends and statistics; production phases and buildings; genetic improvement; reproduction; nutrition; health and biosecurity; nutrient management; marketing and meat quality and career opportunities in the swine industry. Only AN S 280 and AN S 280L or AN S 225 may count toward graduation.

AN S 305. Livestock Evaluation.(0-6) Cr. 3. F. *Prereq:* Junior classification; AN S 270L recommended

Fall semester leads to 475A or D. Breeding animal and market animal evaluation of beef, swine and sheep using contemporary techniques and tools. Communication and decision-making skills are practiced in the context of making selection decisions.

AN S 306. Equine Evaluation.(0-6) Cr. 3. S. *Prereq:* sophomore classification or permission of instructor

Detailed visual evaluation of conformation and performance of the equine athlete. Decision-making skills are practiced in the context of making selection choices. Development of written and oral communication skills as students defend their judgments. Industry trends will be addressed.

AN S 313. Exercise Physiology of Animals.(2-0) Cr. 2. F.S. *Prereq:* AN S 214, BIOL 211, one course in chemistry

Physiological adaptations to athletic training in canine and equine athletes. Topics of emphasis include exercise-related adaptations in metabolism, locomotion, the cardiovascular system, musculoskeletal system, and endocrine system. The roles of nutrition and conditioning programs are assessed.

AN S 317. Fundamentals of Equine Behavior and Training.

(0-6) Cr. 1-3.

Modifying the behavior of the horse using systematic approaches to horse training emphasizing the psychology of training horses. Equipment and its use and preparation of horses for competition. A maximum of 4 credits of An S 317 may be applied toward graduation.

AN S 317A. Fundamentals of Equine Behavior and Training: Young Horses at Halter.

(0-6) Cr. 1-3. F.

Modifying the behavior of the horse using systematic approaches to horse training emphasizing the psychology of training horses. Equipment and its use and preparation of horses for competition. A maximum of 4 credits of An S 317 may be applied toward graduation.

AN S 317B. Fundamentals of Equine Behavior and Training: Yearlings.(0-6) Cr. 3. *Prereq:* Permission of instructor

Modifying the behavior of the horse using systematic approaches to horse training emphasizing the psychology of training horses. Equipment and its use and preparation of horses for competition. A maximum of 4 credits of An S 317 may be applied toward graduation.

AN S 317C. Fundamentals of Equine Behavior and Training: Two-year olds and older.

(0-6) Cr. 3.

Modifying the behavior of the horse using systematic approaches to horse training emphasizing the psychology of training horses. Equipment and its use and preparation of horses for competition. A maximum of 4 credits of An S 317 may be applied toward graduation.

AN S 319. Animal Nutrition.(3-0) Cr. 3. F.S. *Prereq:* AN S 214, course in organic chemistry or biochemistry

Structure and function of organic and inorganic nutrients. Digestion, absorption, metabolism and utilization of nutrients for maintenance and productive functions. Essential nutritive requirements of domestic livestock, poultry, and companion animals. Sources of nutrients, application of energy systems and concepts, and regulation of feed intake in animals.

AN S 320. Animal Feeds and Feeding.(2-2) Cr. 3. F.S. *Prereq:* AN S 319

Composition, physical properties, and storage and processing of feedstuffs. Nutrient requirements of and diet formulation, and preparation systems for food and companion animal species at varying stages of age, activity or production. Manual and computer methodologies for diet formulation.

AN S 324. Food Processing for Companion Animals.(3-0) Cr. 3. F. *Prereq:* AN S 319, Junior Classification

Food processing and nutrition for carnivorous companion animals. Topics covered include meat processing and meat preservation for companion animal diets, regulatory standards, cutting edge technologies for processing meat for companion animals, dietary needs of carnivorous companion animals, effect of different processing methods on safety and nutrient bioavailability.

AN S 331. Domestic Animal Reproduction.(3-0) Cr. 3. F.S. *Prereq:* Course in physiology

Comparative anatomy, physiology, and endocrinology of domestic mammalian animal reproduction. Techniques for the control and manipulation of reproductive processes.

AN S 332. Laboratory Methods in Animal Reproduction.(0-2) Cr. 1. F.S. *Prereq:* Credit or enrollment in AN S 331

Comparative reproductive anatomy with emphasis on the physiology of normal reproductive function; ways to control and improve reproduction; principles of artificial insemination in farm animals; pregnancy testing; selected laboratory exercises with written report.

AN S 333. Embryo Transfer and Related Technologies.(3-0) Cr. 3. F. *Prereq:* AN S 331 or AN S 332

Application of embryo transfer and related technologies to genetic improvement of mammalian livestock. Techniques for control of female reproduction, embryo collection and transfer, embryo cryopreservation, and embryo manipulation. Gender selection. Economic and genetic aspects of embryo transfer.

AN S 334. Embryo Transfer Laboratory.(0-3) Cr. 1. F. *Prereq:* Credit or concurrent enrollment in AN S 333; AN S 332 or VDPAM 416; permission of instructor

Selected laboratory exercises related to embryo transfer such as synchronization of estrus, superovulation, detection of estrus, artificial insemination, embryo collection, embryo evaluation, microscopy, embryo cryopreservation, in vitro fertilization, embryo sexing, rectal palpation, and ultrasonography will be demonstrated and/or performed.

AN S 335. Dairy Cattle Evaluation.(0-6) Cr. 3. S. *Prereq:* Sophomore classification

Evaluation of breeding animals for dairy herds. Comparative terminology, decision making, and presentation of oral reasons. Trips to dairy cattle farms. Livestock handling.

AN S 336. Domestic Animal Behavior and Well-Being.(2-2) Cr. 3. F. *Prereq:* One course in physiology

Principles of behavior relative to animal care, management and environmental design to ensure animal well-being. Examination of basic neural-endocrine mechanisms involved in the animal's response to its environment. Awareness of animal protection, law and legislation. Methods to objectively assess animal well-being.

AN S 337. Lactation.(3-0) Cr. 3. S. *Prereq:* AN S 214

The structure, development and evolution of the mammary gland. Mammary metabolism, milk synthesis; neural and endocrine regulation of mammary function. Immune function and health of the mammary gland. Current events related to lactation.

AN S 345. Growth and Development of Domestic Animals.(3-0) Cr. 3. S. *Prereq:* AN S 214; BIOL 313 or GEN 320

Basic principles of animal growth and development covered at the tissue, cellular and molecular level. Emphasis placed on skeletal muscle, adipose, bone, and immune system growth and development. The effects of genetics, nutrition, and pharmaceuticals on growth.

AN S 352. Genetic Improvement of Domestic Animals.(2-2) Cr. 3. F.S. *Prereq:* One course in statistics, BIOL 211, course in genetics

Principles of qualitative and quantitative genetics applied to creating change in domestic animals. Impact of selection and mating schemes in achieving breeding program goals. Applications and impacts of biotechnological advancements in genetic manipulation.

AN S 360. Fresh Meats.(2-2) Cr. 3. F. *Prereq:* AN S 270; a course in organic or biochemistry

Impact of muscle structure, composition, rigor mortis, inspection, fabrication, handling, packaging and cooking on the palatability, nutritional value, yields, market value, and safety of fresh meat.

AN S 382. Swine Environment Management.(1-0) Cr. 1. *Prereq:* AN S 225 or 280 and 280L. Recommended TSM 210.

Response of swine to thermal environment, ventilation system design and analysis, heating and cooling systems, and examples of various designs for all phases of production. Troubleshooting ventilation systems and energy analysis of production units.

AN S 383. Swine Manure and Nutrient Management.(1-0) Cr. 1. *Prereq:* AN S 225 or AN S 280 and AN S 280L.

Function, application, and advantages and disadvantages of nutrient management systems. Manure production rates, manure handling systems, storage and manure management planning for land application and odor mitigation strategies.

AN S 384. Swine Health and Biosecurity.

(1-0) Cr. 1. *Prereq: AN S 225 or An S 280 and An S 280L. Recommended a course in microbiology.*

Overview of standard biosecurity protocols and identification of behavior and clinical signs of illness in pigs. Treatment administration and prevention methods. Introduction to immune system function and basic swine disease transmission.

AN S 399. Animal Science Internship.

Cr. arr. Repeatable. F.S.SS.

AN S 399A. Animal Science Internship: Graded Internship Experience.

Cr. 2-6. Repeatable. F.S.SS. *Prereq: Permission of the instructor*

Learning experience focused on professional development for a career related to animal science. Journal, presentation, and creative component.

AN S 399B. Animal Science Internship: Supervised Internship Experience.

Cr. R. Repeatable. F.S.SS. *Prereq: Permission of the instructor*

Learning experience focused on professional development for a career related to animal science. Journal, presentation, and creative component.

AN S 411. Addressing Issues in Animal Science.

(0-2) Cr. 1. F.S. *Prereq: Senior classification in An S*

Life skill development emphasized in the context of exploring one's perspective of the most pressing moral and scientific issues facing animal agriculture. Clarification and communication of personal conclusions in small and large group settings expected.

AN S 415. Equine Systems Management.

(2-2) Cr. 3. F.S. *Prereq: AN S 216, AN S 319, AN S 320, AN S 331*

Identification and development of financial and production goals in a horse business. Scientific approach to make decisions in management of enterprises in the horse industry.

AN S 419. Advanced Animal Nutrition.

(2-0) Cr. 2. F. *Prereq: AN S 214, AN S 319, AN S 320*

Detailed consideration of digestion, metabolism, and assimilation of nutrients. Recent advances and developments in basic nutrition.

AN S 424. Companion Animal Systems Management.

(2-2) Cr. 3. S. *Prereq: AN S 224, AN S 319, AN S 320, AN S 331, AN S 352*

Decisions facing the administrator of a companion animal enterprise. Financial and business goal identification, problem clarification, and resource allocation to manage the companion animal system.

AN S 425. Swine Systems Management.

(2-2) Cr. 3. F. *Prereq: AN S 225, AN S 270, AN S 270L, AN S 319, AN S 320, AN S 331, AN S 352; ECON 230 or equivalent recommended*

Decisions facing the administrator of a swine enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the swine enterprise.

AN S 426. Beef Cattle Systems Management.

(2-2) Cr. 3. F.S. *Prereq: AN S 226, AN S 270, AN S 270L, AN S 319, AN S 320, AN S 331, AN S 352; ECON 230 or equivalent recommended*

Decisions facing the administrator of a beef cow-calf or feedlot enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the beef enterprise.

AN S 429. Sheep Systems Management.

(2-2) Cr. 3. S. *Prereq: AN S 229, AN S 319, AN S 320, AN S 331, AN S 352; AGRON 334 recommended; ECON 230 or equivalent recommended*

Decisions facing the administrator of a sheep enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the sheep enterprise.

AN S 434. Dairy Systems Management.

(3-0) Cr. 3. F. *Prereq: AN S 235, AN S 319, AN S 331, AN S 320, AN S 337, AN S 352; ECON 230 or equivalent recommended*

The scientific foundation of dairy cattle management. The impact of dairy farm management practices on the biological processes of the cow. Integrates concepts from the disciplines of lactation, reproduction, nutrition, genetics, and animal health.

AN S 435. Applied Dairy Farm Evaluation.

(2-2) Cr. 3. S. *Prereq: AN S 434; ECON 230*

Evaluate nutrition, reproduction, milk quality, breeding, and related management practices of commercial dairy herds in a case study format. Students will apply knowledge gained in the classroom to commercial dairy farm situations and develop skills in information gathering, decision making, problem solving, and interpersonal communications.

AN S 441. International Animal Agriculture.

(Cross-listed with GLOBE). (3-0) Cr. 3. S. *Prereq: Two courses from AN S 223, AN S 225, AN S 226, AN S 229, AN S 235*

An overview of animal agriculture with emphasis on animal agriculture in developing countries. Historical, economic, environmental; and political considerations will be assessed and evaluated. Issues related to gender, resilience and sustainability for different production systems will be investigated. Meets International Perspectives Requirement.

AN S 460. Processed Meats.

(Dual-listed with AN S 560). (2-2) Cr. 3. S. *Prereq: AN S 270*

Physical, chemical and biological properties of meat important to processed meat product characteristics. Ingredients, technology and equipment used for cured meats, loaf products and fresh, cooked, dry and semi-dry sausage products.

AN S 475. Intercollegiate Judging Training and Competition.

(0-4) Cr. 1-2. Repeatable. F.S. *Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.

AN S 475A. Intercollegiate Judging Training and Competition: Meat Animals.

(0-4) Cr. 1-2. Repeatable. F.S. *Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.

AN S 475B. Intercollegiate Judging Training and Competition: Dairy Cattle.

(0-4) Cr. 1-2. Repeatable. F.S. *Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.

AN S 475C. Intercollegiate Judging Training and Competition: Meats.

(0-4) Cr. 1-2. Repeatable. F.S. *Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.

AN S 475D. Intercollegiate Judging Training and Competition: Meat Animal Evaluation.

(0-4) Cr. 1-2. Repeatable. F.S. *Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.

AN S 475E. Intercollegiate Judging Training and Competition: Horses.

(0-4) Cr. 1-2. Repeatable. F.S. *Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.

AN S 475F. Intercollegiate Judging Training and Competition: Management Systems.

(0-4) Cr. 1-2. Repeatable. F.S. *Prereq: permission of instructor*

Specialized training in evaluation and grading of livestock, livestock products, and livestock production management plans. Maximum of 6 credits may be applied toward graduation.

AN S 480. Animal Industry Leadership Fellows.

Cr. 1. Repeatable. F.S. *Prereq: A. AN S 226; permission of instructor C. AN S 225; permission of instructor*

Students broaden their perspective of the livestock industry through site visits, case-study (Fellows) projects, and cooperative learning experiences that capitalize on interaction skills in the context of studying the structure of the U.S. livestock industry. This for-credit offering represents the central academic focus of the Iowa State University Animal Industry Leadership Fellows Program. Study is species specific, and enrollment is limited. Offered on a satisfactory-fail basis only.

AN S 480A. Animal Industry Leadership Fellows: Beef.

Cr. 1. Repeatable. F.S. *Prereq: AN S 226; permission of instructor*

Students broaden their perspective of the livestock industry through site visits, case-study (Fellows) projects, and cooperative learning experiences that capitalize on interaction skills in the context of studying the structure of the U.S. livestock industry. This for-credit offering represents the central academic focus of the Iowa State University Animal Industry Leadership Fellows Program. Study is species specific, and enrollment is limited. Offered on a satisfactory-fail basis only.

AN S 480C. Animal Industry Leadership Fellows: Pork.

Cr. 1. Repeatable. F.S. *Prereq: AN S 225; permission of instructor*
Students broaden their perspective of the livestock industry through site visits, case-study (Fellows) projects, and cooperative learning experiences that capitalize on interaction skills in the context of studying the structure of the U.S. livestock industry. This for-credit offering represents the central academic focus of the Iowa State University Animal Industry Leadership Fellows Program. Study is species specific, and enrollment is limited. Offered on a satisfactory-fail basis only.

AN S 480G. Animal Industry Leadership Fellows: Poultry.

Cr. 1. Repeatable. F.S. *Prereq: AN S 223; permission of instructor*
Students broaden their perspective of the livestock industry through site visits, case-study (Fellows) projects, and cooperative learning experiences that capitalize on interaction skills in the context of studying the structure of the U.S. livestock industry. Central academic focus of the Iowa State University Animal Industry Leadership Fellows Program. Study is species specific, and enrollment is limited. Offered on a satisfactory-fail basis only.

AN S 489. Issues in Food Safety.

(Cross-listed with FS HN, HSP M, VDPAM). (1-0) Cr. 1. S. *Prereq: Credit or enrollment in FS HN 101 or FS HN 272 or HSP M 233; FS HN 419 or FS HN 420; FS HN 403*

Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

AN S 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

AN S 490A. Independent Study: Animal Science.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

AN S 490B. Independent Study: Dairy Science.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

AN S 490C. Independent Study: Meat Science.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

AN S 490D. Independent Study: Companion Animal Science.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

AN S 490E. Independent Study: Equine Science.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

AN S 490G. Independent Study: Poultry Science.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

AN S 490H. Independent Study: Honors.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

AN S 490I. Independent Study: Entrepreneurship.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of the instructor*

Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. A maximum of 6 credits of An S 490 may be applied toward the total credits required for graduation.

AN S 493. Workshop in Animal Science.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*

Workshop in livestock production. Includes current concepts in breeding, nutrition, reproduction, meats, and technologies that impact the animal industry.

AN S 495. Agricultural Travel Course Preparation.

Cr. R. Repeatable. F.S. *Prereq: Permission of instructor*

Limited enrollment. Students enrolled in this course will also register for Agron 495 and intend to register in Agron 496 and An S 496 the following term. Topics will include the agricultural industries, climate, crops, culture, history, livestock, marketing, soils, and preparation for travel to locations to be visited. Information normally available 9 months before departure.

AN S 496. Agricultural Travel Course.

Cr. arr. Repeatable. *Prereq: Permission of instructor, 30 college credits*

Limited enrollment. Students enroll in both An S 496 and Agron 496. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on livestock and crop production. Locations and duration of tours will vary. Summer tour will usually visit a northern location and winter tour will usually visit a southern location. Information usually available 9 months before departure. Tour expenses paid by students.

AN S 496A. Agricultural Travel Course: International tour.

Cr. arr. Repeatable. *Prereq: Permission of instructor, 30 college credits*

Limited enrollment. Students enroll in both An S 496 and Agron 496. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on livestock and crop production. Locations and duration of tours will vary. Summer tour will usually visit a northern location and winter tour will usually visit a southern location. Information usually available 9 months before departure. Tour expenses paid by students.

Meets International Perspectives Requirement.

AN S 496B. Agricultural Travel Course: Domestic tour.

Cr. arr. Repeatable. *Prereq: Permission of instructor, 30 college credits*

Limited enrollment. Students enroll in both An S 496 and Agron 496. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on livestock and crop production. Locations and duration of tours will vary. Summer tour will usually visit a northern location and winter tour will usually visit a southern location. Information usually available 9 months before departure. Tour expenses paid by students.

AN S 497. Undergraduate Teaching Experiences in Animal Science.

Cr. 1-2. Repeatable, maximum of 4 times. F.S.SS. *Prereq: Permission of instructor*

Development of oral and written communication skills of technical concepts in animal science. Emphasis on organizational skills, conducting activities and interpersonal communication skills. Responsibilities in a class under direct supervision of a faculty member. A maximum of 4 credits of An S 497 may be applied toward graduation.

Courses primarily for graduate students, open to qualified undergraduates:**AN S 500. Computer Techniques for Biological Research.**

(2-0) Cr. 1. F.

Introduction to UNIX and SAS for solving research problems, including organization of data files, transfer of files between workstations, developing models, and techniques for analysis of designed experiments. Introduction to matrix algebra for solving animal breeding problems using MATLAB and computer simulation.

AN S 500A. Computer Techniques for Biological Research: UNIX and SAS.

(2-0) Cr. 1. F.

First half semester course. Introduction to UNIX and SAS for solving research problems, including organization of data files, transfer of files between workstations, developing models, and techniques for analysis of designed experiments. Introduction to matrix algebra for solving animal breeding problems using MATLAB and computer simulation.

AN S 500B. Computer Techniques for Biological Research: Problem solving using matrix algebra.

(2-0) Cr. 1. F.

Second half semester course. Introduction to UNIX and SAS for solving research problems, including organization of data files, transfer of files between workstations, developing models, and techniques for analysis of designed experiments. Introduction to matrix algebra for solving animal breeding problems using MATLAB and computer simulation.

AN S 501. Survey of Animal Disciplines.

(1-0) Cr. 1. F.

Required for Animal Science graduate students. Orientation to departmental and graduate school policies and procedures. Discussion of programs of research and outreach in Animal Science. Issues impacting the animal industry. Offered on a satisfactory-fail basis only.

AN S 503. Seminar in Animal Production.(1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor*

Discussion and evaluation of current topics in animal production and management.

AN S 515. Integrated Crop and Livestock Production Systems.(Cross-listed with A B E, AGRON, SUSAG). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: SUSAG 509*

Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

AN S 518. Digestive Physiology and Metabolism of Non Ruminants.

(Cross-listed with NUTRS). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: AN S 419 or NUTRS 501

Digestion and metabolism of nutrients. Nutritional requirements and current research and feeding programs for poultry and swine.

AN S 520. Digestive Physiology and Metabolism of Ruminants.

(Cross-listed with NUTRS). (2-2) Cr. 3. Alt. S., offered even-numbered years.

Prereq: AN S 419 or NUTRS 501

Digestive physiology and nutrient metabolism in ruminant and preruminant animals.

AN S 533. Physiology and Endocrinology of Animal Reproduction.(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: General physiology course*

Development of structure and function of the reproductive system. Physiologic and endocrine aspects including puberty, gametogenesis, estrous cycle, pregnancy, maternal recognition, fertilization and early embryonic development.

AN S 536. Perinatology.(2-0) Cr. 2. S. *Prereq: One course in physiology; one course in biochemistry*

Regulation of metabolism and development in the mammalian fetus and neonate is explored in a comparative manner. Emphasis will be on the dynamic changes in these relationships occurring at birth.

AN S 537. Topics in Animal Behavior, Welfare.(3-0) Cr. 3. *Prereq: permission of instructor; M.S. or Ph.D. student*

Each semester, the students' focus is on different topics related to animal behavior, animal welfare and contemporary issues related to animal behavior and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line course only. Each topic may be taken only one time for credit.

AN S 537A. Topics in Animal Behavior, Welfare: Animal Behavior.(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: permission of instructor; M.S. or Ph.D. student*

Each semester, the students' focus is on different topics related to animal behavior, animal welfare and contemporary issues related to animal behavior and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line course only. Each topic may be taken only one time for credit.

AN S 537B. Topics in Animal Behavior, Welfare: Contemporary Issues..(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: permission of instructor; M.S. or Ph.D. student*

Each semester, the students' focus is on different topics related to animal behavior, animal welfare and contemporary issues related to animal behavior and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line course only. Each topic may be taken only one time for credit.

AN S 537C. Topics in Animal Behavior, Welfare: Animal Welfare.(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: permission of instructor; M.S. or Ph.D. student*

Each semester, the students' focus is on different topics related to animal behavior, animal welfare and contemporary issues related to animal behavior and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line course only. Each topic may be taken only one time for credit.

AN S 537D. Topics in Animal Behavior, Welfare: Immune and Stress.(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: permission of instructor; M.S. or Ph.D. student*

Each semester, the students' focus is on different topics related to animal behavior, animal welfare and contemporary issues related to animal behavior and welfare. Each topic is separate and distinct, and students may enroll in multiple topics. This is an on-line course only. Each topic may be taken only one time for credit.

AN S 540. Livestock Immunogenetics.(Cross-listed with MICRO, V MPM). (2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq: AN S 561 or MICRO 575 or V MPM 520*

Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

AN S 549. Advanced Vertebrate Physiology I.(Cross-listed with KIN, NUTRS). (4-0) Cr. 4. F. *Prereq: Biol 335; credit or enrollment in BBMB 404 or BBMB 420*

Overview of mammalian physiology. Cell biology, endocrinology, cardiovascular, respiratory, immune, digestive, skeletal muscle and reproductive systems.

AN S 552. Advanced Vertebrate Physiology II.(Cross-listed with KIN, NUTRS). (3-0) Cr. 3. S. *Prereq: BIOL 335; credit or enrollment in BBMB 404 or BBMB 420*

Cardiovascular, renal, respiratory, and digestive physiology.

AN S 556. Current Topics in Genome Analysis.(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: BBMB 405 or GDCB 510*

Introduction to principles and methodology of molecular genetics useful in analyzing and modifying large genomes.

AN S 560. Processed Meats.(Dual-listed with AN S 460). (2-2) Cr. 3. S. *Prereq: AN S 270*

Physical, chemical and biological properties of meat important to processed meat product characteristics. Ingredients, technology and equipment used for cured meats, loaf products and fresh, cooked, dry and semi-dry sausage products.

AN S 561. Population and Quantitative Genetics for Breeding.(Cross-listed with AGRON). (4-0) Cr. 4. F. *Prereq: STAT 401*

Population and quantitative genetics for plant and animal genetics. Study of the genetic basis and analysis of variation in quantitative traits in domestic or experimental populations using phenotypic and molecular marker data, including estimation of heritability and other genetic parameters, linkage analysis and mapping of quantitative trait loci, and the impact of inbreeding, heterosis, and genotype-by-environment interaction.

AN S 562. Methodologies for Population/Quantitative Genetics.(2-0) Cr. 2. S. *Prereq: AN S 561, STAT 402*

Basic theory for genetic analysis of animal breeding data. Course A (1st half semester) covers linear models, selection index methods, and basic theory for best linear unbiased prediction. Course B (2nd half semester) best linear unbiased prediction, including genetic groups, environmental adjustment, repeated records, multiple trait models, maternal effects models, and theory for maximum likelihood estimation of genetic parameters.

AN S 562A. Methodologies for Population/Quantitative Genetics: Linear Models and Genetic Prediction.(2-0) Cr. 2. S. *Prereq: AN S 561, STAT 402*

Basic theory for genetic analysis of animal breeding data. Course A (1st half semester) covers linear models, selection index methods, and basic theory for best linear unbiased prediction. Course B (2nd half semester) best linear unbiased prediction, including genetic groups, environmental adjustment, repeated records, multiple trait models, maternal effects models, and theory for maximum likelihood estimation of genetic parameters.

AN S 562B. Methodologies for Population/Quantitative Genetics: Advanced Genetic Prediction&Parameter Estimation.(2-0) Cr. 2. S. *Prereq: AN S 561, STAT 402*

Basic theory for genetic analysis of animal breeding data. Course A (1st half semester) covers linear models, selection index methods, and basic theory for best linear unbiased prediction. Course B (2nd half semester) best linear unbiased prediction, including genetic groups, environmental adjustment, repeated records, multiple trait models, maternal effects models, and theory for maximum likelihood estimation of genetic parameters.

AN S 570. Advanced Meat Science and Applied Muscle Biology.(2-2) Cr. 3. S. *Prereq: AN S 460*

Ante and postmortem factors impacting composition, structure, and chemistry of red meat and poultry muscle/meat, the conversion of muscle to meat, and the sensory and nutritional attributes of fresh meats. Oral research reports and a research proposal.

AN S 571. Advanced Meat Processing Principles and Technology.(2-2) Cr. 3. Alt. F., offered even-numbered years. *Prereq: AN S 460 or AN S 570*

Physical/chemical relationships during processing. Effects of modern technology, non-meat additives and preservation techniques on quality and safety of processed meat. Laboratory demonstration of principles and technology.

AN S 590. Special Topics.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590A. Special Topics: Animal Breeding.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590B. Special Topics: Animal Nutrition.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590C. Special Topics: Meat Animal Production.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590D. Special Topics: Dairy Production.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590E. Special Topics: Meat Science.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590F. Special Topics: Physiology of Reproduction.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590G. Special Topics: Muscle Biology.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590H. Special Topics: Poultry Nutrition.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590I. Special Topics: Poultry Products.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590J. Special Topics: Experimental Surgery.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590K. Special Topics: Professional Topics.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590L. Special Topics: Teaching.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590M. Special Topics: Molecular Biology.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 590N. Special Topics: Ethology.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

AN S 599. Creative Component.Cr. 1-8. F.S.SS. *Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AN S 599A. Creative Component: Animal Breeding and Genetics.Cr. 1-8. F.S.SS. *Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AN S 599B. Creative Component: Animal Nutrition.Cr. 1-8. F.S.SS. *Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AN S 599C. Creative Component: Animal Physiology.Cr. 1-8. F.S.SS. *Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AN S 599D. Creative Component: Animal Science.Cr. 1-8. F.S.SS. *Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AN S 599E. Creative Component: Meat Science.Cr. 1-8. F.S.SS. *Prereq: Nonthesis M.S*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

Courses for graduate students:**AN S 603. Seminar in Animal Nutrition.**(1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor*

Discussion of current literature; preparation and submission of abstracts.

AN S 618. Vitamins and Minerals.(Cross-listed with NUTRS). Cr. 2. Alt. S., offered even-numbered years. *Prereq: Biochemistry, physiology, basic nutrition*

Understanding molecular aspects of vitamin and mineral metabolism and homeostasis in humans and animals. An in-depth examination of the chemistry of vitamins and minerals, including genetic mutations, proteins involved in absorption and excretion, and their necessity in biological processes.

AN S 619. Advanced Nutrition and Metabolism - Protein.(Cross-listed with NUTRS). (2-0) Cr. 2. F. *Prereq: BBMB 405*

Digestion, absorption, and intermediary metabolism of amino acids and protein. Regulation of protein synthesis and degradation. Integration of cellular biochemistry and physiology of mammalian protein metabolism.

AN S 620. Advanced Nutrition and Metabolism - Energy.(Cross-listed with NUTRS). (2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: BBMB 405*

Energy constituents of feedstuffs and energy needs of animals as related to cellular biochemistry and physiology. Interpretations of classical and current research.

AN S 633. Seminar in Animal Reproduction.(1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor*

Discussion of current literature and preparation of reports and seminars on selected topics concerning animal physiology.

AN S 652. Animal Breeding Strategies.(2-0) Cr. 2. *Prereq: AN S 561*

Basic concepts and methods for design and evaluation of genetic improvement programs for livestock. Topic A. (1st half semester) Prediction of response to selection, selection index theory, multiple trait selection, inbreeding, crossbreeding, and marker-assisted selection. Topic B. (2nd half semester) Advanced concepts in design and evaluation of animal breeding programs, including modeling and optimization, derivation of economic values, gene-flow, and predicting rates of inbreeding. Each topic may be taken only one time for academic credit.

AN S 652A. Animal Breeding Strategies: Breeding Goals and Response to Selection.(2-0) Cr. 2. *Prereq: AN S 561*

Basic concepts and methods for design and evaluation of genetic improvement programs for livestock. Topic A. (1st half semester) Prediction of response to selection, selection index theory, multiple trait selection, inbreeding, crossbreeding, and marker-assisted selection. Topic B. (2nd half semester) Advanced concepts in design and evaluation of animal breeding programs, including modeling and optimization, derivation of economic values, gene-flow, and predicting rates of inbreeding. Each topic may be taken only one time for academic credit.

AN S 652B. Animal Breeding Strategies: Design and Evaluation of Animal Breeding Programs.(2-0) Cr. 2. *Prereq: AN S 561*

Basic concepts and methods for design and evaluation of genetic improvement programs for livestock. Topic A. (1st half semester) Prediction of response to selection, selection index theory, multiple trait selection, inbreeding, crossbreeding, and marker-assisted selection. Topic B. (2nd half semester) Advanced concepts in design and evaluation of animal breeding programs, including modeling and optimization, derivation of economic values, gene-flow, and predicting rates of inbreeding. Each topic may be taken only one time for academic credit.

AN S 653. Applied Animal Breeding Strategies.(2-0) Cr. 2. F. *Prereq: AN S 561 recommended*

Industrial applications of breeding systems, selection methods, and new genetic technologies. One or more field trips to an industry breeding company.

AN S 653A. Applied Animal Breeding Strategies: Swine and Poultry.(2-0) Cr. 2. F. *Prereq: AN S 561 recommended*

Industrial applications of breeding systems, selection methods, and new genetic technologies. One or more field trips to an industry breeding company.

AN S 653B. Applied Animal Breeding Strategies: Beef and Dairy.(2-0) Cr. 2. F. *Prereq: AN S 561 recommended*

Industrial applications of breeding systems, selection methods, and new genetic technologies. One or more field trips to an industry breeding company.

AN S 655. Advanced Computational Methods in Animal Breeding and Genetics.(3-1) Cr. 2. Alt. F., offered odd-numbered years. *Prereq: AN S 500, AN S 562, COM S 207*

Computational methods and strategies for analysis of large data sets with animal breeding data for use in research and industry applications. Course A (1st half semester) Strategies for handling large sets and for prediction using best linear unbiased prediction using a formal language and utility programs. Course B (2nd half semester) Strategies for estimation of genetic parameters and for use of non-linear models for genetic analysis of categorical and survival type data.

AN S 655A. Computational Strategies for Predicting Breeding Values.(3-1) Cr. 2. Alt. F., offered odd-numbered years. *Prereq: AN S 500, AN S 562, COM S 207*

Computational methods and strategies for analysis of large data sets with animal breeding data for use in research and industry applications. Strategies for handling large sets and for prediction using best linear unbiased prediction using a formal language and utility programs.

AN S 655B. Computational Strategies for Genetic Parameter Estimation.(3-1) Cr. 2. Alt. F., offered odd-numbered years. *Prereq: AN S 500, AN S 562, COM S 207*

Computational methods and strategies for analysis of large data sets with animal breeding data for use in research and industry applications. Strategies for estimation of genetic parameters and for use of non-linear models for genetic analysis of categorical and survival type data.

AN S 656. Statistical Methods for Mapping Quantitative Trait Loci.(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: AN S 562, STAT 447*

Statistical methods for mapping quantitative trait loci in out-bred populations. Methods based on modeling covariances between relatives. Likelihood based methods using half-sib and full-sib families and extended pedigrees. Bayesian methods applied.

AN S 658. Seminar in Animal Breeding and Genetics.

(1-0) Cr. 1. Repeatable. F.S.

Presentation of current research related to animal breeding and genetics.

AN S 670. Molecular Biology of Muscle.(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: BBMB 405, BBMB 420, or BBMB 502*

Ultrastructure of muscle; chemistry, structure, function, and molecular biology of muscle proteins. Molecular aspects of muscle contraction, development and turnover. Cytoskeletal proteins and dynamics.

AN S 684. Seminar in Meat Science.(1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor*

Discussion and evaluation of current topics in research publications in meat science.

AN S 685. Seminar in Muscle Biology.(1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor*

Reports and discussion of recent literature and current investigations.

AN S 695. Seminar in Animal Science.

(1-0) Cr. 1. Repeatable. S.

Reports and discussion of current issues and research in animal science.

One credit is required for all M.S. degree candidates with graduate majors in the Department of Animal Science, and two credits are required for all Ph.D. candidates with graduate majors in the Department of Animal Science. Offered on a satisfactory-fail basis only.

AN S 699. Research.

Cr. arr. Repeatable.

AN S 699A. Research: Animal Breeding.

Cr. arr. Repeatable.

AN S 699B. Research: Animal Nutrition.

Cr. arr. Repeatable.

AN S 699C. Research: Meat Animal Production.

Cr. arr. Repeatable.

AN S 699D. Research: Dairy Production.

Cr. arr. Repeatable.

AN S 699E. Research: Meat Science.

Cr. arr. Repeatable.

AN S 699F. Research: Physiology of Reproduction.

Cr. arr. Repeatable.

AN S 699G. Research: Muscle Biology.

Cr. arr. Repeatable.

AN S 699H. Research: Poultry Nutrition.

Cr. arr. Repeatable.

AN S 699I. Research: Poultry Products.

Cr. arr. Repeatable.

AN S 699J. Research: Animal Ethology.

Cr. arr. Repeatable.

Anthropology (ANTHR)

Courses primarily for undergraduates:

ANTHR 201. Introduction to Cultural Anthropology.

(3-0) Cr. 3. F.S.SS.

Comparative study of culture as key to understanding human behaviors in different societies. Using a global, cross-cultural perspective, patterns of family life, economic and political activities, religious beliefs, and the ways in which cultures change are examined.

Meets International Perspectives Requirement.

ANTHR 202. Introduction to Biological Anthropology and Archaeology.

(3-0) Cr. 3. F.S.

Human biological and cultural evolution; survey of the evidence from fossil primates, the human fossil record and the archaeological record, as well as living primates; introduction to research methods in archaeology and biological anthropology.

ANTHR 220. Global Sustainability.

(Cross-listed with ENV S, GLOBE, M E, MAT E, SOC, T SC). (3-0) Cr. 3. F.S.

An introduction to the key global issues in sustainability. Focuses on interconnected roles of energy, materials, human resources, economics, and technology in building and maintaining sustainable systems. Applications discussed will include challenges in both the developed and developing world and will examine the role of technology in a resource-constrained world. Cannot be used for technical elective credit in any engineering department.

Meets International Perspectives Requirement.

ANTHR 230. Globalization and the Human Condition.

(3-0) Cr. 3. F.S.

An introduction to understanding key global issues in the contemporary world. Focuses on social relations, cultural practices and political-economic linkages among Africa, the Americas, Asia, Europe and the Pacific.

Meets International Perspectives Requirement.

ANTHR 306. Cultural Anthropology.

(2-2) Cr. 3. S. Prereq: ANTHR 201

Survey of the major theoretical, methodological and empirical foundations of cultural anthropology. Participatory lab: focus on ethnographic methods through individual research projects.

Meets International Perspectives Requirement.

ANTHR 307. Biological Anthropology.

(2-2) Cr. 3. S. Prereq: ANTHR 202

Human evolution as known from fossil evidence, comparative primate studies, and genetic variations in living populations. Laboratory-tutorial sessions include study and discussion of human osteology, fossil hominids, simple Mendelian traits, and bio-ethics in applied biological anthropology.

ANTHR 308. Archaeology.

(2-2) Cr. 3. F. Prereq: ANTHR 202

Methods and techniques for the recovery and interpretation of archaeological evidence, its role in reconstructing human behavior and past environments. Laboratory sessions include experience in the interpretation of archaeological evidence, the use of classification systems, and prehistoric technologies such as ceramics and stone tools.

ANTHR 309. Introduction to Culture and Language.

(Cross-listed with LING). (3-0) Cr. 3. Prereq: ANTHR 201 recommended

Introduction to study of language, culture and society from an anthropological perspective. Focus on language and thought, ethnography of speaking, discourse and narrative, writing and literacy, and media communication. Discussion of key theories and methods of linguistic anthropology.

Meets International Perspectives Requirement.

ANTHR 313. Kinship and Marriage in a Global Perspective.

(Dual-listed with ANTHR 513). (3-0) Cr. 3. S. Prereq: ANTHR 201 recommended

Comparative and historical overview of the family, marriage and kinship. Examination of cross-cultural differences in the construction and functioning of family and kin relations; role of kinship in structuring individual and collective activities; current critical and theoretical issues in kinship studies, especially integrating work on gender and sexuality.

Meets International Perspectives Requirement.

ANTHR 315. Archaeology of North America.

(Dual-listed with ANTHR 515). (Cross-listed with AM IN). (3-0) Cr. 3. S. Prereq: ANTHR 202

Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture-historical sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Meets U.S. Diversity Requirement

ANTHR 319. Skeletal Biology.

(Dual-listed with ANTHR 519). (2-2) Cr. 3. F. Prereq: ANTHR 307 or college level biology

Comprehensive study of the skeletal anatomy, physiology, genetics, growth, development and population variation of the human skeleton. Applications to forensic anthropology, paleopathology and bioarchaeology are introduced.

ANTHR 320. Great Plains Archaeology.

(Dual-listed with ANTHR 520). (Cross-listed with AM IN). (3-0) Cr. 3. F. Prereq: ANTHR 202

Prehistoric societies of the Great Plains region of North America, from initial occupation to European contact; emphasis on sociocultural changes, continuities, and adaptations to changing environments using archaeological, ecological, ethnographic information.

Meets U.S. Diversity Requirement

ANTHR 321. World Prehistory.

(Dual-listed with ANTHR 521). (3-0) Cr. 3. S. Prereq: ANTHR 202 recommended

An introduction to archaeological sites from around the world including the Near East, Africa, Europe, Mesoamerica, and North and South America. Emphasis is on the interpretation of material cultural remains in reconstructing past societies.

ANTHR 322. Peoples and Cultures of Native North America.

(Dual-listed with ANTHR 522). (Cross-listed with AM IN). (3-0) Cr. 3. Prereq: ANTHR 201 or AM IN 210

Origin, distribution, and pre-contact life of the indigenous peoples of North America. Survey of culture areas; language families, social and political systems, ecological and economic adaptations, religion and spirituality; impact of European contact; cultural resilience and revitalization in contemporary American Indian life.

Meets U.S. Diversity Requirement

ANTHR 323. Topics in Latin American Anthropology.

(Dual-listed with ANTHR 523). (Cross-listed with AM IN). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S. Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

ANTHR 323A. Latin American Anthropology: Violence and Memory.

(Dual-listed with ANTHR 523A). (Cross-listed with AM IN). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S. Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

ANTHR 323B. Latin American Anthropology: Social movements and Democracy.

(Dual-listed with ANTHR 523B). (Cross-listed with AM IN). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S. Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

Meets International Perspectives Requirement.

ANTHR 323C. Latin American Anthropology: Race, Class and Gender.

(Dual-listed with ANTHR 523C). (Cross-listed with AM IN). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S. Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

Meets International Perspectives Requirement.

ANTHR 323D. Latin American Anthropology: Regional Focus.

(Dual-listed with ANTHR 523D). (Cross-listed with AM IN). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S. Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

Meets International Perspectives Requirement.

ANTHR 332. Current Issues in Native North America.

(Dual-listed with ANTHR 532). (Cross-listed with AM IN). (3-0) Cr. 3. S. *Prereq:* ANTHR 201 or ANTHR 306; ANTHR 322 or AM IN 210 recommended
Conditions and issues of contemporary American Indian peoples, historical background of contemporary life; federal policies, treaty rights, and sovereignty. Economic development and politics on reservations, family and gender roles, cultural innovation and revitalization, urbanization, recent social movements, and other current concerns.

Meets U.S. Diversity Requirement

ANTHR 333. Asian American Material Cultures.

(Dual-listed with ANTHR 533). (3-0) Cr. 3.
Examination of material objects made and used by Asian Americans with both historical and contemporary focuses; transnational and interdisciplinary lenses to interpret the material world; contemporary approaches to analysis of artifacts.
Meets U.S. Diversity Requirement

ANTHR 336. Global Development.

(Dual-listed with ANTHR 536). (3-0) Cr. 3. Alt. F., offered odd-numbered years.
Prereq: ANTHR 201 or ANTHR 306
Cross-cultural analysis of current development practices from an anthropological perspective; focus on international aid, development institutions, agrarian reform, indigenous knowledge, humanitarianism and human rights; introduction to main theories of political and economic anthropology.
Meets International Perspectives Requirement.

ANTHR 340. Magic, Witchcraft, and Religion.

(Dual-listed with ANTHR 540). (Cross-listed with RELIG). (3-0) Cr. 3. S. *Prereq:* ANTHR 201 or ANTHR 306
Survey of global religious belief and practice from an anthropological perspective. Emphasis on myth and ritual, shamanism, magic, witchcraft, beliefs in spirits, conceptions of the soul, mind and body relationships, and healing and therapeutic practices. Discussion of religious response to dramatic political and social change; effects of globalization on religious practice.
Meets International Perspectives Requirement.

ANTHR 350. Primate Behavior.

(Dual-listed with ANTHR 550). (2-2) Cr. 3. F.S.SS. *Prereq:* ANTHR 202 and/or basic biology course recommended
An introduction to the Order Primates with a focus on their behavior. Biological and social adaptations of monkeys, apes, and prosimians; basic evolutionary concepts, current trends and theories in the field of Primatology and issues related to primate conservation.

ANTHR 354. War and the Politics of Humanitarianism.

(Cross-listed with POL S). (3-0) Cr. 3. S. *Prereq:* Pol S 235, Pol S 251, or Anthr 230
Humanitarianism as a system of thought and a system of intervention in conflict and post-conflict situations: role of humanitarian organizations and actors in addressing human suffering caused by conflict or war military action as a form of humanitarian intervention.
Meets International Perspectives Requirement.

ANTHR 376. Classical Archaeology.

(Cross-listed with CL ST, RELIG). (3-0) Cr. 3. S.
Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.
Meets International Perspectives Requirement.

ANTHR 376A. Classical Archeology: Bronze Age and Early Iron Age Greece.

(Cross-listed with CL ST, RELIG). (3-0) Cr. 3. S.
Bronze Age (Minoan and Mycenaean palatial cultures) and Early Iron Age Greece (ca 3000-700 BCE). Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.
Meets International Perspectives Requirement.

ANTHR 376B. Classical Archeology: Archaic through Hellenistic Greece (ca 700-30 BCE).

(Cross-listed with CL ST, RELIG). (3-0) Cr. 3. S.
Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.
Meets International Perspectives Requirement.

ANTHR 411. Applied Anthropology.

(Dual-listed with ANTHR 511). (3-0) Cr. 3. F. *Prereq:* ANTHR 201 or ANTHR 306
Theoretical and practical considerations of applying anthropological knowledge to contemporary cultural, political and economic issues. Dynamics of directed change in contemporary world cultures. Principles, theories, and ethics of international development projects from a sociocultural perspective.
Meets International Perspectives Requirement.

ANTHR 418. Global Culture, Consumption and Modernity.

(Dual-listed with ANTHR 518). (3-0) Cr. 3. F. *Prereq:* ANTHR 201 or ANTHR 306 recommended
Cross-cultural study of the impact of globalization, with an emphasis on economic consumption and the movement of goods, ideas, and peoples across cultural and national boundaries.
Meets International Perspectives Requirement.

ANTHR 419. Topics in Cultural Anthropology.

(3-0) Cr. 3. *Prereq:* ANTHR 306
In-depth study of current topics in cultural anthropology, such as recent theoretical trends, new methodologies, or new research on a specific region. Topics vary each time offered. Each section may be taken once for credit up to 9 credits. No more than 9 credits of ANTHR 419 courses may be applied towards graduation.

ANTHR 419A. Topics in Cultural Anthropology: Theory.

(3-0) Cr. 3. *Prereq:* ANTHR 306
In-depth study of current topics in cultural anthropology, such as recent theoretical trends, new methodologies, or new research on a specific region. Topics vary each time offered. No more than 9 credits of ANTHR 419 courses may be applied towards graduation.

ANTHR 419B. Topics in Cultural Anthropology: Methods.

(3-0) Cr. 3. *Prereq:* ANTHR 306
In-depth study of current topics in cultural anthropology, such as recent theoretical trends, new methodologies, or new research on a specific region. Topics vary each time offered. No more than 9 credits of ANTHR 419 courses may be applied towards graduation.

ANTHR 419C. Topics in Cultural Anthropology: Regional Focus.

(3-0) Cr. 3. *Prereq:* ANTHR 306
In-depth study of current topics in cultural anthropology, such as recent theoretical trends, new methodologies, or new research on a specific region. Topics vary each time offered. No more than 9 credits of ANTHR 419 courses may be applied towards graduation.

ANTHR 419D. Topics in Cultural Anthropology: Others.

(3-0) Cr. 3. *Prereq:* ANTHR 306
In-depth study of current topics in cultural anthropology, such as recent theoretical trends, new methodologies, or new research on a specific region. Topics vary each time offered. No more than 9 credits of ANTHR 419 courses may be applied towards graduation.

ANTHR 424. Forensic Anthropology.

(Dual-listed with ANTHR 524). (2-2) Cr. 3. S. *Prereq:* ANTHR 202 or ANTHR 307; ANTHR 319 recommended
Comprehensive study of forensic anthropology, a specialized subfield of biological anthropology. Emphasis is placed on personal identifications from extremely fragmentary, comingled, burnt, cremated and incomplete skeletal remains. All parameters of forensic study are included as they pertain to anthropology, including human variation, taphonomy, entomology, archaeology, pathology, epidemiology; genetics and the non-biological forensic disciplines. An appreciation for the wide range of medicolegal and bioethical issues will also be gained.

ANTHR 425. Professional Preparation in Anthropology.

(2-0) Cr. 2. F. *Prereq:* Junior classification in anthropology or permission from the instructor
Instruction and guidance in the development of professional skills needed for success in academic and non-academic anthropological careers. Topics will include strategies for internship and job searches, creating resumes and CVs, composing personal statements and cover letters, and developing contacts and sources. Offered on a satisfactory-fail basis only.

ANTHR 427I. Field Archaeology.

(Cross-listed with IA LL). Cr. 4. SS.
Nature of cultural and environmental evidence in archaeology and how they are used to model past human behavior and land use; emphasis on Iowa prehistory; basic reconnaissance surveying and excavation techniques.

ANTHR 428. Topics in Archaeological Laboratory Methods and Techniques.

(Dual-listed with ANTHR 528). (2-2) Cr. 3. Repeatable, maximum of 9 credits. S. Prereq: ANTHR 308

Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition and organization, and computer applications.

ANTHR 428A. Topics in Archaeological Laboratory Methods and Techniques: Lithics.

(Dual-listed with ANTHR 528A). (2-2) Cr. 3. Repeatable, maximum of 9 credits. S. Prereq: ANTHR 308

Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition and organization, and computer applications.

ANTHR 428B. Topics in Archaeological Laboratory Methods and Techniques: Ceramics.

(Dual-listed with ANTHR 528B). (2-2) Cr. 3. Repeatable, maximum of 9 credits. S. Prereq: ANTHR 308

Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition and organization, and computer applications.

ANTHR 428C. Topics in Archaeological Laboratory Methods and Techniques: Faunal remains.

(Dual-listed with ANTHR 528C). (2-2) Cr. 3. Repeatable, maximum of 9 credits. S. Prereq: ANTHR 308

Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition and organization, and computer applications.

ANTHR 428D. Topics in Archaeological Laboratory Methods and Techniques: General.

(Dual-listed with ANTHR 528D). (2-2) Cr. 3. Repeatable, maximum of 9 credits. S. Prereq: ANTHR 308

Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition and organization, and computer applications.

ANTHR 429. Topics in Archaeological Laboratory Methods and Techniques: Archaeological Field School.

(Dual-listed with ANTHR 529). Cr. 4-6. SS. Prereq: ANTHR 202 or ANTHR 308
Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence.

ANTHR 431. Ethnographic Field School.

(Dual-listed with ANTHR 531). Cr. 4-6.

Hands-on training in ethnographic field methods; students will carry out research projects in socio-cultural anthropology, learning a variety of investigative research techniques commonly used in social sciences.

ANTHR 434. Internship.

Cr. 2-6. Repeatable, maximum of 6 credits. F.S.SS. Prereq: Junior or senior standing

Supervised practice in government agencies, museums, and business organizations. Offered on a satisfactory-fail basis only. Not more than 6 credits of internship experience may count towards the major. No credits in Anthr 434 may be used to satisfy Anthropology core courses for majors or for the Anthropology minor.

ANTHR 434A. Internship: Archaeology.

Cr. 2-6. Repeatable, maximum of 6 credits. F.S.SS. Prereq: Junior or senior standing

Supervised practice in government agencies, museums, and business organizations. Offered on a satisfactory-fail basis only. Not more than 6 credits of internship experience may count towards the major. No credits in Anthr 434 may be used to satisfy Anthropology core courses for majors or for the Anthropology minor.

ANTHR 434B. Internship: Cultural Anthropology.

Cr. 2-6. Repeatable, maximum of 6 credits. F.S.SS. Prereq: Junior or senior standing

Supervised practice in government agencies, museums, and business organizations. Offered on a satisfactory-fail basis only. Not more than 6 credits of internship experience may count towards the major. No credits in Anthr 434 may be used to satisfy Anthropology core courses for majors or for the Anthropology minor.

ANTHR 434C. Internship: Biological Anthropology.

Cr. 2-6. Repeatable, maximum of 6 credits. F.S.SS. Prereq: Junior or senior standing

Supervised practice in government agencies, museums, and business organizations. Offered on a satisfactory-fail basis only. Not more than 6 credits of internship experience may count towards the major. No credits in Anthr 434 may be used to satisfy Anthropology core courses for majors or for the Anthropology minor.

ANTHR 434D. Internship: Linguistic Anthropology.

Cr. 2-6. Repeatable, maximum of 6 credits. F.S.SS. Prereq: Junior or senior standing

Supervised practice in government agencies, museums, and business organizations. Offered on a satisfactory-fail basis only. Not more than 6 credits of internship experience may count towards the major. No credits in Anthr 434 may be used to satisfy Anthropology core courses for majors or for the Anthropology minor.

ANTHR 438. Primate Evolutionary Ecology and Behavior.

(Dual-listed with ANTHR 538). Cr. 3. S. Prereq: ANTHR 202 or ANTHR 307

Primate behavior and ecology in evolutionary perspective: biological and social adaptations of prosimians, monkeys, and apes. Introduction to the Order Primates, basic evolutionary concepts, and techniques of behavioral observation. Focus on theory and methods current in Primatology, including applied conservation biology.

ANTHR 444. Sex and Gender in Cross-cultural Perspective.

(Dual-listed with ANTHR 544). (Cross-listed with W S). (3-0) Cr. 3. S. Prereq: ANTHR 201; ANTHR 306 recommended

Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

ANTHR 445. Biological Field School.

(Dual-listed with ANTHR 545). Cr. 4-6. SS. Prereq: ANTHR 202 or BIOL 101

Summer field school for training in behavioral and ecological methods for primatologists. Proposal, data collection and analyses, and presentation of research topic in primatology.

ANTHR 450. Historical and Theoretical Approaches in Anthropology.

(3-0) Cr. 3. F. Prereq: ANTHR 306

Survey of the historical foundations of anthropology and its interrelated four sub-fields; key figures in 19th and 20th century anthropology with a focus on major theoretical contributions.

ANTHR 451. Practicum in Anthropology.

Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. Prereq: ANTHR 201 or ANTHR 202 or ANTHR 308

Application of methods under actual laboratory and field conditions, including basic data management, synthesis, and analysis.

ANTHR 451A. Practicum in Anthropology: Archaeology.

Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. Prereq: ANTHR 201 or ANTHR 202 or ANTHR 308

Application of methods under actual laboratory and field conditions, including basic data management, synthesis, and analysis.

ANTHR 451B. Practicum in Anthropology: Cultural Anthropology.

Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. Prereq: ANTHR 201 or ANTHR 202 or ANTHR 308

Application of methods under actual laboratory and field conditions, including basic data management, synthesis, and analysis.

ANTHR 451C. Practicum in Anthropology: Biological Anthropology.

Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. Prereq: ANTHR 201 or ANTHR 202 or ANTHR 308

Application of methods under actual laboratory and field conditions, including basic data management, synthesis, and analysis.

ANTHR 451D. Practicum in Anthropology: Linguistic Anthropology.

Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. Prereq: ANTHR 201 or ANTHR 202 or ANTHR 308

Application of methods under actual laboratory and field conditions, including basic data management, synthesis, and analysis.

ANTHR 482. Topics in Biological Anthropology.

(Dual-listed with ANTHR 582). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F. Prereq: ANTHR 307

In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.

ANTHR 482A. Topics in Biological Anthropology: Paleoanthropology.

(Dual-listed with ANTHR 582A). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F. Prereq: ANTHR 307

In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.

ANTHR 482B. Topics in Biological Anthropology: Primate Cognition.

(Dual-listed with ANTHR 582B). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F. Prereq: ANTHR 307

In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.

ANTHR 482C. Topics in Biological Anthropology: Primate Conservation.

(Dual-listed with ANTHR 582C). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F. Prereq: ANTHR 307

In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.

ANTHR 482D. Topics in Biological Anthropology: Population Genetics and Human Evolution.

(Dual-listed with ANTHR 582D). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F. Prereq: ANTHR 307

In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.

ANTHR 490. Independent Study.

Cr. 1-5. Repeatable, maximum of 9 credits. Prereq: 9 credits in anthropology
No more than 9 credits of Anthr 490 may be counted toward graduation.

ANTHR 490A. Independent Study: Archaeology.

Cr. 1-5. Repeatable, maximum of 9 credits. Prereq: 9 credits in anthropology
No more than 9 credits of Anthr 490 may be counted toward graduation.

ANTHR 490B. Independent Study: Cultural Anthropology.

Cr. 1-5. Repeatable, maximum of 9 credits. Prereq: 9 credits in anthropology
No more than 9 credits of Anthr 490 may be counted toward graduation.

ANTHR 490C. Independent Study: Biological Anthropology.

Cr. 1-5. Repeatable, maximum of 9 credits. Prereq: 9 credits in anthropology
No more than 9 credits of Anthr 490 may be counted toward graduation.

ANTHR 490D. Independent Study: Linguistic Anthropology.

(Cross-listed with LING). Cr. 1-5. Repeatable, maximum of 9 credits. Prereq: 9 credits in anthropology.

No more than 9 credits of Anthr 490 may be counted toward graduation.

ANTHR 490H. Independent Study: Honors.

Cr. 1-5. Repeatable, maximum of 9 credits. Prereq: 9 credits in anthropology
No more than 9 credits of Anthr 490 may be counted toward graduation.

ANTHR 490I. Iowa Lakeside Laboratory.

(Cross-listed with IA LL, NREM). Cr. 1-6. Repeatable, maximum of 9 credits. Prereq: 8 credits in biology and permission of instructor

Research opportunities for undergraduate students in the biological sciences. No more than 9 credits in Biol 490 may be counted toward graduation and of those, only 6 credits may be applied to the major.

Courses primarily for graduate students, open to qualified undergraduates:**ANTHR 503. Biological Anthropology and Archaeology.**

(3-0) Cr. 3. Prereq: ANTHR 307 and ANTHR 308

History of biological anthropology and archaeology, current developments and theoretical issues related to major events in human biocultural evolution and world prehistory.

ANTHR 509. Agroecosystems Analysis.

(Cross-listed with AGRON, SOC, SUSAG). (3-4) Cr. 3. F. Prereq: Senior or above classification

Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecologic, social, etc.) and scales of operation.

ANTHR 510. Theoretical Dimensions of Cultural Anthropology.

(3-0) Cr. 3. F. Prereq: 6 credits in anthropology

Survey of historical and current developments in topical and theoretical approaches to sociocultural anthropology. Examination and assessment of controversies; new research directions and theoretical approaches.

ANTHR 511. Applied Anthropology.

(Dual-listed with ANTHR 411). (3-0) Cr. 3. F. Prereq: ANTHR 201 or ANTHR 306

Theoretical and practical considerations of applying anthropological knowledge to contemporary cultural, political and economic issues. Dynamics of directed change in contemporary world cultures. Principles, theories, and ethics of international development projects from a sociocultural perspective. Meets International Perspectives Requirement.

ANTHR 513. Kinship and Marriage in a Global Perspective.

(Dual-listed with ANTHR 313). (3-0) Cr. 3. S. Prereq: ANTHR 201 recommended

Comparative and historical overview of the family, marriage and kinship. Examination of cross-cultural differences in the construction and functioning of family and kin relations; role of kinship in structuring individual and collective activities; current critical and theoretical issues in kinship studies, especially integrating work on gender and sexuality.

Meets International Perspectives Requirement.

ANTHR 515. Archaeology of North America.

(Dual-listed with ANTHR 315). (3-0) Cr. 3. S. Prereq: ANTHR 202

Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture- historical sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Meets U.S. Diversity Requirement

ANTHR 518. Global Culture, Consumption and Modernity.

(Dual-listed with ANTHR 418). (3-0) Cr. 3. F. Prereq: ANTHR 201 or ANTHR 306 recommended

Cross-cultural study of the impact of globalization, with an emphasis on economic consumption and the movement of goods, ideas, and peoples across cultural and national boundaries.

Meets International Perspectives Requirement.

ANTHR 519. Skeletal Biology.

(Dual-listed with ANTHR 319). (2-2) Cr. 3. F. Prereq: ANTHR 307 or college level biology

Comprehensive study of the skeletal anatomy, physiology, genetics, growth, development and population variation of the human skeleton. Applications to forensic anthropology, paleopathology and bioarchaeology are introduced.

ANTHR 520. Great Plains Archaeology.

(Dual-listed with ANTHR 320). (3-0) Cr. 3. F. Prereq: ANTHR 202

Prehistoric societies of the Great Plains region of North America, from initial occupation to European contact; emphasis on sociocultural changes, continuities, and adaptations to changing environments using archaeological, ecological, ethnographic information.

Meets U.S. Diversity Requirement

ANTHR 521. World Prehistory.

(Dual-listed with ANTHR 321). (3-0) Cr. 3. S. Prereq: ANTHR 202 recommended

An introduction to archaeological sites from around the world including the Near East, Africa, Europe, Mesoamerica, and North and South America. Emphasis is on the interpretation of material cultural remains in reconstructing past societies.

ANTHR 522. Peoples and Cultures of Native North America.

(Dual-listed with ANTHR 322). (3-0) Cr. 3. Prereq: ANTHR 201 or AM IN 210

Origin, distribution, and pre-contact life of the indigenous peoples of North America. Survey of culture areas; language families, social and political systems, ecological and economic adaptations, religion and spirituality; impact of European contact; cultural resilience and revitalization in contemporary American Indian life. Meets U.S. Diversity Requirement

ANTHR 523. Topics in Latin American Anthropology.

(Dual-listed with ANTHR 323). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S.

Prereq: 6 credits in anthropology, ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

ANTHR 523A. Latin American Anthropology: Violence and Memory.
(Dual-listed with ANTHR 323A). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S.
Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered.

ANTHR 523B. Latin American Anthropology: Social movements and Democracy.

(Dual-listed with ANTHR 323B). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S.
Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered. Meets International Perspectives Requirement.

ANTHR 523C. Latin American Anthropology: Race, Class and Gender.

(Dual-listed with ANTHR 323C). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S.
Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered. Meets International Perspectives Requirement.

ANTHR 523D. Latin American Anthropology: Regional Focus.

(Dual-listed with ANTHR 323D). (3-0) Cr. 3. Repeatable, maximum of 9 credits. S.
Prereq: ANTHR 201 or ANTHR 306 recommended

Exploration of key contemporary and historical issues in Latin American Anthropology; discussion of current anthropological approaches to studying Latin American social issues in a global context. Topics vary each time offered. Meets International Perspectives Requirement.

ANTHR 524. Forensic Anthropology.

(Dual-listed with ANTHR 424). (2-2) Cr. 3. S. *Prereq: ANTHR 202 or ANTHR 307; ANTHR 319 recommended*

Comprehensive study of forensic anthropology, a specialized subfield of biological anthropology. Emphasis is placed on personal identifications from extremely fragmentary, commingled, burnt, cremated and incomplete skeletal remains. All parameters of forensic study are included as they pertain to anthropology, including human variation, taphonomy, archaeology, pathology, epidemiology; genetics and the non-biological forensic disciplines. An appreciation for the wide range of medicolegal and bioethical issues will also be gained.

ANTHR 528. Topics in Archaeological Laboratory Methods and Techniques.

(Dual-listed with ANTHR 428). (2-2) Cr. 3. Repeatable, maximum of 9 credits. S.
Prereq: ANTHR 308

Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition organization, and computer applications.

ANTHR 528A. Topics in Archaeological Laboratory Methods and Techniques: Lithics.

(Dual-listed with ANTHR 428A). (2-2) Cr. 3. Repeatable, maximum of 9 credits. S.
Prereq: ANTHR 308

Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition organization, and computer applications.

ANTHR 528B. Topics in Archaeological Laboratory Methods and Techniques: Ceramics.

(Dual-listed with ANTHR 428B). (2-2) Cr. 3. Repeatable, maximum of 9 credits. S.
Prereq: ANTHR 308

Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition organization, and computer applications.

ANTHR 528C. Topics in Archaeological Laboratory Methods and Techniques: Faunal remains.

(Dual-listed with ANTHR 428C). (2-2) Cr. 3. Repeatable, maximum of 9 credits. S.
Prereq: ANTHR 308

Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition organization, and computer applications.

ANTHR 528D. Topics in Archaeological Laboratory Methods and Techniques: General.

(Dual-listed with ANTHR 428D). (2-2) Cr. 3. Repeatable, maximum of 9 credits. S.
Prereq: ANTHR 308

Laboratory processing, analysis, and interpretation of archaeological materials such as lithics, ceramics, and faunal remains. Laboratory sessions emphasize analytical techniques including classification, data acquisition organization, and computer applications.

ANTHR 529. Topics in Archaeological Laboratory Methods and Techniques: Archaeological Field School.

(Dual-listed with ANTHR 429). Cr. 4-6. SS. *Prereq: ANTHR 202 or ANTHR 308*
Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence.

ANTHR 530. Ethnographic Field Methods.

Cr. 3. F. *Prereq: 6 credits in anthropology, permission of instructor*

Field training experience in ethnography. Problems emphasizing field studies in the contemporary societies of the world. Focus on techniques of data gathering and analysis.

ANTHR 531. Ethnographic Field School.

(Dual-listed with ANTHR 431). Cr. 4-6.

Hands-on training in ethnographic field methods; students will carry out research projects in socio-cultural anthropology, learning a variety of investigative research techniques commonly used in social sciences.

ANTHR 532. Current Issues in Native North America.

(Dual-listed with ANTHR 332). (3-0) Cr. 3. S. *Prereq: ANTHR 201 or ANTHR 306; ANTHR 322 or AM IN 210 recommended*

Conditions and issues of contemporary American Indian peoples, historical background of contemporary life; federal policies, treaty rights, and sovereignty. Economic development and politics on reservations, family and gender roles, cultural innovation and revitalization, urbanization, recent social movements, and other current concerns.

Meets U.S. Diversity Requirement

ANTHR 533. Asian American Material Cultures.

(Dual-listed with ANTHR 333). (3-0) Cr. 3.

Examination of material objects made and used by Asian Americans with both historical and contemporary focuses; transnational and interdisciplinary lenses to interpret the material world; contemporary approaches to analysis of artifacts.

Meets U.S. Diversity Requirement

ANTHR 536. Global Development.

(Dual-listed with ANTHR 336). (3-0) Cr. 3. Alt. F., offered odd-numbered years.
Prereq: ANTHR 201 or ANTHR 306

Cross-cultural analysis of current development practices from an anthropological perspective; focus on international aid, development institutions, agrarian reform, indigenous knowledge, humanitarianism and human rights; introduction to main theories of political and economic anthropology.

Meets International Perspectives Requirement.

ANTHR 538. Primate Evolutionary Ecology and Behavior.

(Dual-listed with ANTHR 438). Cr. 3. S. *Prereq: ANTHR 202 or ANTHR 307*

Primate behavior and ecology in evolutionary perspective: biological and social adaptations of prosimians, monkeys, and apes. Introduction to the Order Primates, basic evolutionary concepts, and techniques of behavioral observation. Focus on theory and methods current in Primatology, including applied conservation biology.

ANTHR 540. Magic, Witchcraft, and Religion.

(Dual-listed with ANTHR 340). (Cross-listed with RELIG). (3-0) Cr. 3. S. *Prereq: ANTHR 201 or ANTHR 306*

Survey of global religious belief and practice from an anthropological perspective. Emphasis on myth and ritual, shamanism, magic, witchcraft, beliefs in spirits, conceptions of the soul, mind and body relationships, and healing and therapeutic practices. Discussion of religious response to dramatic political and social change; effects of globalization on religious practice.

Meets International Perspectives Requirement.

ANTHR 541. Seminar in Forensic Sciences.

(1-0) Cr. 1. Repeatable. S. *Prereq: One 200-level science course or graduate classification*

Seminars by professional criminalists, research scientists, Certificate students, and educators. Emphasis on opportunities for research and development, citizen involvement, and educational outreach related to forensic science. Weekly report required.

ANTHR 542. Independent Research and Presentation in Forensic Science.

(1-0) Cr. 1. S. *Prereq: Enrollment in the Graduate Certificate in Forensic Sciences*
Research topic approved by course instructor. Written and oral reports required. Oral report given in forensics seminar, Chem 540.

ANTHR 544. Sex and Gender in Cross-cultural Perspective.

(Dual-listed with ANTHR 444). (Cross-listed with W S). (3-0) Cr. 3. S. *Prereq:* ANTHR 201; ANTHR 306 recommended

Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

ANTHR 545. Biological Field School.

(Dual-listed with ANTHR 445). Cr. 4-6. SS. *Prereq:* ANTHR 202 or BIOL 101 Summer field school for training in behavioral and ecological methods for primatologists. Proposal, data collection and analyses, and presentation of research topic in primatology.

ANTHR 550. Primate Behavior.

(Dual-listed with ANTHR 350). (2-2) Cr. 3. F.S.SS. *Prereq:* ANTHR 202 and/or basic biology course recommended

An introduction to the Order Primates with a focus on their behavior. Biological and social adaptations of monkeys, apes, and prosimians; basic evolutionary concepts, current trends and theories in the field of Primatology and issues related to primate conservation.

ANTHR 582. Topics in Biological Anthropology.

(Dual-listed with ANTHR 482). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F. *Prereq:* ANTHR 307

In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.

ANTHR 582A. Topics in Biological Anthropology: Paleoanthropology.

(Dual-listed with ANTHR 482A). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F. *Prereq:* ANTHR 307

In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.

ANTHR 582B. Topics in Biological Anthropology: Primate Cognition.

(Dual-listed with ANTHR 482B). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F. *Prereq:* ANTHR 307

In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.

ANTHR 582C. Topics in Biological Anthropology: Primate Conservation.

(Dual-listed with ANTHR 482C). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F. *Prereq:* ANTHR 307

In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.

ANTHR 582D. Topics in Biological Anthropology: Population Genetics and Human Evolution.

(Dual-listed with ANTHR 482D). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F. *Prereq:* ANTHR 307

In-depth study of current topics in biological anthropology, such as new fossil specimens, research on the evolution of cognition, the emergence of applied primatology, and the dynamic field of population genetics as each relates to the Order Primates.

ANTHR 590. Graduate Independent Study.

(Cross-listed with A ECL, EEOB, IA LL). Cr. 1-4. Repeatable. SS. *Prereq:* Graduate classification and permission of instructor

ANTHR 590I. Special Topics: Graduate Independent Study.

(Cross-listed with A ECL, EEOB, IA LL). Cr. 1-4. Repeatable. SS. *Prereq:* Graduate classification and permission of instructor

ANTHR 591. Orientation to Anthropology.

(1-0) Cr. 1. F. *Prereq:* Admission to the Anthropology Graduate Program Introduction to the Anthropology program, including the requirements for successful degree completion, department administrative procedures, ethics in anthropology and current trends in the four subfields of anthropology. Required of graduate students. Offered on a satisfactory-fail basis only.

Courses for graduate students:**ANTHR 610. Foundations of Sustainable Agriculture.**

(Cross-listed with A B E, AGRON, SOC, SUSAG). (3-0) Cr. 3. F. *Prereq:* Graduate classification, permission of instructor

Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging agricultural systems in terms of the core concepts of sustainability and their theoretical contexts.

ANTHR 699. Research.

Cr. arr. Repeatable.

ANTHR 699I. Research.

(Cross-listed with A ECL, EEOB, GDCB, IA LL). Cr. 1-4. Repeatable.

Apparel, Events, and Hospitality Management (AESHM)

Courses primarily for undergraduates:

AESHM 112. Orientation for AESHM.

(1-0) Cr. 1. F.S. *Prereq:* Concurrent enrollment with AESHM 113
Orientation policies and procedures of university and college. Guest speakers representing the university. Some online lectures.

AESHM 113. Professional Development for AESHM.

(2-0) Cr. 2. F.S.
Career exploration, presentation and professional skills, teamwork and leadership, creativity, critical thinking, technology, and service learning components. Orientation to policies and procedures of college, department, and program.

AESHM 170. Supervised Work Experience I.

Cr. 1. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* Permission by application; freshman classification
Supervised work experience with a cooperating firm or organization. No more than 12 credits total from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 170D. Supervised Work Experience I: Hospitality.

Cr. 1. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* Permission by application; freshman classification
Supervised work experience with a cooperating firm or organization. No more than 12 credits total from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 170F. Supervised Work Experience I: Event Management.

Cr. 1. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* Permission by application; freshman classification
Supervised work experience with a cooperating firm or organization. No more than 12 credits total from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 170N. Supervised Work Experience I: Apparel.

Cr. 1. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* Permission by application; freshman classification
Supervised work experience with a cooperating firm or organization. No more than 12 credits total from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 170P. Supervised Work Experience I: ISU Dining.

Cr. 1. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* Permission by application; freshman classification
Supervised work experience with a cooperating firm or organization. No more than 12 credits total from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 175. Financial Applications for Retail and Hospitality Industries.

(2-0) Cr. 2. S.
Using an online delivery method, students will learn basic mathematical concepts, calculations and formulas commonly used in the apparel and hospitality industries. Emphasis on problem solving, critical/creative thinking, and mathematical interpretation of calculations and formulas used within the apparel and hospitality industries.

AESHM 175D. Financial Applications for Retail and Hospitality Industries: Hospitality Management.

(2-0) Cr. 2. S.
Using an online delivery method, students will learn basic mathematical concepts, calculations and formulas commonly used in the apparel and hospitality industries. Emphasis on problem solving, critical/creative thinking, and mathematical interpretation of calculations and formulas used within the hospitality industries.

AESHM 175N. Financial Applications for Retail and Hospitality Industries: Retail Merchandising.

(2-0) Cr. 2. S.
Using an online delivery method, students will learn basic mathematical concepts, calculations and formulas commonly used in the apparel and hospitality industries. Emphasis on problem solving, critical/creative thinking, and mathematical interpretation of calculations and formulas used within the apparel industries.

AESHM 211. Leadership Experiences and Development (LEAD).

(3-0) Cr. 3. S.
Introduction to leadership behaviors. Development and utilization of leadership behaviors to positively impact school life, community life, and work life.

AESHM 222. Creative Thinking and Problem Solving.

(3-0) Cr. 3. S.
Focus on creative thinking concepts, strategies, and methods. Systematic application of creative thinking techniques to: view things from different perspectives; identify unique opportunities; solve problems; generate and evaluate original ideas. Field trips might be required.

AESHM 270. Supervised Work Experience II.

Cr. 1-2. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* Minimum 2.0 GPA; permission by application; sophomore classification
Supervised work experience with a cooperating firm or organization. No more than 12 credits total from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 270D. Supervised Work Experience II: Hospitality.

Cr. 1-2. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* Minimum 2.0 GPA; permission by application; sophomore classification; 6 cr in AESHM or HSP M
Supervised work experience with a cooperating firm or organization. No more than 12 credits total from AESHM 170, AESHM 270, and 470 may be applied toward graduation.

AESHM 270F. Supervised Work Experience II: Event Management.

Cr. 1-2. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* Minimum 2.0 GPA; permission by application; sophomore classification; 6 cr in AESHM, HSP M, or EVENT.
Supervised work experience with a cooperating firm or organization. No more than 12 credits total from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 270N. Supervised Work Experience II: Apparel.

Cr. 1-2. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* Minimum 2.0 GPA; permission by application; sophomore classification; 6 cr in AESHM or A M D
Supervised work experience with a cooperating firm or organization. No more than 12 credits total from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 270P. Supervised Work Experience II: ISU Dining.

Cr. 1-2. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* Minimum 2.0 GPA; permission by application; sophomore classification; 6 cr in AESHM or HSP M
Supervised work experience with a cooperating firm or organization. No more than 12 credits total from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 272. Fashion Show Production and Promotion.

(2-2) Cr. 1-3. Repeatable, maximum of 4 credits. F.S. *Prereq:* Application and instructor permission, application form available from the AESHM Department office
Planning and production of fashion show including developing budgets, public relations, advertising, fund-raising, choreography, staging, lighting, and food. Promotion of fashion show and similar events. Maximum of 4 credits can be applied to graduation

AESHM 275. Retail Merchandising.

(3-0) Cr. 3. F.S. *Prereq:* 3 credits in Math
Principles of merchandising as applied to retail-, service-, events-, and hospitality-related businesses. Study of the planning, development, and presentation of apparel- and hospitality-related products, services, and experiences. Industry and market research, planning of new offerings, and development of promotional and competitive strategies.

AESHM 280. Orientation to U.S. Field Study.

Cr. R. Repeatable, maximum of 2 times. F.S.
Orientation to the field study location during the semester preceding the trip.

AESHM 281. Orientation to International Field Study.

Cr. 1. Repeatable, maximum of 2 times. F.S.
Orientation to the field study location during the semester preceding the trip.

AESHM 287. Principles of Management in Human Sciences.

(3-0) Cr. 3. F.S.
Introduction to management concepts and principles with application to human sciences-related businesses and organizations. Includes service quality management, professionalism, and social responsibility.

AESHM 311. Seminar on Careers and Internships.

(1-0) Cr. 1. F.S. *Prereq:* AESHM 112, AESHM 113; *Sophomore classification. Good academic standing*

Internship and career planning, professional expectations and responsibilities. Résumé development, cover letters, interviewing techniques, and business etiquette.

AESHM 340. Hospitality and Apparel Marketing Strategies.

(3-0) Cr. 3. F.S. *Prereq:* ECON 101

Application of marketing principles to the hospitality-, events-, and apparel-related industries. Emphasis on the role of marketing in an organization's overall strategic planning. Development and evaluation techniques available to hospitality, events, apparel, and related businesses, including advertising, sales promotion, packaging, and public relations.

AESHM 342. Aesthetics of Consumer Experience.

(3-0) Cr. 3. F.S. *Prereq:* *Sophomore classification*

Design principles, aesthetic concepts, and research applied to consumer experiences, with an emphasis on hospitality and retail environments and events. Influence of individual differences and cultural patterns on aesthetic preferences. Meets U.S. Diversity Requirement

AESHM 377. Brand Management and Promotions.

(3-0) Cr. 3. F.S. *Prereq:* A M D 245; AESHM 340 or MKT 340

Principles of brand development and management; focus on experiential marketing, promotions, visual merchandising, design/layout of retail spaces, and software applications.

AESHM 379. Community Leadership: Examination of Social Issues.

(3-0) Cr. 3. F.

Study of family and community social issues from diverse perspectives. Application of critical thinking and reflection to issues with a focus on leadership within the community.

Meets U.S. Diversity Requirement

AESHM 380. U.S. Field Study.

(Dual-listed with AESHM 580). Cr. 1-3. Repeatable, maximum of 3 times.

F.S.SS. *Prereq:* 9 credits in A M D, AESHM, EVENT, and/or HSP M; *sophomore classification; minimum 2.0 GPA. Permission by application*

Study and tours of areas of interest to majors in the AESHM Department. Trip to location under supervision of faculty member. Locations and lengths of trip vary. Final projects, reports, journal entries, and analysis are required.

AESHM 381. International Field Study.

(Dual-listed with AESHM 581). Cr. 1-3. Repeatable. F.S.SS. *Prereq:* 9 credits in A M D, AESHM, EVENT, and/or HSP M; *sophomore classification; minimum 2.0 GPA. Permission by application*

Study and tours of areas of interest to majors in the AESHM Department. Trip to location under supervision of faculty member. Locations and lengths of trip vary. Final projects, reports, journal entries, and analysis are required.

Meets International Perspectives Requirement.

AESHM 398. Cooperative Education.

Cr. R. Repeatable. F.S.SS. *Prereq:* *Permission of adviser; junior classification* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AESHM 411. Seminar on Current Issues.

Cr. 1. F.S. *Prereq:* *Permission of instructor.*

Trends, issues, and scholarship in apparel, events, and hospitality management.

AESHM 411E. Seminar on Current Issues: Events and Hospitality.

Cr. 1. F.S. *Prereq:* *senior classification in AESHM.*

Trends, issues, and scholarship in events and hospitality management.

AESHM 411N. Seminar on Current Issues: Apparel.

(1-0) Cr. 1. Repeatable, maximum of 2 times. F.S. *Prereq:* AESHM 470

Trends, issues, and scholarship in apparel.

AESHM 421. Developing Global Leadership: Maximizing Human Potential.

(3-0) Cr. 3. S.

Development of leadership in a global environment. Focus on global concerns that impact on the well-being of individuals, families, and communities. Strategies for working with individuals, families and communities in other countries and cultures. Taking local action on global issues. Participation in a service activity.

Meets International Perspectives Requirement.

AESHM 438. Human Resource Management.

(3-0) Cr. 3. S. *Prereq:* AESHM 270, AESHM 275 or AESHM 287; *junior classification*

Principles and practices of human resource management relevant to human science-related organizations. Emphasis on the entry-level manager's role.

AESHM 470. Supervised Professional Internship.

Cr. arr.

Supervised work experience with a cooperating firm or organization.

AESHM 470D. Supervised Professional Internship: Hospitality.

Cr. 3-6. Repeatable. F.S.SS. *Prereq:* AESHM 170, 311, 9 credits in HSP M, and minimum 2.0 GPA; *permission by application; junior or senior classification*

Supervised work experience with a cooperating firm or organization. No more than 12 credits from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 470F. Supervised Professional Internship: Event Management.

Cr. 3-6. Repeatable. F.S.SS. *Prereq:* AESHM 311

Supervised work experience with a cooperating firm or organization. No more than 12 credits from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 470N. Supervised Professional Internship: Apparel.

Cr. 3-6. Repeatable. F.S.SS. *Prereq:* AESHM 311, 9 credits in A M D, and minimum 2.0 GPA; *permission by application; junior or senior classification*

Supervised work experience with a cooperating firm or organization. No more than 12 credits from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 470P. Supervised Professional Internship: ISU Dining.

Cr. 3-6. Repeatable. F.S.SS. *Prereq:* AESHM 311, 9 credits in AESHM or HRI, and minimum 2.0 GPA; *permission by application; junior or senior classification*

Supervised work experience with a cooperating firm or organization. No more than 12 credits from AESHM 170, 270, and 470 may be applied toward graduation.

AESHM 472. Fashion Show Management.

(2-2) Cr. 2-3. Repeatable, maximum of 5 credits. S. *Prereq:* *Permission of instructor*

Provide leadership and communicate direction for planning and production of fashion show, including developing budgets, publicity, advertising, fundraising, choreography, staging, lighting, and food.

AESHM 474. Entrepreneurship in Human Sciences.

(Dual-listed with AESHM 574). (3-0) Cr. 3. F.S. *Prereq:* AESHM 275 or AESHM 287 or ACCT 284 or 3 cr in MKT or *permission of instructor*

Comprehensive approach to entrepreneurship including concepts of innovation, creativity, opportunity assessment, and business planning. Focus on human sciences-related businesses: retail, service, hospitality, event, food-related, family-owned, rural, and community businesses. Interaction with entrepreneurs, market research, feasibility analysis, business proposals, and business/community outreach and consulting.

AESHM 477. Multi-channel Retailing.

(3-0) Cr. 3. F.S. *Prereq:* 3 credits in marketing or AESHM 275 or 287

A customer-centric view of marketing with a focus on the retailer-customer relationship and online strategies. Integration of key characteristics of online and offline marketing including store formats, e-commerce, catalog, TV, mobile, and direct sales.

AESHM 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. *Prereq:* *Permission of adviser; senior classification* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduates:**AESHM 510. Research Methods in Apparel and Hospitality.**

Cr. 3. SS. *Prereq:* *Graduate standing in the Department*

Overview of research methods. Methods for collecting and analyzing quantitative and qualitative data. Development of research plan.

AESHM 511. Seminar.

Cr. 1-3. Repeatable, maximum of 6 times. *Prereq:* 6 graduate credits in A M D, AESHM, or HSP M. *Permission of instructor*

Discussion of scholarship and current issues. Topics vary.

AESHM 545. Consumer Aesthetics and Retail Branding.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* *One course in design elements and principles, psychology, consumer behavior, or marketing*

Examination of hedonic nature of consumer experience and its application to experiential design and branding of retail/hospitality establishments. Emphasis on consumer behavior, environmental psychology, and marketing literature.

AESHM 570. Practicum.

Cr. 1-3. Repeatable, maximum of 2 times. F.S.SS. *Prereq:* 6 graduate credits in program area; *permission of instructor*

Supervised experience related to career objective. Proposal must be approved semester before placement.

AESHM 570A. Apparel Merchandising and Design.

Cr. 1-3. Repeatable, maximum of 2 times. F.S.SS. *Prereq: 6 graduate credits in program area; permission of instructor*

Supervised experience related to career objective. Proposal must be approved semester before placement.

AESHM 570B. Hospitality Management.

Cr. 1-3. Repeatable, maximum of 2 times. F.S.SS. *Prereq: 6 graduate credits in program area; permission of instructor*

Supervised experience related to career objective. Proposal must be approved semester before placement.

AESHM 574. Entrepreneurship in Human Sciences.

(Dual-listed with AESHM 474). (3-0) Cr. 3. F.S. *Prereq: AESHM 275 or AESHM 287 or ACCT 284 or 3 cr in MKT or permission of instructor*

Comprehensive approach to entrepreneurship including concepts of innovation, creativity, opportunity assessment, and business planning. Focus on human sciences-related businesses: retail, service, hospitality, event, food-related, family-owned, rural, and community businesses. Interaction with entrepreneurs, market research, feasibility analysis, business proposals, and business/community outreach and consulting.

AESHM 577. E-Commerce for Apparel and Hospitality Companies.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Course in marketing or permission of instructor*

Analysis of technology and consumer trends, industry practices, and marketing strategies for e-commerce. Evaluation and development of apparel or hospitality company websites. Theory application to the development of multi-channel business strategies.

AESHM 580. U.S. Field Study.

(Dual-listed with AESHM 380). Cr. 1-3. Repeatable, maximum of 3 times. F.S.SS. *Prereq: 9 credits in A M D, AESHM, EVENT, and/or HSP M; sophomore classification; minimum 2.0 GPA. Permission by application*

Study and tours of areas of interest to majors in the AESHM Department. Trip to location under supervision of faculty member. Locations and lengths of trip vary. Final projects, reports, journal entries, and analysis are required.

AESHM 581. International Field Study.

(Dual-listed with AESHM 381). Cr. 1-3. Repeatable. F.S.SS. *Prereq: 9 credits in A M D, AESHM, EVENT, and/or HSP M; sophomore classification; minimum 2.0 GPA. Permission by application*

Study and tours of areas of interest to majors in the AESHM Department. Trip to location under supervision of faculty member. Locations and lengths of trip vary. Final projects, reports, journal entries, and analysis are required.

Meets International Perspectives Requirement.

Courses for graduate students:**AESHM 611. Seminar.**

Cr. 1-3. Repeatable. *Prereq: 6 graduate credits in AESHM, HRI, or A M D. Permission of instructor*

Scholarship and current issues. Topics vary.

AESHM 670. Teaching Practicum.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 graduate credits in program area; permission of instructor*

Supervised experience in the university classroom. Proposal must be approved semester before placement.

AESHM 670A. Teaching Practicum: Apparel Merchandising and Design.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 graduate credits in program area; permission of instructor*

Supervised experience in the university classroom. Proposal must be approved semester before placement.

AESHM 670B. Teaching Practicum: Hospitality Management.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 graduate credits in program area; permission of instructor*

Supervised experience in the university classroom. Proposal must be approved semester before placement.

Apparel, Merchandising and Design (A M D)

Courses primarily for undergraduates:

A M D 120. Apparel Construction Techniques.

(3-0) Cr. 3. SS.

Assemble components and completed garments with the use of basic sewing equipment. Learn basic construction techniques, applications and vocabulary. Students will need access to a home sewing machine, iron, computer and the internet. Not available for credit for A M D majors.

A M D 131. Overview of the Fashion Industry.

(3-0) Cr. 3. F.

Introduction to fashion industry, industry structure from concept to consumer. Focus on fashion-driven consumer goods.

A M D 165. Dress and Diversity in Society.

(3-0) Cr. 3. F.S.

Examination of diversity among consumers and forecasting future trends in consumer behavior. Introduction to social justice and responsibility issues. Meets U.S. Diversity Requirement

A M D 178. Introduction to Apparel Design Studio.

(0-4) Cr. 2. F.S.

Introduction to the elements and principles of design in fashion and apparel including skill development in fashion illustration, technical drawing, and fabric rendering using traditional media. Application of written and verbal presentations to communicate fashion and apparel design concepts.

A M D 204. Textile Science.

(3-2) Cr. 4. F.S. *Prereq: A M D 131*

Textile fibers, yarns, fabrication, coloration, and finishes. Quality and performance application to consumer soft goods and technical textiles. Online components and lab work.

A M D 210. Computer Applications in Digital Design and Data Management.

(2-2) Cr. 3. F.S. *Prereq: A M D 131, A M D 245 or concurrent; AESHM 111*

Applications of basic skills in Photoshop, Illustrator, PLM-type software, Excel, and databases. Introduction to digital product design and line development. Focus on elements and principles of design. Introduction to digital portfolio development for design and merchandising. Online lectures.

A M D 221. Apparel Assembly Processes.

(1-4) Cr. 3. F.S. *Prereq: A M D 204 or concurrent*

Principles of garment assembly. Use of mass production equipment and methods to analyze, develop and assemble garments.

A M D 225. Patternmaking I: Drafting and Flat Pattern.

(1-4) Cr. 3. F.S. *Prereq: A M D 204, A M D 221. Permission of instructor*

Application of patternmaking tools and their functions, measurement techniques, pattern labeling, and patternmaking communication documents. Sloper drafting and flat pattern manipulation methods for women's apparel. Design and construction of original garments using drafted slopers and flat pattern manipulation methods to enable the analysis of fit.

A M D 231. Product Development and Manufacturing.

(3-2) Cr. 4. F.S. *Prereq: A M D 204*

Analysis of apparel product development, sourcing, and manufacturing processes. Focus on materials and specifications relative to quality, performance, cost, and price. Applications of software for PLM.

A M D 245. Aesthetics and Brand Image.

(3-0) Cr. 3. F.S. *Prereq: A M D 131, A M D 165, A M D 204 or concurrent*

Elements and principles of design. Analysis of sensory, expressive, and symbolic aspects that build brand image, with a focus on fashion products and promotional settings.

A M D 257. Museum Studies.

(3-0) Cr. 3. *Prereq: Sophomore standing*

Overview of museums including history, functions, and philosophy. Collection and curatorial practices. Funding and governance issues. Hands-on object research and exhibit development. Required field trip.

A M D 278. Fashion Illustration.

(0-6) Cr. 3. F.S. *Prereq: A M D 210 or concurrent enrollment, A M D 245 or concurrent enrollment. Permission of instructor.*

Development of drawing and rendering skills, including line, shape, perspective, texture, and value. Introduction to the fashion figure, technical drawings/flats, and apparel using a variety of media. Fashion presentation and introduction to portfolio development.

A M D 301. Basic Design Concepts Review.

Cr. R. Repeatable, maximum of 1 times. F.S. *Prereq: Completion or enrollment in A M D 225, A M D 278*

Project review and skill assessment related to 2-dimensional and 3-dimensional visualization, apparel assembly, basic product knowledge, design problem solving. Review of fashion illustration, textiles, flat pattern, basic apparel assembly, design problem solving. Offered on a satisfactory-fail basis only. Only one credit in 301 may be counted towards graduation.

A M D 305. Quality Assurance of Textiles and Apparel.

(Dual-listed with A M D 505). (2-2) Cr. 3. F. *Prereq: A M D 231, one course in natural science; STAT 101, STAT 226, or STAT 401*

Principles of product and materials evaluation and quality assurance. Developing specifications and using standard practices for evaluating materials, product characteristics, performance, and quality.

A M D 321. Computer Integrated Textile and Fashion Design.

(0-6) Cr. 3. *Prereq: A M D 210, A M D 278 or concurrent enrollment. Permission of instructor*

Analysis and advanced use of computer-aided design software for textile and fashion design for various markets. Digital presentation and portfolio development.

A M D 325. Patternmaking II: Draping.

(0-6) Cr. 3. F.S. *Prereq: A M D 301; permission of instructor.*

Principles of patternmaking through basic draping techniques on industry standard body forms. Apparel design through analysis of fit and design; problem solving and interaction of fabric characteristics with style features.

A M D 328. Design Seminar.

(Dual-listed with A M D 528). Cr. arr. Repeatable. F.S.SS. *Prereq: Vary with topic.* Focus on artisanal textile, apparel, or surface and structural design techniques. Design processes for specialty fabrics and markets. Topics vary by term.

A M D 354. History of European and North American Dress.

(3-0) Cr. 3. F. *Prereq: 3 credits from Hist or Art H*

Survey of history of dress from ancient times through 19th century; focus on European and North American dress. Emphasis on connection of dress to the social, cultural, environmental, and technological contexts of the Western world. Meets International Perspectives Requirement.

A M D 356. History of Twentieth Century Fashion.

(3-0) Cr. 3. *Prereq: 3 credits HIST or ART H; A M D 204 recommended.*

Survey of major design and technological developments in 20th Century fashion. Emphasis on fashion as a system of design and production, culture of consumption, fashion change, and trends in art, society, and culture.

A M D 362. Cultural Perspectives of Dress.

(3-0) Cr. 3. *Prereq: A M D 165 or 3 credits in anthropology, psychology, or sociology.*

Analysis of multiple factors related to dress in selected societies, including technology, cultural identity, aesthetics, social organization, ritual, stability and change. Applications to apparel business. Meets International Perspectives Requirement.

A M D 372. Sourcing and Global Issues.

(3-0) Cr. 3. F.S. *Prereq: A M D 231, AESHM 275; ECON 101 or ECON 102 recommended*

Evaluation of key issues facing textile and apparel industries in global markets considering ethical, economic, political, social, and professional implications. Sourcing strategies in a global environment. Corporate and consumer social responsibility and sustainability.

Meets International Perspectives Requirement.

A M D 376. Merchandise Planning and Control.

(3-2) Cr. 4. F.S. *Prereq: AESHM 275; 3 credits from ACCT 284, MATH 104, MATH 105, MATH 140, MATH 150, or equivalent.*

Calculations and computer application in the planning and control of merchandise. Emphasis on retail math as it pertains to assortment planning, the six-month buying plan process, and other buying concepts and strategies. Online modules.

A M D 404. Advanced Textile Science.

(Dual-listed with A M D 504). (2-2) Cr. 3. S. *Prereq: A M D 204, A M D 245; one natural science course (physics or chemistry recommended).*

Theories and principles of textile science. Effect of fiber structure on fabric properties and performance; new developments in textiles. Color theory, dyes, and color matching as applied to textiles and textile products.

A M D 415. Technical Design Processes.

(2-2) Cr. 3. F. *Prereq: A M D 225; A M D 231*

Garment development and analysis of fit, performance, quality, cost. Exploration of alternative materials, construction methods, grading; specifications and portfolio development.

A M D 426. Creative Design Processes.

(Dual-listed with A M D 526). (1-4) Cr. 3. F.S. *Prereq: A M D 301, A M D 321*

Exploration of the creative process and sources of inspiration with emphasis on fashion presentation and line development for a variety of markets. Continued development of fashion illustration techniques, including digital illustrations. Development of digital and paper portfolio.

A M D 431. Apparel Production Management.

(3-0) Cr. 3. S. *Prereq: A M D 231; A M D 221 recommended; A M D 372 or concurrent.*

Procedures and experiences related to application and use of process controls: method analysis, work measurement, costing, pricing, and production planning. Resource management, technology applications, and quality assurance.

A M D 467. Consumer Behavior.

(2-2) Cr. 3. F. *Prereq: A M D 165; AESHM 340; STAT 101 or STAT 104 or STAT 226;*

Application of concepts and theories from the social sciences to the study of consumer behavior related to dress, textile and apparel products, and retail experiences. Experience in conducting consumer research.

A M D 475. Retail Information Analysis.

(2-2) Cr. 3. S. *Prereq: A M D 376*

Evaluation of information needed to make effective retail decisions. Use of technology in analyzing and interpreting retail systems data. Application of concepts related to forecasting, consumer demand, assortment planning, market research, data mining, database interface, pattern recognition, supply-chain/logistics management, retail technology applications such as Visual Retailing, PLM, and Sourcing Simulator.

A M D 490. Independent Study.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490A. Independent Study: Textile Science.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490B. Independent Study: History of Dress and Textiles.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490C. Independent Study: Textile and Apparel Design.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490D. Independent Study: Aesthetics.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490E. Independent Study: Entrepreneurship.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490F. Independent Study: Sociological and Psychological Aspects of Dress and Textiles.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490G. Independent Study: Consumer Behavior.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490H. Independent Study: Honors.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490I. Independent Study: Retail Merchandising.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490K. Independent Study: Cultural Analysis of Dress and Textiles.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490M. Independent Study: Museums.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490N. Independent Study: Apparel Production Management.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490O. Independent Study: Technical Design.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490Q. Independent Study: Quality Assurance.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490T. Independent Study: Public Relations and Publishing.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490U. Independent Study: Product Development.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 490V. Independent Study: Sourcing and Global Issues.

Cr. arr. Repeatable. F.S.SS. *Prereq: 6 credits in textiles and clothing. Permission of the instructor, adviser, and department chair*

A M D 495. Senior Design Studio.

(Dual-listed with A M D 595). (0-6) Cr. 3. F. *Prereq: A M D 325, A M D 426.*

Permission of instructor.

Creation of an apparel line from target market research to prototypes through the use of manual techniques and CAD technologies. The line is to be included in a professional portfolio and pieces submitted to a juried exhibition.

A M D 496. Fashion Forecasting and Product Development.

(3-0) Cr. 3. F.S. *Prereq: A M D 231, A M D 245, AESHM 275*

Applying consumer, aesthetic, and quantitative trend information to develop value-added apparel/textile products and product lines with merchandising/promotion campaigns for diverse target markets. Multi-function team projects. Presentation to industry representatives.

A M D 499. Undergraduate Research.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Senior classification, 15 credits in A M D.*

Permission of instructor, adviser, and department chair

Research experience in textiles and clothing with application to a selected problem.

Courses primarily for graduate students, open to qualified undergraduates:**A M D 504. Textile Color Theory.**

(Dual-listed with A M D 404). (2-2) Cr. 3. Alt. F., offered even-numbered years.

Prereq: A M D 204, A M D 245; one natural science course (physics or chemistry recommended).

Color theory, dyes and color matching as applied to textiles and textile products.

A M D 505. Quality Assurance of Textiles and Apparel.

(Dual-listed with A M D 305). (2-3) Cr. 3. *Prereq: A M D 231; STAT 226 or STAT 401; one natural science course*

Principles of product and materials evaluation and quality assurance. Developing specifications and using standard practices for evaluating materials, product characteristics, performance, and quality. Proposal and research project.

A M D 510. Foundation of Scholarship in Textiles and Clothing.

(3-0) Cr. 3. F. *Prereq: Graduate classification*

Overview of scholarship in textiles and clothing with emphasis on current and future directions. Fundamentals of writing literature reviews. Examination of ethical issues in scholarship and academic life. Introduction to creativity, sustainability, and entrepreneurship. Development of teaching units.

A M D 521. Digital Technologies in Textile and Apparel Design.

(3-0) Cr. 3. *Prereq: Research Methods course. Permission of instructor.*

Digital technologies in textile and apparel design. Theories and practices of mass customization and personalization, digital textile printing, 3D body scanning, creating avatars from body scans, and fitting digital apparel designs.

A M D 526. Creative Design Processes.

(Dual-listed with A M D 426). (1-4) Cr. 3. Repeatable. *Prereq: A M D 301, A M D 321*

Exploration of the creative process and sources of inspiration with emphasis on fashion presentation and line development for a variety of markets. Continued development of fashion illustration techniques. Development of digital and paper portfolio.

A M D 528. Design Seminar.

(Dual-listed with A M D 328). Cr. arr. Repeatable. F.S.SS. *Prereq: Vary with topic.* Focus on artisanal textile, apparel, or surface and structural design techniques. Design processes for specialty fabrics and markets. Topics vary by term.

A M D 557. Textile Conservation and Collection Management.

(3-0) Cr. 3. *Prereq: A M D 204*

Condition assessment, repair, and stabilization of textiles and apparel in museum collections. Dry and aqueous cleaning. Examination of storage and exhibition techniques, materials, and conditions. Experience with cataloging and management practices.

A M D 565. Sustainability: Theory and Practical Application.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 3 credits in research methods; basic knowledge of apparel industry and product development; permission of instructor.*

Overview of current sustainability theory, research, and methodology. Emphasis on the evaluation and discussion of current sustainability literature and sustainable practice of apparel, textiles, and related products and services through people, processes, and the environment. Development and presentation of original scholarly and creative design work under various sustainability frameworks.

A M D 567. Consumer Behavior and Apparel.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: A M D 467 or MKT 447; STAT 401*

Application of concepts and theories from the social sciences to the study of consumer behavior. Experience in conducting research; manuscript writing.

A M D 572. Sourcing and Global Issues.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: a course in merchandising or marketing*

Evaluation of key issues facing textile and apparel industries in global markets considering ethical, economic, political, social, and professional implications. Sourcing strategies in a global environment. Corporate and consumer social responsibility and sustainability. Experience in conducting research using secondary data.

Meets International Perspectives Requirement.

A M D 576. Industry Applications in Merchandising and Management.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: A M D 376 or equivalent; AESHM 275 or equivalent. Permission of instructor*

Using the case study method, students apply merchandising theory, principles, and practices to industry scenarios. Emphasis on problem solving, creative thinking, data analysis, and data interpretation involved in business operations. Focus on the development of leadership skills while functioning in small and large groups.

A M D 590. Special Topics.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590A. Special Topics: Textile Science.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590B. Special Topics: History of Dress and Textiles.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590C. Special Topics: Textile and Apparel Design.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590D. Special Topics: Aesthetics.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590E. Special Topics: Entrepreneurship.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590F. Special Topics: Sociological and Psychological Aspects.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590G. Special Topics: Consumer Behavior.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590I. Special Topics: Merchandising.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590K. Special Topics: Cultural Analysis of Dress and Textiles.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590L. Special Topics: Conservation.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590M. Special Topics: Museums.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590N. Special Topics: Apparel Production Management.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590O. Special Topics: Technical Design.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590P. Special Topics: Interdisciplinary.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590Q. Special Topics: Quality Assurance.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590T. Special Topics: Public Relations and Publishing.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590U. Special Topics: Product Development.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 590V. Special Topics: Sourcing and Global Issues.

Cr. arr. Repeatable. *Prereq: Permission of department chair and instructor(s)* Individually designed textile and clothing-related projects that reflect the special interests of the student.

A M D 595. Senior Design Studio.

(Dual-listed with A M D 495). (0-6) Cr. 3. F. *Prereq: A M D 325, A M D 526. Permission of instructor.*

Creation of an apparel line from concept to prototypes through the use of manual and CAD technologies. The line is to be included in a professional portfolio and submitted to a juried exhibition.

A M D 599. Creative Component.

Cr. arr. Repeatable. *Prereq: 9 graduate credits in A M D*

Courses for graduate students:**A M D 611. Seminar.**

Cr. 1-3. Repeatable. *Prereq: 6 graduate credits in textiles and clothing. Permission of instructor* Discussion of scholarship and current issues. Topics vary.

A M D 625. Design Theory and Process.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Permission of instructor.* Analysis and application of design theory and creative processes, including strategies for solving aesthetic, functional, and/or technology-focused design problems. Design criticism and frameworks for practice led design research.

A M D 665. Social Science Theories of Appearance.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: 6 credits in sociology or psychology*

Analysis of social science theories and concepts applicable to clothing and appearance research. Emphasis on qualitative research and philosophy of knowledge, including postmodern, symbolic interaction, semiotic, and feminist theories. Qualitative data collection and analysis for a research project.

A M D 676. Merchandising Theory and Research Applications.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: AESHM 275 or equivalent; statistics course recommended.*

Review of current merchandising theory, research, and methodology. Emphasis on the evaluation and discussion of current and seminal merchandising literature, understanding research processes, interpretation of findings, assessing implications of research for future directions in merchandising, and the development and presentation of original scholarly work.

A M D 690. Advanced Topics.

Cr. arr. Repeatable. *Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E*

A M D 699. Research.

Cr. arr. Repeatable.

Arabic (ARABC)

Courses primarily for undergraduates:

ARABC 101. Elementary Arabic I.

(4-0) Cr. 4. F.

Beginning level development of reading, writing, listening comprehension, and speaking in Arabic, within the context of Arabic culture. Attention to the use of the Arabic alphabet.

ARABC 102. Elementary Arabic II.

(4-0) Cr. 4. S. *Prereq: ARABC 101 or placement by department exam.*

Continuation of ARABC 101. Beginning level development of reading, writing, listening comprehension, and speaking in Arabic, within the context of Arabic culture.

Meets International Perspectives Requirement.

ARABC 195. Study Abroad.

Cr. arr. Alt. SS., offered irregularly.

Supervised instruction in Arabic language and culture, formal class instruction at level appropriate to student's training, augmented by practical living experience. Taught in Arabic.

ARABC 201. Intermediate Arabic I.

(4-0) Cr. 4. F. *Prereq: ARABC 102 or placement by department exam*

Intermediate level development of reading, writing, listening comprehension, and speaking in Arabic, within the context of Arabic culture.

Meets International Perspectives Requirement.

ARABC 202. Intermediate Arabic II.

(4-0) Cr. 4. *Prereq: ARABC 201 or placement by department exam*

Intermediate development of reading, writing, listening comprehension, and speaking skills in Modern Standard Arabic within the context of the Arabic world.

Meets International Perspectives Requirement.

ARABC 295. Study Abroad.

Cr. arr. Alt. SS., offered irregularly. *Prereq: ARABC 102 or equivalent*

Supervised instruction in Arabic language and culture, formal class instruction at level appropriate to student's training, augmented by practical living experience. Taught in Arabic.

Architecture (ARCH)

Courses primarily for undergraduates:

ARCH 201. Architectural Design I.

(1-15) Cr. 6. F. *Prereq: Completion of the pre-professional program and admission into the professional program in Architecture*

Introduction to architectural design. Introduction to architectural design, including precedent research, drawing conventions, model making, and diagramming. Studio projects focus on investigating the impact of specific site conditions on design, threshold conditions, and small-scale domestic space. Students will learn skills in problem solving, visualization, and written, oral, and graphic communication. Field trips to relevant architectural sites.

ARCH 201H. Architectural Design I, Honors.

(1-15) Cr. 6-7. F. *Prereq: Completion of the pre-professional program and admission into the professional program in Architecture*

Introduction to architectural design. Introduction to architectural design, including precedent research, drawing conventions, model making, and diagramming. Studio projects focus on investigating the impact of specific site conditions on design, threshold conditions, and small-scale domestic space. Students will learn skills in problem solving, visualization, and written, oral, and graphic communication. Field trips to relevant architectural sites.

ARCH 202. Architectural Design II.

(1-15) Cr. 6. S. *Prereq: ARCH 201; MATH 142; PHYS 111*

Continuation of fundamental architectural design exploration. Studio projects focus on the generation of ideas based on experience and an understanding of urban spaces. Emphasis on systematic analysis of urban culture, scale, materiality, and networks. Students work in groups and individually. Representational methods expand on architectural conventions through experimentation. Fieldtrips to relevant architectural sites.

ARCH 202H. Architectural Design II, Honors.

(1-15) Cr. 6-7. S. *Prereq: ARCH 201, MATH 142 and PHYS 111*

Continuation of fundamental architectural design exploration. Studio projects focus on the generation of ideas based on experience and an understanding of urban spaces. Emphasis on systematic analysis of urban culture, scale, materiality, and networks. Students work in groups and individually. Representational methods expand on architectural conventions through experimentation. Fieldtrips to relevant architectural sites.

ARCH 221. History of Architecture I.

(3-0) Cr. 3. F.

Survey of western architectural ideas and practices in their social, cultural, and representational contexts. Comparisons with global examples. Ancient through 1750.

Meets International Perspectives Requirement.

ARCH 222. History of Architecture II.

(3-0) Cr. 3. S.

Survey of western architectural ideas and practices in their social, cultural and representational contexts. Comparisons with global examples. 1750 to present.

Meets International Perspectives Requirement.

ARCH 230. Design Communications I.

(2-2) Cr. 3. F. *Prereq: Admission to the professional program in architecture*
Investigations of various design media—including computer graphics and freehand drawing—and their applications to design, specifically to the course work in ARCH 201. Exercises to develop manual skill and perceptual sensitivity.

ARCH 245. Building Science and Technology I.

(2-2) Cr. 3. F. *Prereq: Admission to the professional program in architecture*
Integrated architectural technology fundamentals in three modules: environmental, material, and structural technologies. Introductory topics include: sustainable considerations in environmental forces and systems, (solar orientation, climate, daylight, ventilation, human comfort & occupancy patterns), basic materials and assemblies (physical properties & building codes) and structural concepts (forces, equilibrium, and stability).

ARCH 301. Architectural Design III.

(1-15) Cr. 6. F. *Prereq: ARCH 202*

Consideration of landscape as a constructed, cultural artifact. Projects address the perceptual aspects and strategies of situation and location; examination of environmental phenomena and patterns of use and settlement as revealed and affected by the architectural artifact. Development of a critical design process is stressed.

ARCH 301H. Architectural Design III, Honors.

(1-15) Cr. 6-7. F. *Prereq: ARCH 202*

Consideration of landscape as a constructed, cultural artifact. Projects address the perceptual aspects and strategies of situation and location; examination of environmental phenomena and patterns of use and settlement as revealed and affected by the architectural artifact. Development of a critical design process is stressed.

ARCH 302. Architectural Design IV.

(1-15) Cr. 6. S. *Prereq: ARCH 301 and minimum 2.0 GPA in previous studio courses*

Continuation of ARCH 301, examining housing in the urban situation; diverse scales of use and occupation within the city as shaped by cultural tendencies. Projects examine collective and individual identities related by the condition of adjacency, the ability to consider varieties of scale within a project, and a further development of critical and technical methods.

ARCH 302H. Architectural Design IV, Honors.

(1-15) Cr. 6-7. S. *Prereq: ARCH 301 and minimum 2.0 GPA in previous studio courses*

Continuation of ARCH 301, examining housing in the urban situation; diverse scales of use and occupation within the city as shaped by cultural tendencies. Projects examine collective and individual identities related by the condition of adjacency, the ability to consider varieties of scale within a project, and a further development of critical and technical methods.

ARCH 321. History of the American City.

(3-0) Cr. 3. *Prereq: Sophomore classification*

Study of the development of the built environment and urban condition in the United States from the colonial period to today. Through the theme of infrastructure, primary attention is given to urban spatial organization, built form, technological change, regulatory and funding patterns, and social categories such as class, race, and gender.

Meets U.S. Diversity Requirement

ARCH 323. Theories of Architecture.

(3-0) Cr. 3. *Prereq: ARCH 221, 222. Course restricted to ARCH majors only.*

Survey of theories impacting the production of architecture, historically and in contemporary practice. Emphasis will be given to recent movements and architectural manifestations, as well as close examinations of socio-cultural conditions.

ARCH 334. Computer Applications in Architecture.

(2-2) Cr. 3.

Current and potential applications of digital computers in architecture. Projects employing computer graphics and modeling methods. Awareness of programming languages related to applications.

ARCH 335. Three-Dimensional Studio.

(Cross-listed with ARTIS). (1-4) Cr. 3. Repeatable, maximum of 6 credits.

This course deals with three dimensional problems in visual invention, organization, and expression emphasizing creative manipulation of tools, materials, and techniques as means for three dimensional thinking. Projects cover the additive (modeling), subtractive (carving), substitutional (casting) as well as constructive techniques.

ARCH 341. Building Science and Technology II.

(3-4) Cr. 5. S. *Prereq: ARCH 245, MATH 142 and PHYS 111*

Continued exploration of integrated architectural technology fundamentals in three modules: environmental, material, and structural technologies. Topics include environmental systems (building envelope systems and heat transfer, passive heating and cooling, daylighting, thermal comfort, analytical guidelines and calculation methods), materials & assemblies (composite building materials and framing systems) and structural systems (exploration relationship between applied forces and structural forms).

ARCH 342. Building Science and Technology III.

(3-4) Cr. 5. F. *Prereq: ARCH 341*

In-depth explorations of integrated architectural technology fundamental topics in three modules: environmental, material, and structural technologies with a focus on sustainable concepts and formal/material explorations. Examination of a design process that incorporates climate into the control of thermal, luminous, and acoustic environments. Introduction to plumbing systems. Complex construction assemblies and large-scale construction will be studied. Structural components (beams, columns, & slabs) will be designed, computed, and analyzed.

ARCH 343. Building Science and Technology IV.(3-4) Cr. 5. S. *Prereq:* ARCH 342

In-depth explorations of fundamental integrated architectural technology topics in three modules: environmental, material, and structural technologies with a focus on sustainable concepts and formal/material explorations. An overview of active environmental control systems in response to occupant comfort, patterns of use, health, and safety regulations. Use and design of mechanical, electrical, plumbing, fire safety, transportation, and conveying systems and subsystems. Structural module investigates complex structural systems and behaviors with a focus on documentation and integration with other building technologies.

ARCH 351. Whole Building Energy Performance Modeling.(3-0) Cr. 3. S. *Prereq:* ARCH 202, 245, 341. *Open to non-majors by permission of instructor.*

Architectural design, design evaluation and technical analysis using energy performance modeling tools. Emphasis will be given to whole building energy efficiency including passive and active systems integration.

ARCH 371. Human Behavior and Environmental Theory.(3-0) Cr. 3. *Prereq:* Completion of the pre-professional program and admission into the professional program in architecture

Exploration of theories that describe social structure and order and the manner in which individuals and societies organize themselves and structure their environment.

ARCH 401. Architectural Design V.(1-15) Cr. 6. F. *Prereq:* ARCH 302

A rigorous examination of how buildings participate sustainably in socio-political and environmental systems. Student projects consider in a comprehensive proposal how issues of physical site, socio-economic context, programming, structure, form, materiality, and building systems are interconnected through the design process and within the built environment. Projects typically focus on a smaller scale urban public building that is closely connected to its physical, environmental, and social context.

ARCH 401H. Architectural Design V, Honors.(1-15) Cr. 6-7. F. *Prereq:* ARCH 302

A rigorous examination of how buildings participate sustainably in socio-political and environmental systems. Student projects consider in a comprehensive proposal how issues of physical site, socio-economic context, programming, structure, form, materiality, and building systems are interconnected through the design process and within the built environment. Projects typically focus on a smaller scale urban public building that is closely connected to its physical, environmental, and social context.

ARCH 402. Architectural Design VI.(1-15) Cr. 6. S. *Prereq:* ARCH 401 and minimum 2.0 GPA in previous studio courses

An examination of the relationship between architecture and the city. Studio projects stress analysis and interpretation of the diverse forces and conditions that impact and inform architecture in the urban environment. Urban design project. Study abroad option.

Meets International Perspectives Requirement.

ARCH 402H. Honors (6-7 cr.).(1-15) Cr. 6. S. *Prereq:* 401 and minimum 2.0 GPA in previous studio courses

An examination of the relationship between architecture and the city. Studio projects stress analysis and interpretation of the diverse forces and conditions that impact and inform architecture in the urban environment. Urban design project. Study abroad option.

Meets International Perspectives Requirement.

ARCH 403. Architectural Design VII.(1-15) Cr. 6. F. *Prereq:* ARCH 402

A rigorous examination of architecture's relationship with culture and technology. Studio projects stress the interpretation and integration of contextual and historical considerations, as well as structural, environmental, and communication systems, in a comprehensive design proposal.

ARCH 403H. Architectural Design VII, Honors.(1-15) Cr. 6-7. F. *Prereq:* ARCH 402

A rigorous examination of architecture's relationship with culture and technology. Studio projects stress the interpretation and integration of contextual and historical considerations, as well as structural, environmental, and communication systems, in a comprehensive design proposal.

ARCH 404. Architectural Design VIII.(1-15) Cr. 6. S. *Prereq:* ARCH 403

Advanced forum for architectural research and/or design. Choice of thematic studios or student initiated research and design. Experimentation and innovation are encouraged. DSN S 446 or DSN S 546, for 6 cr. each time taken, can be substituted for this class and be taken up to a maximum of 12 credits.

ARCH 404H. Architectural Design VIII, Honors.(1-15) Cr. 6-7. S. *Prereq:* ARCH 403

Advanced forum for architectural research and/or design. Choice of thematic studios or student initiated research and design. Experimentation and innovation are encouraged. DSN S 446 or DSN S 546, for 6 cr. each time taken, can be substituted for this class and be taken up to a maximum of 12 credits.

ARCH 420. Topics in American Architecture.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq:* Junior classification History, theory, and principles of American architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of ARCH 420 may be applied to degree program. Meets U.S. Diversity Requirement

ARCH 422. Topics in Medieval Architecture.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq:* Junior classification History, theory, and principles of medieval architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of ARCH 422 may be applied to degree program. Meets International Perspectives Requirement.

ARCH 423. Topics in Renaissance to Mid-Eighteenth Century Architecture.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq:* Junior classification History, theory, and principles of renaissance to mid-eighteenth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of ARCH 423 may be applied to degree program. Meets International Perspectives Requirement.

ARCH 424. Topics in Nineteenth Century Architecture.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq:* Junior classification History, theory, and principles of nineteenth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of ARCH 424 may be applied to degree program.

ARCH 425. Topics in Twentieth Century Architecture.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq:* Junior classification History, theory, and principles of twentieth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture requirements. A maximum of 6 credits of ARCH 425 may be applied to degree program.

ARCH 426. Topics in Native American Architecture.

(Cross-listed with AM IN). (3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq:* Junior classification History, theory, and principles of Native American/American Indian architecture, landscape architecture and planning considering relationships to the culture, visual arts, site, and surroundings. Credit counts toward fulfillment of Studies in Architecture and Culture. A maximum of 6 credits of ARCH 426 may be applied to degree program. Meets U.S. Diversity Requirement

ARCH 427. History, Theory, and Criticism of Chinese Architecture.

(Dual-listed with ARCH 527). (3-0) Cr. 3. F. *Prereq:* Junior classification The history and theoretical concept of Chinese built environment with emphasis on the morphology of built form and its relationship to art, landscape design, and urban structure. Credit counts toward fulfillment of Studies in Architecture and Culture. Meets International Perspectives Requirement.

ARCH 429. Topics in Italian Architecture and Urbanism.

(3-0) Cr. 3. S. History, theory and principles of Italian architecture and urban design considering relationships to the culture, visual arts, site, and surroundings.

ARCH 431. Analytical Drawing.(1-6) Cr. 3. Repeatable, maximum of 12 credits. F.S. *Prereq:* ARCH 230 and ARCH 302

Exploration of 2- and 3-dimensional representations. Emphasis on on-site freehand sketching, perspective and orthographic drawing, rendering of shadows and textures, and use of diverse media.

ARCH 432. Advanced Computer Lighting and Rendering.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq:* ARCH 230 and ARCH 301 Exploration of the computer as a design and communication tool. Emphasis on lighting and rendering techniques.

ARCH 433. File to Fabrication.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. F.S. *Prereq: ARCH 230 and ARCH 301*

Exploration of the computer as a design and manufacturing tool. Emphasis on fabrication techniques and rapid prototyping including laser-cutting, 3-D printing and CNC routing.

ARCH 434. Computer-aided Architectural and Environmental Design.

(1-4) Cr. 3. *Prereq: ARCH 334*

Emphasis on application of the computer as a design tool, topical applications and computer graphic methods, development of computer software for architectural and environmental problem solving.

ARCH 436. Advanced Design Media.

(2-2) Cr. 3. Repeatable. F.S.S. *Prereq: ARCH 230*
Special topics in design media applications.

ARCH 437. Architectural Photography.

(3-0) Cr. 3. *Prereq: ARCH 202*

Emphasis on use of the camera and lighting in photographing drawings and interior and exterior building environments.

ARCH 445. Building Science and Technology V.

(2-2) Cr. 3. F. *Prereq: ARCH 343*

Technical topics which ground architectural design decisions and concepts in the physical world and the human perception thereof and have environmental sustainability as an emphasis. Synthesis of material, environmental, structural and systems design and related design modeling and simulation.

ARCH 482. Professional Practice.

(Dual-listed with ARCH 582). (3-0) Cr. 3. F. *Prereq: ARCH 202*

Emphasis on the circumstances and opportunities of the professional practice of architecture: practice as profession, process, organization, business, and evolving models of practice.

ARCH 486. Design: Made in Italy.

(3-0) Cr. 3. S.

An investigation of the history of Italian design in its contemporary form as part of International study abroad program in Rome.

ARCH 490. Independent Study.

Cr. 1-9. Repeatable. *Prereq: Written approval of instructor and department chair on required form*

Independent investigation.

ARCH 490A. Independent Study: Design Communications..

Cr. 1-9. Repeatable. *Prereq: Written approval of instructor and department chair on required form*

Independent investigation.

ARCH 490B. Independent Study: Design.

Cr. 1-9. Repeatable. *Prereq: Written approval of instructor and department chair on required form*

Independent investigation.

ARCH 490C. Independent Study: Building Science and Technology.

Cr. 1-9. Repeatable. *Prereq: Written approval of instructor and department chair on required form*

Independent investigation.

ARCH 490D. Independent Study: Architectural History.

Cr. 1-9. Repeatable. *Prereq: Written approval of instructor and department chair on required form*

Independent investigation.

ARCH 490E. Independent Study: Behavioral Studies.

Cr. 1-9. Repeatable. *Prereq: Written approval of instructor and department chair on required form*

Independent investigation.

ARCH 490F. Independent Study: Practice.

Cr. 1-9. Repeatable. *Prereq: Written approval of instructor and department chair on required form*

Independent investigation.

ARCH 490H. Independent Study: Honors.

Cr. 1-9. Repeatable. *Prereq: Written approval of instructor and department chair on required form*

Independent investigation.

Courses primarily for graduate students, open to qualified undergraduates:

ARCH 505. Architectural Design and Media I: Mapping, Programming, Building.

(0-10) Cr. 5. F. *Prereq: Admission to the M Arch program. Concurrent enrollment in ARCH 541 and ARCH 595*

An introduction to comprehensive architectural design projects that focuses on three interrelated design skills: mapping, programming and building. Projects establish a framework for designing buildings that considers multiple factors such as environmental forces, construction methods, building codes, urban regulations, social relationships, and cultural values.

ARCH 506. Architectural Design and Media II: Materiality and Representation.

(0-10) Cr. 5. S. *Prereq: ARCH 505, ARCH 541, ARCH 595 and concurrent enrollment in ARCH 542 and ARCH 596*

Small-scale architectural design projects that investigate design representation through analogue and digital means. The projects explore different representation strategies to help students develop an understanding of the particular modes of architectural representation that advance the designer's knowledge of space as a complex interaction between materials with inherent physical characteristics, mobile socializing bodies, and changing environmental cycles.

ARCH 507. Architectural Design and Media III: Design in Detail.

(0-10) Cr. 5. SS. *Prereq: ARCH 506, ARCH 542, ARCH 596 and concurrent enrollment in ARCH 581*

Design projects that emphasize the multi-faceted role of the architectural detail in the design process through first, understanding the historical specificity of building construction and detailing; second, utilizing working drawing as a mode of communication; and third, designing with details. The term-long project will consider a set of working drawings of past buildings as a site for design intervention.

ARCH 519. Middle Eastern Cities.

(Cross-listed with C R P). (3-0) Cr. 3. *Prereq: Graduate or Senior classification*

Introduction to basic academic writings on Middle Eastern cities in addition to other contemporary cultural productions of the region. Study of various aspects of Middle Eastern life and the built environments that this life produces. Meets International Perspectives Requirement.

ARCH 527. History, Theory, and Criticism of Chinese Architecture.

(Dual-listed with ARCH 427). (3-0) Cr. 3. F. *Prereq: Junior classification*

The history and theoretical concept of Chinese built environment with emphasis on the morphology of built form and its relationship to art, landscape design, and urban structure. Credit counts toward fulfillment of Studies in Architecture and Culture.

Meets International Perspectives Requirement.

ARCH 528. Topical Studies in Architecture.

(3-0) Cr. 2-3. Repeatable, maximum of 6 times. *Prereq: ARCH 221, ARCH 222 or senior classification or graduate standing*
n/a.

ARCH 528A. Studies in Architecture: Culture.

(3-0) Cr. 2-3. Repeatable, maximum of 6 times. *Prereq: ARCH 221, ARCH 222 or senior classification or graduate standing*

ARCH 528B. Studies in Architecture: Technology.

(3-0) Cr. 2-3. Repeatable, maximum of 6 times. *Prereq: ARCH 221, ARCH 222 or senior classification or graduate standing*
n/a.

ARCH 528C. Studies in Architecture: Communications.

(3-0) Cr. 2-3. Repeatable, maximum of 6 times. *Prereq: ARCH 221, ARCH 222 or senior classification or graduate standing*
n/a.

ARCH 528D. Studies in Architecture: Design.

(3-0) Cr. 2-3. Repeatable, maximum of 6 times. *Prereq: ARCH 221, ARCH 222 or senior classification or graduate standing*

ARCH 528E. Studies in Architecture: Practice.

(3-0) Cr. 2-3. Repeatable, maximum of 6 times. *Prereq: ARCH 221, ARCH 222 or senior classification or graduate standing*

ARCH 529. Spatial Dialectics in the American Midwest.

(3-0) Cr. 3. *Prereq: Graduate or Senior classification*

The American Midwest has witnessed dramatic transformation during the last two centuries which impacted its physical, environmental, economic and social characteristics. This course is an interdisciplinary study of the evolution and sustainability of Midwestern space in relationship to forces of flow shaped by the mobility of bodies, products, meanings, and symbols that are enforced, incorporated, reproduced or destroyed.

Meets U.S. Diversity Requirement

ARCH 534. Advanced Computer-aided Architectural Design.

(1-4) Cr. 3. Repeatable, maximum of 6 credits. F. Prereq: ARCH 434 and permission of instructor

Emphasis on concepts, algorithms, data structures, advanced modeling, rendering, animation, and virtual reality applications in architectural design.

ARCH 535. Advanced Three-Dimensional Studio.

(1-4) Cr. 3. Repeatable, maximum of 6 credits. Prereq: ARCH 335 or Graduate classification

Advanced investigation of sculptural expression with emphasis on individual projects.

ARCH 541. Science and Technology for Architects I.

(4-2) Cr. 5. F. Prereq: Admission to the M. Arch. program and concurrent enrollment in ARCH 505 and 595

Introduction to Human Factors, Descriptive Geometry, Basic Building Materials, and Small-Scale Building Envelopes. Theory and case studies, stressing the connectivity of technical issues to broader formal, social, and cultural spheres.

ARCH 542. Science and Technology for Architects II.

(4-2) Cr. 5. S. Prereq: ARCH 505, ARCH 541, ARCH 595 and concurrent enrollment in ARCH 506 and ARCH 596

Elementary Statics and Beam Theory, Basic Construction Materials, and Site and Building Circulation. Theory and case studies stressing the connectivity of technical issues to broader formal, social, and cultural spheres.

ARCH 558. Sustainability and Green Architecture.

(3-0) Cr. 3. Prereq: Graduate or Senior classification

Issues of Sustainability as related to living patterns and city design, population, pollution and use and availability of natural resources for the built environment; Issues of Green Architecture as it relates to building material selection, systems of building materials, the environment of the United States and the World, architects and examples of buildings with green or sustainable designations.

ARCH 567. Preservation, Restoration, and Rehabilitation.

(3-0) Cr. 3. S. Prereq: Senior classification

Construction standards and procedures for preserving, restoring, reconstructing, and rehabilitating existing buildings following the guidelines of the National Park Service and the National Trust for Historic Preservation. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

ARCH 571. Design for All People.

(Cross-listed with GERON). (3-0) Cr. 3. S. Prereq: Graduate or Senior classification

Principles and procedures of universal design in response to the varying ability level of users. Assessment and analysis of existing buildings and sites with respect to standards and details of accessibility for all people, including visually impaired, mentally impaired, and mobility restricted users. Design is neither a prerequisite nor a required part of the course. Enrollment open to students majoring in related disciplines. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Meets U.S. Diversity Requirement

ARCH 575. Contemporary Urban Design Theory.

(3-0) Cr. 3. Prereq: Graduate or Senior classification

Current urban design theory and its application to urban problems. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

ARCH 576. Study Abroad Options.

Cr. 1-12. Repeatable, maximum of 12 credits. SS.

Special topics in environmental design, architectural history and contemporary practice. Travel to relevant countries. General cultural and historical studies, topical projects and individual inquiry. Courses may be taught by departmental faculty or faculty from approved Iowa State Study Abroad programs. See current offerings for detailed syllabus.

Meets International Perspectives Requirement.

ARCH 581. Service Learning.

(1-12) Cr. 5. SS. Prereq: ARCH 506, 542 and ARCH 596

Planning and execution of a project serving a community need. Learning occurs through both theory and active involvement in on-site work. Projects connect previous coursework to practical applications and community involvement.

ARCH 582. Professional Practice.

(Dual-listed with ARCH 482). (3-0) Cr. 3. F. Prereq: ARCH 202

Emphasis on the circumstances and opportunities of the professional practice of architecture: practice as profession, process, organization, business, and evolving models of practice.

ARCH 583. Research in Practice.

(3-0) Cr. 3. S. Prereq: Graduate or Senior classification

Foundational course in the methods and conceptual tools of design research in the context of practice. Through team and individual guided projects, students generate, analyze and represent knowledge in design-related communications and contexts. Alternative models of practice, client groups and communities are addressed within projects that precede, feed, follow, or overlap with architectural contracts.

ARCH 590. Special Topics.

Cr. 1-5. Repeatable. Prereq: Written approval of instructor and department chair on approved form

Investigation of architectural issues having a specialized nature.

ARCH 595. Seminar on the Built Environment I: History.

(5-0) Cr. 5. F. Prereq: Admission to the M. Arch. program and concurrent enrollment in ARCH 505 and ARCH 541

Introduction to historical canons and traditions of architecture and urbanism. Discussion of the relationship between historical inquiry and contemporary practice. Students learn skills in critical thinking, visual analysis, and research methods. Course sessions develop thematically with interdisciplinary readings, group discussions, student presentations, and research projects.

ARCH 596. Seminar on the Built Environment II: Landscape and Society.

(5-0) Cr. 5. S. Prereq: ARCH 505, ARCH 541, ARCH 595 and concurrent enrollment in ARCH 506 and ARCH 542

Introduction to landscape as artifact and multi-disciplinary knowledge-base for design thinking. Literatures and methods of environmental psychology, cultural geography, landscape and architectural history and theory, site and circulation design as intersection of built infrastructural, natural, and social systems. Emphasis on sensory perception, and human movement; investigations of climate, environmental conditions, and values toward consumption and sustainability in everyday experience of the built environment.

ARCH 597. Seminar on the Built Environment III: Theory.

(3-0) Cr. 3. F. Prereq: Graduate or Senior classification

Multidisciplinary overview of contemporary theories concerned with the production of the built environment. Particular attention to urbanism as a discourse that relates social interactions and power structures to material space. Meets International Perspectives Requirement.

ARCH 598. Seminar on the Built Environment IV: Topical Study.

(3-0) Cr. 3. S. Prereq: Graduate or Senior classification

A research seminar which considers a topic within contemporary discourses on the built environment outside of Europe and North America. The topic will be studied from multiple perspectives highlighting the historical and theoretical relationships between architecture, global cultures, geography, landscape, and urban planning. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.

Courses for graduate students:**ARCH 601. Sustainable Building Design.**

(0-12) Cr. 6. F. Prereq: ARCH 507, ARCH 542, ARCH 596 and concurrent enrollment in ARCH 643

Design projects that are developed through integrative design strategies that explore the relationship between buildings and environmental forces to maximize non-wasteful, efficient use of resources such as energy, water and building materials. Projects will include investigations of the impact of solar energy, airflow, building materials, passive and active systems and wall sections on spatial quality and form making. Design decisions will be quantitatively validated through energy modeling and performance simulation.

ARCH 602. Community, Building and the Environment.

(0-12) Cr. 6. S. Prereq: ARCH 601, ARCH 643, ARCH 597 and concurrent enrollment in ARCH 644

Design projects that explore the relationships between architectural, cultural, and environmental landscapes. Emphasis on regional sites, socio-economic conditions, and sustainable design and planning practices at multiple scales. Projects stress engagement with local circumstances and stakeholders; systemic interconnections and strategies; and the application of interdisciplinary research.

ARCH 603. Comprehensive Design.

(0-12) Cr. 6. F. Prereq: ARCH 601

Rigorous examination of architecture's relationship with culture and technology. Studio projects stress the interpretation of contextual and historical considerations, as well as structural, environmental, mechanical, electrical and plumbing systems, in a comprehensive design proposal. This course fulfills the Graduate College Creative Component Requirement.

ARCH 604. Design Studio Options.

(0-12) Cr. 6. Repeatable, maximum of 12 credits. S. *Prereq: ARCH 602*
Design studio selected by the students, which may include but is not limited to: independent design study, interdisciplinary design studio, study abroad, and design build. DSN S 546 for 6 cr. may be substituted for this course.

ARCH 643. Science and Technology for Architects III.

(2-2) Cr. 3. F. *Prereq: ARCH 507, ARCH 542, ARCH 596, ARCH 581 and concurrent enrollment in ARCH 601 or Graduate classification and concurrent enrollment in ARCH 601*

Third in a four-course series in building science and technologies. Structural Elements and Systems, and Building Services. Theory and case studies stressing the connectivity of technical issues to broader formal, social and cultural spheres.

ARCH 644. Science and Technology for Architects IV.

(2-2) Cr. 3. S. *Prereq: ARCH 643 or Graduate classification*

Fourth of a four-course series in building science and technologies. Building Enclosures, Interior Construction and Sensory Qualities, Fabrication and Construction. Theory and case studies stressing the connectivity of technical issues to broader formal, social and cultural spheres. Summative Student Project.

ARCH 690. Independent Design Study.

(1-15) Cr. 6. Repeatable. *Prereq: Admission to the M. S. in Arch. program*
Independent architectural design projects commensurate with student interests requiring approval of Architecture Graduate Committee.

ARCH 698. Graduate Seminar.

Cr. R. Repeatable. F.S. *Prereq: Admission to the M. Arch. or M. S. in Arch. programs*
Special topics and guest speakers.

ARCH 699. Research.

(1-18) Cr. 3-9. Repeatable.
Research.

Art Education (ARTED)

Courses primarily for undergraduates:

ARTED 209. Methods of Teaching in and Through Art.

Cr. 2. F.S. *Prereq: Sophomore level*

Methods of teaching in and through visual art are experienced and applied in this course. Art-centered and interdisciplinary art education methods for K-8 teaching are designed to develop creativity, authentic expression, collaboration, esthetic sensitivity and pluralistic, global perspectives.

ARTED 211. Introduction to Art Education.

(0-6) Cr. 3. F.S.

Teaching methods for K-12 art education. Hands-on discipline-specific and integrated art activities are experienced and designed; emphasis is on creativity, artistic and human diversity, and thinking skills development in art education.

Art History (ART H)

Courses primarily for undergraduates:

ART H 280. History of Art I.

(3-0) Cr. 3. F.

Development of the visual arts including painting, sculpture, architecture, and crafts, from the prehistoric through Gothic period.

Meets International Perspectives Requirement.

ART H 281. History of Art II.

(3-0) Cr. 3. S.

Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts; from the Renaissance to the twentieth century.

Meets International Perspectives Requirement.

ART H 281H. History of Art II: Honors.

(3-0) Cr. 3. S.

Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts; from the Renaissance to the twentieth century.

Meets International Perspectives Requirement.

ART H 292. Introduction to Visual Culture Studies.

(3-0) Cr. 3.

An introduction to various topics in visual culture studies. The lecture course will provide students with a creative and intellectual context in which to study historical and contemporary instances of the visual in culture. Individual lectures examine significant trends in the visual arts, mass media, scientific imagery, visual communications, and other areas related to visual literacy and visual representation in local and global contexts. Cross cultural viewpoints and issues of diversity will be presented in relation to visual culture and related fields.

Meets U.S. Diversity Requirement

ART H 293. Origins and Evolution of Modern Design.

(3-0) Cr. 3. F.S.

History of designed artifacts, their creators, and their cultural environments in Western Europe and America from the beginning of the Industrial Revolution to the present.

ART H 378. Popes and Caesars: 2000 Years of Art History in Rome.

(3-0) Cr. 3. *Prereq: Permission of instructor*

Survey of Italian art and architecture from the Etruscans to Bernini, including lectures and tours of museums and historical sites. Study abroad course taught in Rome, with travel to other Italian cities.

ART H 382. Art and Architecture of Asia.

(3-0) Cr. 3.

Introduction to the history of art and architecture in Asia. Cultures may include China, Korea, Japan, and India before the modern era. Visual materials selected based on important themes that are critical in understanding Asian culture and art tradition.

Meets International Perspectives Requirement.

ART H 383. Greek and Roman Art.

(Cross-listed with CL ST). (3-0) Cr. 3.

Greek art from Neolithic to Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West.

ART H 383H. Greek and Roman Art: Honors.

(Cross-listed with CL ST). (3-0) Cr. 3-4.

Greek art from Neolithic to Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West.

ART H 384. Art of Islam.

(3-0) Cr. 3.

Historical survey of the painting, sculpture, crafts, and architecture of the various civilizations of the Islamic world.

Meets International Perspectives Requirement.

ART H 384H. Art of Islam, Honors.

(3-0) Cr. 3-4.

Historical survey of the painting, sculpture, crafts, and architecture of the various civilizations of the Islamic world.

Meets International Perspectives Requirement.

ART H 385. Renaissance Art.

(3-0) Cr. 3.

European art including painting, sculpture, architecture, and crafts; thirteenth through sixteenth centuries.

ART H 385H. Renaissance Art, Honors.

(3-0) Cr. 3.

European art including painting, sculpture, architecture, and crafts; thirteenth through sixteenth centuries.

ART H 386. American Art to 1945.

(3-0) Cr. 3.

Survey of American art from the early colonial period to 1945, with emphasis on historical and cultural issues that underlie art production in the United States.

Meets U.S. Diversity Requirement

ART H 388. Modern Art and Theory.

(3-0) Cr. 3.

Visual arts and critical theory of the early 20th century, including Expressionism, Cubism, Futurism, Suprematism, Dada, and Surrealism.

ART H 395. Art and Theory Since 1945.

(3-0) Cr. 3.

Visual arts and critical theory after 1945, including Abstract Expressionism, Pop Art, and Performance Art.

Meets U.S. Diversity Requirement

ART H 396. History of Photography.

(3-0) Cr. 3.

Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an art historical perspective, emphasizing causative factors, cultural influences, and major masters and schools.

ART H 481. Art and Architecture of India.

(Dual-listed with ART H 581). (3-0) Cr. 3.

Survey of Indian-style art and architecture through history. Examination of how art and architecture developed in the Indian world has come to define the Indian identity religiously, culturally, socially, and politically.

Meets International Perspectives Requirement.

ART H 486. Art and Design Field Study.

Cr. R. Repeatable. *Prereq: Concurrent enrollment in an art and design studio or art history course and permission of instructor*

Study and tours of museums, galleries, artist and/or designer studios and other areas of interest within art and design. Offered on a satisfactory-fail basis only.

ART H 487. Nineteenth Century Art.

(3-0) Cr. 3.

European and American art and architecture from 1780 to 1900 focusing on the major movements of western Europe, including: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism.

ART H 489. History of Comics.

(Dual-listed with ART H 589). Cr. 3.

An art-historical survey of comic strips, comic books, and graphic novels from their origins in the 19th century to present.

ART H 489H. History of Comics: Honors.

Cr. 3-4.

An art-historical survey of comic strips, comic books, and graphic novels from their origins in the 19th century to present.

ART H 490. Independent Study.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form before the semester of enrollment*

Student must have completed art history coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ART H 490H. Independent Study, Honors.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form before the semester of enrollment*

Student must have completed art history coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ART H 491. Art History in Europe Seminar.

(1-0) Cr. 1. *Prereq: Permission of instructor and planned enrollment in ART H 492*
Cultural and historical aspects of art and design in Western Europe in preparation for study abroad. Area of study varies each time offered. Offered on a satisfactory-fail basis, only.

Meets International Perspectives Requirement.

ART H 492. Art History in Europe.

(Dual-listed with ART H 592). (3-0) Cr. 3. *Prereq: Graduate classification, ART H 491 or equivalent, permission of instructor*

International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities. Related activities depending on specific area of study which may vary each time offered.

Meets International Perspectives Requirement.

ART H 494. Women/Gender in Art.

(Cross-listed with W S). (3-0) Cr. 3.

Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture.

Meets U.S. Diversity Requirement

ART H 497. Museum/Gallery Internship.Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Advanced classification in a department curriculum*

Written approval of supervising instructor on required form in advance of semester of enrollment. Supervised experience with a cooperating museum or gallery or art center. Offered on a satisfactory-fail basis only.

ART H 498. Selected Topics in Art History.

(Dual-listed with ART H 598). (3-0) Cr. 3. Repeatable, maximum of 9 credits.

Specialized study in the history or criticism of art and/or design.

Courses primarily for graduate students, open to qualified undergraduates:**ART H 501. Issues in Visual and Material Culture Seminar.**(3-0) Cr. 3. *Prereq: Permission of instructor*

Issues and debates that pertain to the study of visual objects and material artifacts in their cultural context. Examination of the role of visual and material culture studies as both relate to allied disciplines including, but not limited to: anthropology, art history, design history, design studies, and new media studies.

ART H 581. Art and Architecture of India.(Dual-listed with ART H 481). (3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor*

Survey of Indian art and architecture through history. Examination of how art and architecture developed in the Indian world has come to define the Indian identity religiously, culturally, socially, and politically.

ART H 586. Museum/Gallery Internship.Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Graduate classification and permission of instructor. Written approval in advance of semester of enrollment.*

Supervised experience with a cooperating museum or gallery or art center. Offered on a satisfactory-fail basis only.

ART H 587. Nineteenth Century Art.(3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor*

European and American art and architecture from 1780 to 1900, focusing on the major movements of western Europe including: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism.

ART H 588. Modern Art and Theory.(3-0) Cr. 3. *Prereq: Graduate classification and permission of instructor*

Visual arts and critical theory of the early 20th century, including: Expressionism, Cubism, Futurism, Suprematism, Dada and Surrealism.

ART H 589. History of Comics.

(Dual-listed with ART H 489). (3-0) Cr. 3.

An art history survey of comic strips, comic books, and graphic novels from their origins in the 19th century to the present.

ART H 590. Special Topics.Cr. arr. *Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment.*

Special Topics for Art History.

ART H 591. Independent Study.Cr. arr. *Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment.*

Independent Study in Art History.

ART H 592. Art History in Europe.(Dual-listed with ART H 492). (3-0) Cr. 3. *Prereq: Graduate classification, ART H 491 or equivalent, permission of instructor*

International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities. Related activities depending on specific area of study which may vary each time offered.

Meets International Perspectives Requirement.

ART H 594. Women/Gender in Art.(Cross-listed with W S). (3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor*

Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture.

ART H 595. Art and Theory Since 1945.(3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor*

Visual arts and critical theory after 1945, including Abstract Expressionism, Pop Art, and Performance Art.

ART H 596. History of Photography.(3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor*

Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an art historical perspective, emphasizing causative factors, cultural influences, and major masters and schools.

ART H 597. Green Art: Earthworks and Beyond.(3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor*

Seminar covering aspects of art and design based on ecological principles, including earthworks, land-based art, recycled/reused objects, ecofeminism, ephemerality, and green design.

ART H 598. Selected Topics in Art History.

(Dual-listed with ART H 498). (3-0) Cr. 3. Repeatable, maximum of 9 credits.

Specialized study in the history or criticism of art and/or design.

Astronomy and Astrophysics (ASTRO)

Courses primarily for undergraduates:

ASTRO 102. North Star Astronomy.

Cr. 1. F.S.

An entirely web-based course covering topics in observing the sky and navigation by the stars for students with little or no previous experience. The course combines material on common naked-eye phenomena, such as daily and seasonal variations in the sky, with information on how these helped navigators determine where they are on Earth. The course "lectures" are on-line, interactive units with build in exercises, hands-on (offline) activities and layers of help. Graded homework and quizzes are administered via Blackboard Learn. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

ASTRO 103. Evening Star.

Cr. 1. F.S.

An entirely web-based course covering topics in celestial mechanics ("Rocket science!") for students with little or no previous experience. It combines the geography of the solar system with discussion of methods of traveling to the other planets. The course "lectures" are on-line, interactive units with built-in exercises, hands-on (offline) activities, and layers of help. Graded homework and quizzes are administered via Blackboard Learn. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

ASTRO 106. Earth and Space Science for Elementary Education Majors.

(Cross-listed with GEOL). (2-0) Cr. 2. F.S. *Prereq: Major in elementary or early childhood education.*

Fundamental concepts of Earth and Space Science, including the solar system, weather and climate, water and soils, plate tectonics, and geologic hazards. Online course format.

ASTRO 106L. Earth and Space Science for Elementary Education Majors: Laboratory.

(Cross-listed with GEOL). (0-2) Cr. 1. F.S. *Prereq: Restricted to elementary and early childhood education majors; to be taken concurrently with GEOL 106/ASTRO 106*

Inquiry-based lab exploring fundamental concepts of Earth and Space Science, including the solar system, weather and climate, water and soils, plate tectonics, and geologic hazards. Must be taken concurrently with GEOL/ASTRO 106.

ASTRO 120. The Sky and the Solar System.

(3-0) Cr. 3. F.S.SS.

For the nonscientist. The sky: constellations; motions of the sun, moon, and planets; seasons and the calendar; eclipses. The solar system: origin and evolution; characteristics of the sun, planets, satellites, comets, meteorites, and asteroids. Extensive use of the planetarium is included. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

ASTRO 125L. The Sky and the Solar System Laboratory.

(0-2) Cr. 1. F.S. *Prereq: Concurrent or previous enrollment in ASTRO 120*

Laboratory course to accompany Astro 120. Students carry out practical exercises involving naked eye and telescopic observing to explore and reinforce ideas covered in Astro 120. Activities based on a sky-simulation computer program and other weather-independent exercises are also included.

ASTRO 150. Stars, Galaxies, and Cosmology.

(3-0) Cr. 3. F.S.

For the nonscientist. Observational aspects of stellar astronomy: motions, distances, sizes, spectra; types of stars; variability; binary systems. Stellar evolution: the birth, life, and death of stars, including supernovae, neutron stars, and black holes. The Milky Way Galaxy: clouds of matter in space, the structure and evolution of our galaxy. Other galaxies, clusters of galaxies, quasars. Theories of the origin of the universe.

ASTRO 250. Astronomy Bizarre.

(3-0) Cr. 3. S. *Prereq: ASTRO 120 or ASTRO 150*

For the nonscientist. New and exciting topics in modern astronomy. Galaxy and star formation. Black holes and pulsars. Colliding galaxies. Quasars. Cosmology, the Big Bang and the future of the universe. Prospects and searches for extraterrestrial life.

ASTRO 290. Independent Study.

Cr. 1-4. Repeatable. *Prereq: Permission of instructor*

ASTRO 342. Introduction to Solar System Astronomy.

(3-0) Cr. 3. F. *Prereq: PHYS 222*

Analytical and comparative studies of solar system objects-planets, satellites, rings, asteroids, comets, meteoroids, and interplanetary dust-with emphasis on the physical processes affecting them, their interactions, and their evolution. Orbital mechanics, including perturbations, stability, and resonances. Tidal forces and effects. Radiation laws and thermal physics with applications. Brief study of the sun as a star, and of stellar evolution. Origin and evolution of the solar system. Detection of other planetary systems.

ASTRO 344L. Astronomy Laboratory.

(1-6) Cr. 3. F. *Prereq: PHYS 222*

Experiments in optical astronomy. Observational techniques, ranging from stellar photometry to CCD imaging. Available instruments include a variety of small telescopes up to 14-inch in size. Class meets at Fick Observatory south of Boone.

ASTRO 346. Introduction to Astrophysics.

(3-0) Cr. 3. S. *Prereq: PHYS 222*

Basic radiation theory; spectra. Observational determination of stellar properties; spectral classification. Binary systems. Stellar structure and evolution. White dwarfs, neutron stars, black holes. The Galaxy: structure and composition; the interstellar medium. Other galaxies; active galaxies; cosmology.

ASTRO 405. Astrophysical Cosmology.

(Dual-listed with ASTRO 505). (3-0) Cr. 3. S. *Prereq: ASTRO 346 or permission of instructor*

Introduction to modern cosmology; mathematical and observational fundamentals associated with the origin, structure, and evolution of the Universe. Scale of the Universe, Hubble's Law, the cosmic microwave background, Big Bang nucleosynthesis, the origin of elements, dark energy and the accelerating universe, and dark matter. For senior undergraduates and graduate students in all areas of physics.

ASTRO 450. Undergraduate Research.

Cr. 1-6. Repeatable. F.S.SS. *Prereq: Permission of instructor*
Research under supervision of astronomy faculty.

ASTRO 450L. Undergraduate Research.

Cr. 1-6. Repeatable. F.S.SS. *Prereq: ASTRO 344L and permission of instructor*
Laboratory or observational project under supervision of astronomy faculty.

ASTRO 490. Independent Study.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq: 6 credits in astronomy, permission of instructor*

No more than 9 credits of Astro 490 may be counted toward graduation.

ASTRO 490H. Independent Study: Honors.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq: 6 credits in astronomy, permission of instructor*

No more than 9 credits of Astro 490 may be counted toward graduation.

Courses primarily for graduate students, open to qualified undergraduates:

ASTRO 505. Astrophysical Cosmology.

(Dual-listed with ASTRO 405). (3-0) Cr. 3. S. *Prereq: ASTRO 346 or permission of instructor*

Introduction to modern cosmology; mathematical and observational fundamentals associated with the origin, structure, and evolution of the Universe. Scale of the Universe, Hubble's Law, the cosmic microwave background, Big Bang nucleosynthesis, the origin of elements, dark energy and the accelerating universe, and dark matter. For senior undergraduates and graduate students in all areas of physics.

ASTRO 510. Observational Astrophysics.

(2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: ASTRO 405 or ASTRO 505 or permission of instructor*

Techniques in optical and near-IR astronomy, including spectroscopy and CCD photometry. Emphasis on projects involving proficiency in the use of research telescopes and modern instrumentation. Project topics range from photometric studies of pulsating and binary star systems to deep CCD imaging of faint nebulae and galaxies.

ASTRO 580. Stellar Astrophysics.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: ASTRO 405 or ASTRO 505 or permission of the instructor*

The interior structure and atmospheric properties of stars: Stellar structure equations and constitutive relations: energy generation, energy transport by radiation and convection; equation of state, nuclear energy generation and nucleosynthesis. Numerical and analytic solutions to the equations of structure and evolution. Observational connections through the theory of radiative transfer. Line and continuum processes and sources of opacity. Non-LTE and statistical equilibrium. Line profiles. Interpretation of stellar spectra: temperature, pressure, and abundance determinations. Stellar evolution from formation to final phases.

ASTRO 582. High Energy Astrophysics.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: ASTRO 405 or ASTRO 505 or permission of the instructor*

Interactions of high-energy particles, non-thermal radiation processes, spectral evolution of non-thermal systems, cosmic rays, active galactic nuclei, pulsars, neutrinos, measurement techniques for relativistic charged particles, high energy photons, and neutrinos.

ASTRO 584. Galactic Astronomy.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: ASTRO 405 or ASTRO 505 or permission of instructor*

Overall structure of our Galaxy and the interstellar medium. Physical processes in the interstellar medium (e.g., heating and cooling mechanisms, turbulence). Observational techniques for studying the interstellar medium. Kinematics and chemical evolution of the Galaxy.

ASTRO 586. Extragalactic Astronomy.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: ASTRO 405 or ASTRO 505 or permission of the instructor*

Galaxy evolution, dynamics of external galaxies, evolution and classification of galaxies, groups and clusters of galaxies, extragalactic radio sources, quasars, structure formation, cosmological models and their observational consequences.

ASTRO 590. Special topics.

Cr. arr. Repeatable.

ASTRO 599. Creative Component.

Cr. arr. *Prereq: Permission of instructor*

Individually directed study of research-level problems for students electing the nonthesis M.S. option in astronomy.

Courses for graduate students:

ASTRO 650. Advanced Seminar.

(1-0) Cr. 1. Repeatable. F.S.

Topics of current interest in astronomy and astrophysics. Offered on a satisfactory-fail basis only.

ASTRO 660. Advanced Topics in Astronomy and Astrophysics.

Cr. 1-3. Repeatable. F.S.

Topics in stellar, galactic, and extragalactic astronomy, including stellar evolution, solar physics, variable stars, compact objects, the interstellar medium, active galaxies and quasars, formation and evolution of galaxies, cosmology, high energy astrophysics, advanced observational techniques, and astrophysical applications of hydrodynamics.

ASTRO 675. Advanced Stellar Astrophysics.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: ASTRO 580 or permission of instructor*

Advanced topics in stellar astrophysics. Dynamic and extended atmospheres, chromospheres, coronae, and stellar winds. MHD, stellar activity, and dynamo theory. Radiative transfer and the transition from extended atmospheres to the interstellar medium. Diffusive processes in stellar atmospheres and interiors. Techniques for quantitative analysis of planetary and stellar spectra including detailed modeling and spectrum synthesis. Evolution in interacting binaries. Nucleosynthesis II. Variable stars. Supernovae. Neutron stars and black holes.

ASTRO 699. Research.

Cr. arr. Repeatable.

Athletic Training (A TR)

Courses primarily for undergraduates:

A TR 218. Orientation to Athletic Training Clinical Experience.

(0-2) Cr. 0.5. F.

Pre-athletic training clinical experience designed to orientate students to the athletic training profession prior to enrolling in athletic training course sequence. Students will observe athletic trainers in various athletic training clinical sites. Open to pre-athletic training students only. Offered on a satisfactory-fail basis only.

A TR 219. Clinical Practicum in Athletic Training.

(0-2) Cr. 1. F.

Athletic training clinical experiences designed to review human anatomical structures including origin, insertion, action, innervations of muscles. Students will gain experience with palpation of these structures to help identify location of anatomical landmarks. Students will also gain experience identifying bones, ligaments, and tendons. Open to athletic training students only.

A TR 220. Basic Athletic Training.

(1-2) Cr. 2. Prereq: BIOL 155 or BIOL 255 and BIOL 256

Introduction to methods of prevention and immediate care of athletic injuries. Basic information concerning health supervision of athletes, and some basic wrapping and strapping techniques for common injuries. Non A TR majors only.

A TR 221. Pre-Athletic Training Clinical Practicum.

(0-3) Cr. 1. S. Prereq: Credit or enrollment in A TR 222

Athletic training clinical observation experiences to accompany A TR 222. Utilize knowledge to evaluate, analyze and demonstrate appropriate taping, wrapping and basic skill techniques. Open to students interested in the athletic training option. Offered on a satisfactory-fail basis only.

A TR 222. Basic Athletic Training for Athletic Trainers.

(2-2) Cr. 3. S. Prereq: BIOL 255, BIOL 255L

Provides pre-athletic training students with the knowledge of the profession of a certified athletic trainer, factors associated with injury prevention, treatment, emergency care of athletic injuries, protective equipment, basic organization, administrative, and legal concepts in the athletic training setting. To be taken concurrently with A TR 221.

A TR 223. Clinical Practicum in Athletic Training.

(0-3) Cr. 1. F. Prereq: Permission of Athletic Training Program Director

Athletic training clinical experiences for athletic training students during pre-season intercollegiate football. Clinical experiences include: Professional Rescuer CPR, AED certification, emergency splinting and spineboarding, medical record keeping and HIPPA regulations, environmental conditions, prevention of injury screening strategies, athletic training room and education program policies and procedures, review of athletic taping techniques, acute injury management, mouthpiece formation, and anatomy review. Offered on a satisfactory-fail basis only.

A TR 224. Evaluation of Athletic Injuries I.

(2-3) Cr. 3. F. Prereq: Permission of athletic training program director

Sport injury assessment procedures and evaluation techniques for lower body injuries. Includes an overview of mechanisms of injury, general musculoskeletal disorders, and spine or neurological dysfunction. Designed for students in the athletic training major.

A TR 225. Athletic Injuries I Clinical Practicum.

(0-3) Cr. 1. F. Prereq: Permission of athletic training program director

Athletic training clinical experience to accompany A TR 224. Open to students in the athletic training major. Offered on a satisfactory-fail basis only.

A TR 226. Evaluation of Athletic Injuries II.

(2-3) Cr. 3. S. Prereq: Permission of athletic training program director

Sport injury assessment procedures and evaluation techniques for lower body injuries. Includes an overview of common illnesses of athletes and sport specific injuries. Designed for students in the athletic training major.

A TR 227. Athletic Injuries II Clinical Practicum.

(0-3) Cr. 1. S. Prereq: Permission of athletic training program director

Athletic training clinical experience to accompany A TR 226. Open to students in the athletic training major. Offered on a satisfactory-fail basis only.

A TR 240. Introduction to Taping, Equipment, and Bracing Techniques.

(0-3) Cr. 1. S. Prereq: Permission of athletic training program director

Basic information and laboratory instruction regarding basic taping techniques, athletic equipment fitting procedures, and the use and proper fitting of prophylactic braces. Open to students in the athletic training major. Offered on a satisfactory-fail basis only.

A TR 323. Therapeutic Modalities for Athletic Trainers.

(2-2) Cr. 3. F. Prereq: Permission of athletic training program director

Theory and technique of therapeutic modalities used in the management of injuries.

A TR 324. Therapeutic Modalities Clinical Practicum.

(0-3) Cr. 1. F. Prereq: Permission of athletic training program director

Athletic training clinical experience to accompany A TR 323. Open to students in athletic training major. Offered on a satisfactory-fail basis only.

A TR 326. Rehabilitation of Athletic Injuries.

(2-2) Cr. 3. S. Prereq: Permission of athletic training program director

Theory and practical application of rehabilitation principles used in the management of athletic injuries.

A TR 327. Rehabilitation of Athletic Injuries Clinical Practicum.

(0-3) Cr. 1. S. Prereq: Permission of athletic training program director

Athletic training clinical experience to accompany A TR 326. Open to students in the athletic training major. Offered on a satisfactory-fail basis only.

A TR 425. Organization and Administration of Athletic Training.

(3-0) Cr. 3. F. Prereq: Permission of athletic training program director, senior classification

Current administrative, professional, and legal issues pertaining to athletic training. Job search techniques and strategies including preparation of materials for athletic training students.

A TR 450. Medical Concerns for the Athletic Trainer.

(3-0) Cr. 3. F. Prereq: Permission of athletic training program director

Current medical issues and concerns, including pathology of illness and injury, dermatological conditions, exposure to allied health care professionals, and pharmacological indications in relation to the profession of athletic training and in patient/athlete care.

A TR 488. Evidence Based Practice in Athletic Training.

Cr. 2. S. Prereq: Permission of athletic training program director

Clinical experiences in application of athletic training techniques under supervision of certified athletic trainers. Participation in monthly research journal discussion. Offered on a satisfactory-fail basis only.

A TR 489. Review of Athletic Training Competencies and Clinical Proficiencies.

Cr. 1. F.S. Prereq: Senior classification, permission of athletic training program director

Preparation for professional endorsement and certification by review of required competencies and clinical proficiencies. Required for endorsement or approval to sit for Board of Certification Exam. Offered on a satisfactory-fail basis only.

Biochemistry, Biophysics, and Molecular Biology (BBMB)

Courses primarily for undergraduates:

BBMB 101. Introduction to Biochemistry.

(1-0) Cr. 1. F.

Research activities, career opportunities in biochemistry and biophysics, and an introduction to the structure of biologically important compounds. For students majoring in biochemistry, agricultural biochemistry or biophysics or considering one of these majors.

BBMB 102. Introduction to Biochemistry Laboratory.

(0-2) Cr. 1. S. Prereq: *Credit or enrollment in CHEM 177 and CHEM 177L or CHEM 201 and CHEM 201L*

Topics in the scientific background of biochemistry, such as macromolecules, metabolism, and catalysis. Laboratory experimentation covers biochemical concepts and the study of bio-molecules including proteins, lipids and nucleic acids. A significant component is practice in scientific communication. For students majoring in biochemistry, agricultural biochemistry or biophysics or considering one of these majors.

BBMB 201. Chemical Principles in Biological Systems.

(2-0) Cr. 2. S. Prereq: *Credit or enrollment in CHEM 332*

Survey of chemical principles as they apply in biological systems including: water, organic chemistry of functional groups in biomolecules and biochemical cofactors, weak bonds and their contribution to biomolecular structure, oxidation-reduction reactions and redox potential, thermodynamic laws and bioenergetics, chemical equilibria and kinetics, inorganic chemistry in biological systems, data presentation. The subjects will be taught using molecules from biological systems as examples. Intended for majors in biochemistry, biophysics or agricultural biochemistry.

BBMB 221. Structure and Reactions in Biochemical Processes.

(3-0) Cr. 3. F. Prereq: *CHEM 163, CHEM 167, or CHEM 177*

Fundamentals necessary for an understanding of biochemical processes. Primarily for students in agriculture. Not acceptable for credit toward a major in biochemistry, biophysics, or agricultural biochemistry. Credit for both BBMB 221 and Chem 231 may not be applied toward graduation.

BBMB 301. Survey of Biochemistry.

(3-0) Cr. 3. F.S.SS. Prereq: *CHEM 231 or CHEM 331*

A survey of biochemistry: structure and function of amino acids, proteins, carbohydrates, lipids, and nucleic acids; enzymology; metabolism; biosynthesis; and selected topics. Not acceptable for credit toward a major in biochemistry, biophysics, or agricultural biochemistry.

BBMB 316. Principles of Biochemistry.

(3-0) Cr. 3. F. Prereq: *CHEM 231 or CHEM 331; BIOL 212.*

Understanding biological systems at the molecular level; chemistry of biological macromolecules, enzyme function and regulation, metabolic pathways; integration of metabolism in diverse living systems. For students in biology and related majors who do not require the more rigorous treatment of biochemistry found in BBMB 404/405. Not acceptable for credit toward a major in biochemistry, biophysics, or agricultural biochemistry.

BBMB 404. Biochemistry I.

(3-0) Cr. 3. F. Prereq: *CHEM 332*

A general overview for graduate and advanced undergraduate students in agricultural, biological, chemical and nutritional sciences. Chemistry of amino acids, proteins, carbohydrates, and lipids, vitamins; protein structure; enzymology; carbohydrate metabolism. Credit for both BBMB 420 and the BBMB 404 - 405 sequence may not be applied toward graduation.

BBMB 405. Biochemistry II.

(3-0) Cr. 3. S. Prereq: *BBMB 404*

A general overview for graduate and advanced undergraduate students in agricultural, biological, chemical, and nutritional sciences. Metabolism of carbohydrates, amino acids, nucleotides and lipids; formation, turnover, and molecular relationships among DNA, RNA, and proteins; genetic code; regulation of gene expression; selected topics in the molecular physiology of plants and animals. Credit for both BBMB 420 and the BBMB 404 - BBMB 405 sequence may not be applied toward graduation.

BBMB 411. Techniques in Biochemical Research.

(2-8) Cr. 4. F. Prereq: *Credit or enrollment in BBMB 404 or BBMB 501; CHEM 211*

Laboratory experimentation and techniques for studying biochemistry, including: chromatographic methods; electrophoresis; spectrophotometry; enzyme purification; enzyme kinetics; and characterization of carbohydrates, proteins, lipids, and nucleic acids.

BBMB 420. Physiological Chemistry.

(3-0) Cr. 3. F. Prereq: *CHEM 332, BBMB 301 or BIOL 314*

Structure and function of proteins; enzymology; biological oxidation; chemistry and metabolism of carbohydrates, lipids, amino acids and nucleic acids; protein synthesis and the genetic code; relationship of biochemistry to selected animal diseases. Biochemistry of higher animals emphasized. Not acceptable for credit toward a major in agricultural biochemistry or biochemistry. Acceptable for credit toward a major in biophysics. Credit for both BBMB 420 and the BBMB 404 - 405 sequence may not be applied toward graduation.

BBMB 430. Prokaryotic Diversity and Ecology.

(Dual-listed with BBMB 530). (Cross-listed with MICRO). (3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: *MICRO 302, MICRO 302L*

Survey of the diverse groups of prokaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

BBMB 440. Laboratory in Microbial Physiology, Diversity, and Genetics.

(Cross-listed with MICRO). (2-6) Cr. 4. F. Prereq: *MICRO 302, MICRO 302L, CHEM 332, BIOL 313L*

Fundamental techniques and theory for studying the cellular mechanisms and diversity of microbial life. Experimental techniques will include isolation and physiological characterization of bacteria that inhabit different environments. Also included are techniques for phylogenetic characterization, measuring gene expression, and genetic manipulation of diverse species of bacteria. Essential components for the effective communication of scientific results are also emphasized.

BBMB 461. Molecular Biophysics.

(Dual-listed with BBMB 561). (2-0) Cr. 2. S. Prereq: *Credit or enrollment in MATH 166 and CHEM 178 and PHYS 222 or PHYS 112.*

Physical methods for the study of molecular structure and organization of biological materials. X-ray diffraction, nuclear magnetic resonance, hydrodynamics and fluorescence spectroscopy. Registration for the graduate credit commits the student to graduate-level examinations, which differ from undergraduate-level examinations in the number and/or difficulty of questions.

BBMB 490. Independent Study.

Cr. 1-3. Repeatable. F.S.SS. Prereq: *College of Agriculture: junior or senior classification and permission of instructor; College of Liberal Arts and Sciences: permission of instructor.*

Independent study with a faculty mentor. No more than 9 credits of BBMB 490 may count toward graduation.

BBMB 490H. Independent Study, Honors.

Cr. 1-3. Repeatable. F.S.SS. Prereq: *College of Agriculture: junior or senior classification and permission of instructor; College of Liberal Arts and Sciences: permission of instructor*

Independent study with a faculty mentor. No more than 9 credits of BBMB 490 may count toward graduation.,

BBMB 499. Undergraduate Research.

Cr. 1-5. Repeatable. F.S.SS. Prereq: *Permission of faculty member with whom student proposes to work.*

Independent research under faculty guidance.

Courses primarily for graduate students, open to qualified undergraduates:

BBMB 503. Bioinorganic Chemistry.

(Cross-listed with CHEM). (2-0) Cr. 2. Alt. S., offered even-numbered years.

Prereq: *CHEM 402 or BBMB 405*

Essential elements: transport and storage of ions and of oxygen; metalloenzymes and metallocoenzymes; electron-transfer processes in respiration and photosynthesis; metabolism of nonmetals and redox processes involved in it; medicinal aspects of inorganic chemistry.

BBMB 504. Amino Acids and Proteins.(2-0) Cr. 2. F. *Prereq: CHEM 332 or equivalent*

Review of amino acids and proteins, including atomic interactions, thermodynamics, structure and properties of amino acids, post-translational modifications, protein expression, purification and analysis, protein secondary, tertiary and quaternary structure, protein folding, oxygen transport and hemoglobin, models for equilibrium binding, elementary reactions and enzyme kinetics, biosynthesis of amino acids: pathways and mechanisms.

BBMB 505. Bioenergetics and Metabolism.(2-0) Cr. 2. F. *Prereq: CHEM 211, CHEM 332; a previous course in biochemistry is strongly recommended*

Examination of catabolic pathways involved in the oxidation of organic and inorganic molecules, and energy metabolism involving inputs from light or other non-light sources. Central metabolism and glycolysis, fermentation, aerobic and anaerobic respiration, photosynthesis.

BBMB 506. Membrane Biochemistry.(2-0) Cr. 2. *Prereq: CHEM 332 or equivalent*

Analysis of the structure, function, and synthesis of membranes. Bacterial and eukaryotic membrane characteristics. Membrane transport and signaling mechanisms. Analysis of the structure and function of lipids and membrane proteins.

BBMB 507. Biochemistry of Nucleic Acids.(2-0) Cr. 2. S. *Prereq: CHEM 332 or equivalent*

Analysis of the chemical structure, function, synthesis, and metabolism of nucleic acids. Chemical characterization of nucleotides, polynucleotides, DNA, and RNA. Analysis of transcription, translation, and the genetic code.

BBMB 530. Prokaryotic Diversity and Ecology.(Dual-listed with BBMB 430). (Cross-listed with MICRO). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: MICRO 302, MICRO 302L*

Survey of the diverse groups of prokaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

BBMB 542. Introduction to Molecular Biology Techniques.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

BBMB 542A. Introduction to Molecular Biology Techniques: DNA Techniques.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

BBMB 542B. Introduction to Molecular Biology Techniques: Protein.(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.SS. *Prereq: Graduate classification*

Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

BBMB 542C. Introduction to Molecular Biology Techniques: Cell Techniques.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

BBMB 542D. Introduction to Molecular Biology Techniques: Plant Transformation.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Includes *Agrobacterium* and particle gun-mediated transformation of tobacco, *Arabidopsis*, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

BBMB 542E. Introduction to Molecular Biology Techniques: Proteomics.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

BBMB 542F. Introduction to Molecular Biology Techniques: Metabolomics.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

BBMB 542G. Introduction to Molecular Biology Techniques: Genomic.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

BBMB 552. Biomolecular NMR Spectroscopy.(2-0) Cr. 2. Alt. F., offered even-numbered years. *Prereq: CHEM 325 or permission of instructor*

Advanced solution state Nuclear Magnetic Resonance spectroscopy as applied to biological systems. Topics include theoretical principles of NMR, practical aspects of experimental NMR, methodologies for protein structure determination, NMR relaxation, recent advances in NMR spectroscopy.

BBMB 561. Molecular Biophysics.(Dual-listed with BBMB 461). (2-0) Cr. 2. S. *Prereq: Credit or enrollment in MATH 166 and CHEM 178 and PHYS 222 or PHYS 112.*

Physical methods for the study of molecular structure and organization of biological materials. X-ray diffraction, nuclear magnetic resonance, hydrodynamics and fluorescence spectroscopy. Registration for the graduate credit commits the student to graduate-level examinations, which differ from undergraduate-level examinations in the number and/or difficulty of questions.

BBMB 561L. Laboratory in Molecular Biophysics.(1-3) Cr. 2. S. *Prereq: Credit or enrollment in BBMB 461/BBMB 561*

Practice in methods of X-ray diffraction, nuclear magnetic resonance, hydrodynamics and fluorescence spectroscopy as applied to macromolecules.

BBMB 569. Bioinformatics III (Structural Genome Informatics).(Cross-listed with BCB, COM S, CPR E). (3-0) Cr. 3. F. *Prereq: BCB 567, GEN 411, STAT 430*

Algorithmic and statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

BBMB 590. Special Topics.Cr. arr.
By arrangement.**BBMB 593. Workshop in Biochemistry and Biophysics.**Cr. 1. Repeatable. F.S. *Prereq: Permission and signature of course administrator required.*

Workshops in selected topics in biochemistry and biophysics. Credit in this course does not meet the requirement for advanced graduate electives in Biochemistry. Spring only: BBMB Undergraduate Research Symposium participation. Scheduled class meetings are required in addition to attending the symposium.

Courses for graduate students:**BBMB 607. Plant Biochemistry.**(2-0) Cr. 2. Alt. F., offered even-numbered years. *Prereq: BBMB 405 or BBMB 502*

Description of unique aspects of plant biochemistry including lipid metabolism, cell wall structure, secondary metabolism, phytoalexin biosynthesis, and plant defenses.

BBMB 615. Molecular Immunology.(Cross-listed with MICRO, V MPM). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: BBMB 405 or BBMB 502*

Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signaling pathways leading to expression of genes that control and activate immune function.

BBMB 622. Carbohydrate Chemistry.(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: BBMB 404 or BBMB 501*

Structure, occurrence, properties, function, and chemical and enzymatic modifications of monosaccharides, oligosaccharides, polysaccharides, and glycoproteins.

BBMB 632. Kinetics of Enzyme Action.

(2-0) Cr. 2. Alt. F., offered even-numbered years. *Prereq: BBMB 501*

Fundamental and advanced enzyme kinetics. Topics include integrated rate equations, methods for deriving initial-rate equations, inhibition, product effects, methods for verifying kinetic mechanisms, allostery, hysteresis, isotope effects, and complex kinetic mechanisms.

BBMB 642. Mechanisms of Enzymatic Catalysis.

(2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq: BBMB 404, BBMB 420, or BBMB 501*

The chemical basis of enzymatic catalysis with emphasis on mechanisms of substrate recognition, general acid-base catalysis and stereo-electronic factors.

BBMB 645. Molecular Signaling.

(2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq: BBMB 405, BBMB 420, or BBMB 502*

Molecular mechanisms of cellular signaling including receptor activation, desensitization and cross talk, signal transduction pathways, and nuclear receptors. Discussion includes a variety of cell surface receptors and their hormone; growth factor and extracellular matrix activators; protein kinases; caspase and transcription factor downstream signals; lipids, gases and cyclic nucleotides as regulators of cell signaling. Course content includes current literature, student and instructor presentations and research proposal writing.

BBMB 652. Protein Chemistry - Chemical Methods.

(2-0) Cr. 1. Alt. F., offered odd-numbered years. *Prereq: BBMB 404 or BBMB 501*
First 8 weeks. Chemical reactions as a means of determining protein structure and biological function.

BBMB 653. Protein Chemistry - Physical Methods.

(2-0) Cr. 1. Alt. F., offered odd-numbered years. *Prereq: BBMB 404 or BBMB 501*
Second 8 weeks. Protein structure determination as a means of understanding biological function.

BBMB 660. Membrane Biochemistry.

(2-0) Cr. 2. Alt. F., offered even-numbered years. *Prereq: BBMB 405 or BBMB 502*

Protein and lipid constituents of biological membranes. Structure and topography of membrane proteins. Selected topics concerning the membrane proteins involved in diverse biochemical processes, such as energy transduction transport across membranes, neurotransmission and signal transduction.

BBMB 661. Current Topics in Neuroscience.

(Cross-listed with GDCB, NEURO). (2-0) Cr. 2-3. Repeatable. Alt. S., offered even-numbered years. *Prereq: NEURO 556 (or comparable course) or permission of instructor*

Topics may include molecular and cellular neuroscience, neurodevelopment, neuroplasticity, neurodegenerative diseases, cognitive neuroscience, sensory biology, neural integration, membrane biophysics, neuroethology, techniques in neurobiology and behavior.

BBMB 675. Nucleic Acid Structure and Function.

(2-0) Cr. 2. Alt. F., offered even-numbered years. *Prereq: BBMB 405 or BBMB 502*

In-depth discussion of nucleic acid properties, structures and structure/function relationships. Interactions between nucleic acids and proteins will be emphasized.

BBMB 676. Biochemistry of Gene Expression in Eucaryotes.

(Cross-listed with MCDB). (2-0) Cr. 2. Alt. S., offered even-numbered years.
Prereq: BBMB 404 or BBMB 501, BBMB 405 or BBMB 502 or GDCB 511

Analysis of the biochemical processes involved in expression of eucaryotic genes and the regulation thereof, including RNA polymerase, transcriptional regulatory proteins, enhancers and silencers, chromosome structure, termination, RNA processing, RNA transport, RNA turnover, small RNAs translational regulation, protein turnover.

BBMB 681. Advanced Seminar.

Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor*
Student presentations.

BBMB 682. Departmental Seminar.

Cr. R. F.S. *Prereq: Permission of instructor*
Faculty, staff and invited guest research seminar.

BBMB 696. Research Seminar.

(Cross-listed with AGRON, FOR, GDCB, HORT, PLBIO). Cr. 1. Repeatable. F.S.
Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

BBMB 698. Seminar in Molecular, Cellular, and Developmental Biology.

(Cross-listed with GDCB, MCDB, MICRO, V MPM). (2-0) Cr. 1-2. Repeatable. F.S.
Student and faculty presentations.

BBMB 699. Research.

Cr. arr. Repeatable. F.S. *Prereq: Permission of instructor*

Bioinformatics and Computational Biology (BCB)

Courses primarily for undergraduates:

BCB 444. Introduction to Bioinformatics.

(Dual-listed with BCB 544). (Cross-listed with BCBIO, BIOL, COM S, CPR E, GEN). (4-0) Cr. 4. F. *Prereq: MATH 165 or STAT 401 or equivalent*
Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics, systems biology.

BCB 490. Independent Study.

Cr. 1-5. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Permission of instructor*

Courses primarily for graduate students, open to qualified undergraduates:

BCB 544. Introduction to Bioinformatics.

(Dual-listed with BCB 444). (Cross-listed with COM S, CPR E, GDCB). (4-0) Cr. 4. F. *Prereq: MATH 165 or STAT 401 or equivalent*
Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative, functional genomics, and systems biology.

BCB 567. Bioinformatics I (Fundamentals of Genome Informatics).

(Cross-listed with COM S, CPR E). (3-0) Cr. 3. F. *Prereq: COM S 228; COM S 330; STAT 341; credit or enrollment in BIOL 315, STAT 430*
Biology as an information science. Review of algorithms and information processing. Generative models for sequences. String algorithms. Pairwise sequence alignment. Multiple sequence alignment. Searching sequence databases. Genome sequence assembly.

BCB 568. Bioinformatics II (Advanced Genome Informatics).

(Cross-listed with COM S, GDCB, STAT). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, BIOL 315, STAT 430, credit or enrollment in GEN 411*
Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

BCB 569. Bioinformatics III (Structural Genome Informatics).

(Cross-listed with BBMB, COM S, CPR E). (3-0) Cr. 3. F. *Prereq: BCB 567, GEN 411, STAT 430*
Algorithmic and statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

BCB 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology).

(Cross-listed with COM S, CPR E, GDCB, STAT). (3-0) Cr. 3. S. *Prereq: BCB 567, BIOL 315, COM S 311 and either 208 or 228, GEN 411, STAT 430*
Algorithmic and statistical approaches in computational functional genomics and systems biology. Elements of experiment design. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Multi-scale, multi-granularity models. Ontology-driven, network based, and probabilistic approaches to information integration.

BCB 590. Special Topics.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

BCB 593. Workshop in Bioinformatics and Computational Biology.

(1-0) Cr. 1. Repeatable. F.S.
Current topics in bioinformatics and computational biology research. Lectures by off-campus experts. Students read background literature, attend preparatory seminars, attend all lectures, meet with lecturers.

BCB 598. Cooperative Education.

Cr. R. Repeatable. F.S.SS. *Prereq: Permission of the program chair*
Off-campus work periods for graduate students in the field of bioinformatics and computational biology.

BCB 599. Creative Component.

Cr. arr.

Courses for graduate students:

BCB 660. Selected Topics in Bioinformatics and Computational Biology.

(3-0) Cr. 1-4. Repeatable, maximum of 4 times. F.S.SS. *Prereq: Permission of Instructor*

Topics of interest in the major research areas of computational molecular biology, including genomics, structural genomics, functional genomics, and computational systems biology.

BCB 690. Student Seminar in Bioinformatics and Computational Biology.

Cr. 1. Repeatable. S.
Student research presentations.

BCB 691. Faculty Seminar in Bioinformatics and Computational Biology.

(1-0) Cr. 1. Repeatable.
Faculty research series.

BCB 697. Graduate Research Rotation.

Cr. arr. Repeatable. F.S.SS.
Graduate research projects performed under the supervision of selected faculty members in the Bioinformatics and Computational Biology major.

BCB 699. Research.

Cr. arr. Repeatable.

Bioinformatics and Computational Biology (BCBIO)

Courses primarily for undergraduates:

BCBIO 110. BCBIO Orientation.

(1-0) Cr. 0.5. F.

First 8 weeks. Orientation to the area of bioinformatics and computational biology. For students considering a major in BCBIO. Specializations and career opportunities. Offered on a satisfactory-fail basis only.

BCBIO 211. Introduction to Bioinformatics and Computational Biology.

(3-0) Cr. 3. S.

Perl programming, molecular biology, biological databases, sequence alignment, homology search, identification of sequence patterns, construction of phylogenetic trees, gene function prediction, gene structure prediction, genomic annotation and comparative genomics.

BCBIO 401. Fundamentals of Bioinformatics and Computational Biology I.

(3-0) Cr. 3. F. *Prereq: BCBIO 211 and basic programming experience (e.g. COM S 207, COM S 208, COM S 227 or permission of instructor)*

Application of computer science to molecular biology. String algorithms, sequence alignments, indexing data structures, homology search methods, pattern recognition, fragment assembly, genome annotation, construction of bioinformatics databases, and gathering and distribution of biological information with the Internet.

BCBIO 402. Fundamentals of Bioinformatics and Computational Biology II.

(3-0) Cr. 3. S. *Prereq: BCBIO 401*

Genomics: Gene structure prediction, gene function prediction and comparative genomics. Post-genomics: Gene expression studies, DNA microarrays, next-generation sequencing of transcriptome. Structural biology: Protein and RNA structure predictions, structure representation, comparison and visualization. Systems biology: Signal transduction pathway inference, biological networks and systems.

BCBIO 442. Bioinformatics and Computational Biology Techniques.

(0.2-0.5) Cr. 0.5. Repeatable, maximum of 2 credits. S.SS. *Prereq: BIOL 314 recommended*

Modular minicourses consisting of guided tutorials and hands-on computer software exercises focused on fundamental problems, approaches, and software applications in bioinformatics and computational biology. Offered on a satisfactory-fail basis only.

BCBIO 442A. Bioinformatics and Computational Biology Techniques: Sequence Database Searching.

(0.2-0.5) Cr. 0.5. Repeatable, maximum of 2 credits. S.SS. *Prereq: BIOL 314 recommended*

Modular minicourses consisting of guided tutorials and hands-on computer software exercises focused on fundamental problems, approaches, and software applications in bioinformatics and computational biology. Offered on a satisfactory-fail basis only.

BCBIO 442B. Bioinformatics and Computational Biology: Protein Structure Databases, Visualization, and Prediction.

(0.2-0.5) Cr. 0.5. Repeatable, maximum of 2 credits. S.SS. *Prereq: BIOL 314 recommended*

Modular minicourses consisting of guided tutorials and hands-on computer software exercises focused on fundamental problems, approaches, and software applications in bioinformatics and computational biology. Offered on a satisfactory-fail basis only.

BCBIO 442C. Bioinformatics and Computational Biology Techniques: Phylogenetic Analysis.

(0.2-0.5) Cr. 0.5. Repeatable, maximum of 2 credits. S.SS. *Prereq: BIOL 314 recommended*

Modular minicourses consisting of guided tutorials and hands-on computer software exercises focused on fundamental problems, approaches, and software applications in bioinformatics and computational biology. Offered on a satisfactory-fail basis only.

BCBIO 442D. Bioinformatics and Computational Biology Techniques: Microarray Analysis.

(0.2-0.5) Cr. 0.5. Repeatable, maximum of 2 credits. S.SS. *Prereq: BIOL 314 recommended*

Modular minicourses consisting of guided tutorials and hands-on computer software exercises focused on fundamental problems, approaches, and software applications in bioinformatics and computational biology. Offered on a satisfactory-fail basis only.

BCBIO 444. Introduction to Bioinformatics.

(Cross-listed with BCB, BIOL, COM S, CPR E, GEN). (4-0) Cr. 4. F. *Prereq: MATH 165 or STAT 401 or equivalent*

Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics, systems biology.

BCBIO 490. Independent Study.

Cr. 1-5. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: BCBIO 211, junior or senior classification, permission of instructor*

Students in the College of Liberal Arts and Sciences may use no more than 9 credits of BCBIO 490 and 491 toward graduation.

BCBIO 491. Team Research Projects.

Cr. 1-5. Repeatable, maximum of 9 credits. *Prereq: BCBIO 211, junior or senior classification, permission of instructor*

Research projects in bioinformatics and computational biology done by teams of students. Students in the College of Liberal Arts and Sciences may use no more than 9 credits of BCBIO 490 and 491 toward graduation.

Biological/Pre-Medical Illustration (BPM I)

Courses primarily for undergraduates:

BPM I 323. Scientific Illustration Principles and Techniques.

(Cross-listed with ARTIS). (0-6) Cr. 3. Repeatable. *Prereq: 6 credits in art and design and 3 credits in biological sciences*

Studio basics and professional techniques in black & white, continuous tone, and color. Emphasis on tools, materials, and rendering.

BPM I 326. Illustration and Illustration Software.

(Cross-listed with ARTIS). (0-6) Cr. 3. Repeatable. *Prereq: ARTIS 323*

Application of painting, drawing, and image making techniques to communication. Development of technical abilities using illustration software. Digital and print production techniques.

BPM I 327. Illustration as Communication.

(Cross-listed with ARTIS). (0-6) Cr. 3. *Prereq: ARTIS 326*

Studio problems in illustration emphasizing composition and communication. Problem solving methodologies.

BPM I 337. Application of Scientific Illustration Techniques.

(Cross-listed with ARTIS). (0-6) Cr. 3. Repeatable, maximum of 6 credits. S.

Prereq: ARTIS 327

Rendering techniques applied to different types of biological and scientific subjects emphasizing communication. The use of traditional and digital media. Term project required.

BPM I 395. Field Illustration.

Cr. 1-3. Repeatable, maximum of 6 credits. S.S.S. *Prereq: Permission of instructor*

A combination seminar and field trip course emphasizing nature interpretation, field sketching techniques and preparation of a final illustration based on field experience.

BPM I 398. Cooperative Education.

Cr. R. F.S.S.S. *Prereq: Permission of the program cooperative education coordinator, junior classification*

Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

BPM I 435I. Illustrating Nature I Sketching.

(Cross-listed with IA LL). Cr. 2. SS.

Sketching plants, animals and terrain. Visual communication, development of a personal style, and integration of typographic and visual elements on a page will be emphasized.

BPM I 436I. Illustrating Nature II Photography.

(Cross-listed with IA LL). Cr. 2. SS.

Beginning to intermediate technical and compositional aspects of color photography of natural areas and their plants and animals.

BPM I 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 3 credits. *Prereq: Written approval of instructor and advisory committee chair on required form in advance of semester of enrollment*

BPM I 494. Special Topics in Illustration.

Cr. 1-3. Repeatable.

Intensive exploration of illustration techniques in a studio or field setting.

BPM I 497. Illustration Internship.

Cr. 1-6. Repeatable, maximum of 6 credits. *Prereq: Junior or senior classification in BPM I, written approval of supervising instructor and advisory committee chair on required form in advance of semester of enrollment*

Offered on a satisfactory-fail basis only.

Biology (BIOL)

Courses primarily for undergraduates:

BIOL 101. Introductory Biology.

(3-0) Cr. 3. F.S.SS.

Life considered at cellular, organism, and population levels. Function and diversity of the living world. Presentation of basic biological principles as well as topics and issues of current human interest. Does not satisfy biology major requirements.

BIOL 110. Introduction to Biology.

Cr. 1. F.

Orientation to the scope of the biological sciences, and discussion of professional opportunities. Required of first year biology majors. Offered on a satisfactory-fail basis only.

BIOL 111. Opportunities in Biology.

(1-0) Cr. 0.5. S.

Introduction to biological science disciplines and professional opportunities through faculty presentations which examine a variety of current research topics. Offered on a satisfactory-fail basis only.

BIOL 112. Transfer Student Orientation.

Cr. R. F.S.

Orientation to opportunities in Biology. Review of degree requirements and other information needed by students that have not participated in the first year Biology orientation courses. Offered on a satisfactory-fail basis only.

BIOL 155. Human Biology.

(3-0) Cr. 3. F.S.

A survey course of human biology, including principal structures and functions of the body systems and the diseases and disorders associated with them. Designed to meet general education requirements in natural science. Not recommended for those seeking a career in the allied health professions or for students majoring in life science. Does not satisfy biology major requirements.

BIOL 173. Environmental Biology.

(Cross-listed with ENV S). (3-0) Cr. 3. F.S.

An introduction to the structure and function of natural systems at scales from the individual to the biosphere and the complex interactions between humans and their environment. Discussions of human population growth, biodiversity, sustainability, resource use, and pollution. Does not satisfy biology major requirements.

BIOL 201. Introduction to Environmental Issues.

(Cross-listed with ENSCI, ENV S). (2-0) Cr. 2. F.

Discussion of current and emerging environmental issues such as human population growth, energy use, loss of biodiversity, water resources, and climate change.

BIOL 204. Biodiversity.

(Cross-listed with ENV S). (4-0) Cr. 2. S. Prereq: One course in life sciences

Survey of the major groups of organisms and biological systems. Definition, measurements, and patterns of distribution of organisms. Sources of information about biodiversity. Does not satisfy biology major requirements. Half semester course.

BIOL 211. Principles of Biology I.

(3-0) Cr. 3. F.S. Prereq: High school biology

Introduction to the nature of life, including the diversity of microbial, plant, and animal life; the nature of heredity; evolution; and principles of ecology. Intended for life science majors.

BIOL 211L. Principles of Biology Laboratory I.

(0-3) Cr. 1. F.S. Prereq: Credit or enrollment in BIOL 211

Laboratory to accompany 211.

BIOL 212. Principles of Biology II.

(3-0) Cr. 3. F.S. Prereq: High School Biology; high school chemistry or credit or enrollment in CHEM 163 or CHEM 177

Introduction to the chemical, molecular, and cellular basis of life; form and function of microbial, plant, and animal life. Intended for life science majors.

BIOL 212L. Principles of Biology Laboratory II.

(0-3) Cr. 1. F.S. Prereq: credit or enrollment in BIOL 212

Laboratory to accompany 212.

BIOL 251. Biological Processes in the Environment.

(Cross-listed with ENSCI). (3-0) Cr. 3. S.

Plant and microbial processes in environmental systems including their interactions with human activities.

BIOL 255. Fundamentals of Human Anatomy.

(3-0) Cr. 3. F. Prereq: High School Biology and Chemistry, or BIOL 101

An introduction to human anatomy, beginning with cells and tissues, surveying all body systems, relating form to function. Systems covered include: integumentary, bones and joints, muscles, nervous, sensory, endocrine, circulatory, lymphatic, respiratory, digestive, urinary, and reproductive. Pre-Medical students should consider BIOL 351 for their anatomy background. Does not satisfy biology major requirements.

BIOL 255L. Fundamentals of Human Anatomy Laboratory.

(0-3) Cr. 1. F. Prereq: Credit or enrollment in BIOL 255

Investigation of human anatomy using models and dissections of preserved organs and model mammals. Pre-Medical students should consider 351 for their anatomy background. Does not satisfy biology major requirements.

BIOL 256. Fundamentals of Human Physiology.

(3-0) Cr. 3. S. Prereq: High School Biology and Chemistry, or BIOL 101, or BIOL 255 (recommended)

An introduction to human physiology, studying the function of all body systems. Systems covered include: integumentary, bones and joints, muscles, nervous, sensory, endocrine, circulatory, lymphatic and immune, respiratory, digestive, urinary, and reproductive. Pre-Medical students should consider 335 for their physiology background. Does not satisfy biology major requirements.

BIOL 256L. Fundamentals of Human Physiology Laboratory.

(0-3) Cr. 1. S. Prereq: Credit or enrollment in BIOL 256

Student-conducted experiments investigating concepts of human physiology with computer data acquisition and analysis. Interpretation of experimental results and preparation of lab reports. Pre-Medical students should consider 335 for their anatomy and physiology background. Does not satisfy biology major requirements.

BIOL 258. Human Reproduction.

(Cross-listed with W S). (3-0) Cr. 3. F. Prereq: BIOL 101, or BIOL 155, or BIOL 211

Anatomy and physiology of human reproductive systems, including fertility, pregnancy, and delivery. Does not satisfy biology major requirements.

BIOL 306. Metabolic Physiology of Mammals.

Cr. 3. Prereq: BIOL 211, BIOL 212

Introduction to physiology of metabolic function in mammals and other animals. Metabolic processes and their interactions with various subsystems, approached from an organismal perspective. Integration of cellular, gastrointestinal, cardiovascular, respiratory, and renal processes, relevant to their control and integration at the nervous and endocrine system levels. Functional aspects of organismal physiology; energy and water balances, physiology of rest exercise, and environmental stress. Students cannot receive credit for both BIOL 306 and BIOL 335.

BIOL 307. Women in Science and Engineering.

(Cross-listed with W S). (3-0) Cr. 3. F. Prereq: a 200 level course in science, engineering or women's studies; ENGL 250

The interrelationships of women and science and engineering examined from historical, sociological, philosophical, and biological perspectives. Factors contributing to under-representation; feminist critiques of science; examination of successful strategies. Does not satisfy biology major advanced credit requirements.

Meets U.S. Diversity Requirement

BIOL 312. Ecology.

(Cross-listed with A ECL, ENSCI). (3-3) Cr. 4. F.SS. Prereq: BIOL 211, BIOL 211L, BIOL 212, and BIOL 212L

Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

BIOL 313. Principles of Genetics.

(Cross-listed with GEN). (3-0) Cr. 3. F.S.SS. Prereq: BIOL 211, BIOL 211L, BIOL 212, and BIOL 212L

Introduction to the principles of transmission and molecular genetics of plants, animals, and bacteria. Recombination, structure and replication of DNA, gene expression, cloning, quantitative and population genetics. Students may receive graduation credit for no more than one of the following: Gen 260, Gen 313 and 313L, Gen 320, Biol 313 and 313L, and Agron 320.

BIOL 313L. Genetics Laboratory.

(Cross-listed with GEN). (0-3) Cr. 1. F.S. Prereq: Credit or enrollment in BIOL 313 Laboratory to accompany 313. Students may receive graduation credit for no more than one of the following: Biol 313 and 313L, Gen 260, Gen 313, Gen 320, and Agron 320.

BIOL 314. Principles of Molecular Cell Biology.

(3-0) Cr. 3. F.S. *Prereq: BIOL 211, BIOL 211L, BIOL 212, and BIOL 212L.*
Integration of elementary principles of metabolism, bioenergetics, cell structure and function to develop a molecular view of how the cell works.

BIOL 315. Biological Evolution.

(3-0) Cr. 3. F.S. *Prereq: BIOL 211, BIOL 211L, BIOL 212, BIOL 212L. Biol 313 recommended.*

The mechanisms of evolution. Topics in microevolution: population genetics, natural selection, genetic variation, and adaptation. Macroevolution: speciation, extinction, phylogeny, and major evolutionary patterns.

BIOL 328. Molecular and Cellular Biology of Human Diseases.

Cr. 3. F. *Prereq: BIOL 212*

Survey of molecular, genetic and cellular aspects of human diseases. Fundamental concepts of cell biology and how they are linked to the pathologies of different classes of human diseases. Recent scientific advances with an emphasis on new methods of diagnosis and treatment.

BIOL 330. Principles of Plant Physiology.

(3-0) Cr. 3. *Prereq: BIOL 313 or GEN 320; BIOL 314 or BBMB 301; CHEM 231 or CHEM 332; PHYS 106, PHYS 115, or PHYS 111*

An overview of classical and current concepts, principles and approaches regarding the basic mechanisms of plant function underlying growth, development and survival of plants. Topics covered include environmental and developmental signals, plant hormone action, signal transduction, mineral nutrition, water relations, metabolism and photosynthesis.

BIOL 335. Principles of Human and Other Animal Physiology.

(3-3) Cr. 4. F.S. *Prereq: BIOL 314*

Introduction to systemic functions with emphasis on mammals.

BIOL 336. Ecological and Evolutionary Animal Physiology.

Cr. 3. *Prereq: BIOL 211, BIOL 212*

Study of mechanisms by which animals perform life-sustaining functions; the evolution and adaptive significance of physiology traits, the diversity of physiological mechanisms, and how physiology and ecology interact.

BIOL 349. The Genome Perspective in Biology.

(Cross-listed with GEN, MICRO, V PTH). (2-0) Cr. 2. S. *Prereq: GEN 313 or GEN 320*

Analysis of genome, RNA, and protein data using computer technology to answer biological questions on topics ranging from microbial diversity to human health. An introduction for students in the life sciences to the fields of genomics, bioinformatics and systems.

BIOL 350. Comprehensive Human Anatomy.

(3-0) Cr. 3. F. *Prereq: Credit in BIOL 211 and BIOL 212*

Comprehensive survey of human anatomy, emphasizing structural and functional relationships of major organ systems. Compartmental study of normal anatomy; practical clinical application of anatomical regions.

BIOL 351. Comparative Chordate Anatomy.

(3-4) Cr. 5. S. *Prereq: BIOL 212, junior classification*

The evolution of chordates as reflected in the anatomy of extinct and living forms. Lecture topics include the history and diversity of chordates; comparisons of anatomic structures among major groups, the adaptive significance of anatomic structures. Laboratory involves dissection of representative species.

BIOL 352. Vertebrate Histology.

(3-3) Cr. 4. S. *Prereq: BIOL 212*

Microscopic structure of vertebrate tissues and organs, with an introduction to histological techniques.

BIOL 353. Introductory Parasitology.

(Cross-listed with MICRO, V PTH). (3-0) Cr. 3. S. *Prereq: BIOL 212*

Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites.

BIOL 354. Animal Behavior.

(3-0) Cr. 3. F. *Prereq: BIOL 212*

Ethological and sociobiological approaches to animal behavior. Genetic and developmental aspects of behavior, biological rhythms, orientation (including navigation, migration), communication, and social behavior (mating, aggression, parental care).

BIOL 354L. Laboratory in Animal Behavior.

(0-3) Cr. 1. F. *Prereq: Credit or enrollment in BIOL 354*

Laboratory techniques for observation, description and analysis of animal activities; independent projects.

BIOL 355. Plants and People.

(3-0) Cr. 3. S. *Prereq: Credit in BIOL 211 and BIOL 211L*

Uses of plants and fungi by humans and the importance of plants in the past, present and future. Discussion of fruits, vegetables, grains, herbs, spices, beverages, oils, fibers, wood, medicines, and drugs, in the context of their agricultural, cultural, and economic roles in modern societies. Emphasis on origins and worldwide diversity of culturally important plants, their characteristics, and uses.

BIOL 356. Dendrology.

(Cross-listed with FOR). (2-4) Cr. 4. F. *Prereq: BIOL 211*

Identification and ecology of North American woody plant species. Importance of woody plants in timber production and wildlife habitat. Natural disturbances, human impacts, management and restoration concerns for major North American forest regions will be addressed.

BIOL 364. Invertebrate Biology.

Cr. 3-4. F. *Prereq: BIOL 212*

Emphasis on diversity, development, physiology and behavior of invertebrate organisms- the "spineless wonders" of the world. Laboratory involves hands-on study and investigation of living invertebrates.

BIOL 365. Vertebrate Biology.

(Cross-listed with A ECL). (3-2) Cr. 4. F. *Prereq: BIOL 212, BIOL 212L*

Evolution, biology, and classification of fish, amphibians, reptiles, birds, and mammals. Emphasis on a comparative analysis of the structure and function of organ systems. Laboratory exercises concentrate on morphology and identification of orders of vertebrates.

BIOL 366. Plant Systematics.

(2-4) Cr. 4. S. *Prereq: BIOL 211*

Introduction to plant phylogenetic systematics, plant classification, survey of flowering plant families, identification and field study of local plants.

BIOL 371. Ecological Methods.

(Cross-listed with A ECL). (2-3) Cr. 3. S. *Prereq: A ECL 312; STAT 101 or STAT 104*

Quantitative techniques used in management of natural resources with emphasis on inventory and manipulation of habitat and animal populations.

BIOL 381. Environmental Systems I: Introduction to Environmental Systems.

(Dual-listed with EEOB 581). (Cross-listed with ENSCI, ENV S, MICRO). Cr. 3-4.

F. *Prereq: 12 credits of natural science including biology and chemistry*

Introduction to the structure and function of natural environmental systems. Emphasis on the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

BIOL 382. Environmental Systems II: Analysis of Environmental Systems.

(Dual-listed with EEOB 582). (Cross-listed with ENSCI). (2-2) Cr. 3. S. *Prereq: ENSCI 381*

Continuation of EnSci 381. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

BIOL 393. North American Field Trips in Biology.

Cr. 1-4. Repeatable. *Prereq: Two courses in the biological sciences and by approval of application*

Extended field trips, usually during break periods, to North American locations of interest to biologists. Inquire in the Biology Program Office, 103 Bessey Hall, for trip schedule.

BIOL 393A. North American Field Trips in Biology: Pre-trip Seminar.

(1-0) Cr. 1. Repeatable. *Prereq: Two courses in the biological sciences and by approval of application*

Discussion of relevant biological and cultural topics during semester preceding extended field trips to North American locations of interest to biologists.

BIOL 393B. North American Field Trips in Biology: North American Field trip.

Cr. 1-3. Repeatable. *Prereq: Two courses in the biological sciences and by approval of application*

Extended field trip to North American location under supervision of faculty member, usually during break periods, to North American locations of interest to biologists. Inquire in the Biology Program Office, 103 Bessey Hall, for trip schedule. Report required.

BIOL 394. International Field Trips in Biology.

Cr. 1-4. Repeatable. *Prereq: Two courses in the biological sciences and by approval of application*

Extended field trips, usually during break periods, to international locations of interest to biologists. Inquire in the Biology Program Office, 103 Bessey Hall, for trip schedule.

Meets International Perspectives Requirement.

BIOL 394A. International Field Trips in Biology: Pre-trip Seminar.

(1-0) Cr. 1. Repeatable. *Prereq: Two courses in the biological sciences and by approval of application*

Discussion of relevant biological and cultural topics during semester preceding extended field trip to international locations of interest to biologists.

BIOL 394B. International Field Trips in Biology: Field Trip to International Location.

Cr. 1-3. Repeatable. *Prereq: Two courses in the biological sciences and by approval of application*

Extended field trips, under supervision of faculty member, usually during break periods, to international locations of interest to biologists. Inquire in the Biology Program Office, 103 Bessey Hall, for trip schedule. Offered on a satisfactory-fail basis only.

BIOL 402. Introduction to Pathology.

(Cross-listed with V PTH). (3-0) Cr. 3. S. *Prereq: BIOL 211 and BIOL 212 with labs*

Introductory exploration of pathology as a medical discipline. This includes study of disease mechanisms via an introduction to general pathology topics (cell degeneration, necrosis, disturbances of growth, disturbances of blood flow, inflammation, neoplasia) and organ system-specific response to injury.

BIOL 414. Life History and Reproductive Strategies.

(Dual-listed with EEOB 514). (3-0) Cr. 3. F. *Prereq: BIOL 315 or equivalent recommended.*

Evolution of ecological adaptations at the individual, population, and species level. Emphasis is on evolutionary mechanisms and adaptive strategies related to life histories and reproduction; age and size at maturity; lifespan and senescence; offspring size/number trade-offs; sex and mating systems; sex determination and sex ratios.

BIOL 423. Developmental Biology.

(3-0) Cr. 3. S. *Prereq: BIOL 313*

Principles of embryogenesis and animal development. Establishment of body axes, organ and limb development, and specification of cell fates. Emphasis on cell signaling and the control of gene expression within the context of a developing organism. Medically relevant subjects will be discussed, including stem cells, cancer biology, fertilization, and cloning.

BIOL 423L. Developmental Biology Laboratory.

(0-3) Cr. 1. S. *Prereq: Credit or enrollment in BIOL 423*

Experiments and explorations illustrating fundamental principles of multicellular development.

BIOL 428. Topics in Cell Biology.

(3-0) Cr. 3. S. *Prereq: BIOL 314*

Selected topics on biological organization and function at the cellular level. Emphasis on biomembranes.

BIOL 434. Endocrinology.

(Dual-listed with EEOB 534). (3-0) Cr. 3. S. *Prereq: BIOL 211, BIOL 212*

Chemical integration of vertebrate organisms. The structure, development, and evolution of the endocrine glands and the function and structure of their hormones.

BIOL 436. Neurobiology.

(3-0) Cr. 3. F. *Prereq: BIOL 212*

Basic principles of brain function and development. Signaling of nerve cells, synaptic transmission, structure/function of ion channels and receptors, memory and synaptic plasticity, movement and central control, sensation and sensory processing, construction of neural circuits, early brain development, complex brain functions in health and disease.

BIOL 439. Environmental Physiology.

(Dual-listed with EEOB 539). Cr. 3-4. Alt. S., offered even-numbered years.

Prereq: BIOL 335; physics recommended

Physiological adaptations to the environment with an emphasis on vertebrates.

BIOL 444. Introduction to Bioinformatics.

(Dual-listed with EEOB 544). (Cross-listed with BCB, BCBO, COM S, CPR E, GEN). (4-0) Cr. 4. F. *Prereq: MATH 165 or STAT 401 or equivalent*

Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics, systems biology.

BIOL 451. Plant Evolution and Phylogeny.

(Dual-listed with EEOB 551). (3-3) Cr. 4. F. *Prereq: BIOL 315 or equivalent.*

Survey of land plant evolution; phylogenetic comparison of anatomical, reproductive, and life history specializations. Relationships among bryophytes, lycophytes, pteridophytes, gymnosperms, and angiosperms emphasizing significant evolutionary changes documented by paleobotanical, morphological, and molecular studies.

BIOL 454. Plant Anatomy.

(3-3) Cr. 4. F. *Prereq: BIOL 212L; BIOL 366 recommended*

Characteristics of cell and tissue types in vascular plants. Anatomy of developing and mature stems, roots, and leaves, including secondary (woody) growth. Introduction to the special anatomy of flowers and seeds.

BIOL 455. Bryophyte and Lichen Biodiversity.

(Cross-listed with EEOB 555). Cr. 3. *Prereq: BIOL 211, BIOL 211L*

Introduction to the biology and ecology of mosses, liverworts, and lichens. Emphasis on identification and diversity of local representatives of these three groups of organisms. Required field trips and service-learning.

BIOL 456. Principles of Mycology.

(Cross-listed with MICRO). (2-3) Cr. 3. F. *Prereq: 10 credits in biological sciences*
Morphology, diversity, and ecology of fungi; their relation to agriculture, industry, and human health.

BIOL 457. Herpetology.

(Cross-listed with A ECL). (2-0) Cr. 2. F. *Prereq: BIOL 351 or BIOL 365*

Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

BIOL 457L. Herpetology Laboratory.

(Cross-listed with A ECL). (0-3) Cr. 1. F. *Prereq: BIOL 351 or BIOL/A ECL 365; concurrent registration in BIOL 457 or A ECL 457*

Laboratory to accompany Biology/Animal Ecology 457. Focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

BIOL 458. Ornithology.

(Cross-listed with A ECL). (2-0) Cr. 2. S. *Prereq: A ECL 365 or BIOL 351*

Biology, evolution, ecology and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation.

BIOL 458L. Ornithology Laboratory.

(Cross-listed with A ECL). (0-3) Cr. 1. S. *Prereq: BIOL 351 or AECL/BIOL 365.*

Concurrent enrollment in AECL/BIOL 458 is required.

Laboratory complements lecture topics with emphasis on external anatomy, identification and distribution of Midwest birds, and field trips.

BIOL 459. Mammalogy.

(Dual-listed with EEOB 559). (Cross-listed with A ECL). (2-0) Cr. 2. S. *Prereq: BIOL 351 or A ECL 365*

Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation.

BIOL 459L. Mammalogy Laboratory.

(Cross-listed with A ECL). (0-3) Cr. 1. S. *Prereq: BIOL 351 or BIOL/AECL 365; concurrent enrollment in AECL 459 or BIOL 459 required.*

Laboratory focus on identification, survey methods, distribution, habits, and habitats of mammals. Several field trips.

BIOL 462. Evolutionary Genetics.

(Cross-listed with GEN). (3-0) Cr. 3. F. *Prereq: BIOL 315*

The genetic basis of evolutionary processes in higher organisms. The role of genetic variation in adaptation, natural selection, adaptive processes, and the influence of random processes on evolutionary change.

BIOL 464. Wetland Ecology.

(Dual-listed with EEOB 564). (Cross-listed with ENSCI). (3-0) Cr. 3. S. *Prereq: 15 credits in biological sciences.*

Ecology, classification, creation and restoration, and management of wetlands. Emphasis on North American temperate wetlands.

BIOL 465. Morphometric Analysis.

(Dual-listed with EEOB 565). (3-2) Cr. 4. Alt. S., offered even-numbered years. *Prereq: STAT 401*

A comprehensive overview of the theory and methods for the analysis of biological shape with emphasis on data acquisition, standardization, statistical analysis, and visualization of results. Methods for both landmark and outline data will be discussed.

BIOL 471. Introductory Conservation Biology.

Cr. 3. Prereq: BIOL 312

Examination of conservation issues from a population and community perspective. The role of genetics, demography, and environment in determining population viability, habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology.

BIOL 472. Community Ecology.

(3-0) Cr. 3. S. Prereq: BIOL 312

The effect of interspecific interactions on the structure and dynamics of natural and managed communities; including concepts of guild structure and trophic web dynamics and their importance to the productivity, diversity, stability, and sustainability of communities. The implications of interspecific interactions in the management of wild species will be emphasized with illustrative case histories of interactions between plants, invertebrates, and vertebrates.

BIOL 474. Plant Ecology.

(3-0) Cr. 3. S. Prereq: BIOL 312

Principles of plant population and community ecology.

BIOL 476. Functional Ecology.

(Dual-listed with EEOB 576). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: BIOL 312

The nature of adaptations to physical and biotic environments. Biophysical, biomechanical, and physiological bases of the structure, form, growth, distribution, and abundance of organisms.

BIOL 480. Studies in Marine Biology.

Cr. 1-8. Repeatable.

Courses taken at Gulf Coast Research Laboratory and other marine biological stations are transferred to Iowa State University under this number.

BIOL 481. Summer Field Studies.

Cr. 1-8. Repeatable.

Courses taken at summer biological field stations are transferred to Iowa State University under this number. See www.biology.iastate.edu for links to field stations located in different biomes: coastal, Great Lakes, taiga, deciduous forests, deserts, Rocky Mountains.

BIOL 482. Tropical Biology.

Cr. 1-4. Repeatable, maximum of 8 credits. Prereq: One year of college biology; knowledge of Spanish desirable but not required

Students registering for courses taught by the Organization for Tropical Studies will receive credit for this ISU course when requesting a transfer of credits.

BIOL 484. Ecosystem Ecology.

(Cross-listed with ENSCI). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: Combined 12 credits in biology, chemistry, and physics.

Introduction of the study of ecosystems and the biological and physical factors that influence their properties and dynamics. Conceptual foundations for ecosystem studies. Interactions among organisms, biological diversity, and ecosystem attributes. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems. Global change issues.

BIOL 486. Aquatic Ecology.

(Dual-listed with EEOB 586). (Cross-listed with A ECL, ENSCI). (3-0) Cr. 3. F.

Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301

Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology.

BIOL 486L. Aquatic Ecology Laboratory.

(Cross-listed with A ECL, ENSCI). (0-3) Cr. 1. F. Prereq: Concurrent enrollment in BIOL 486

Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts.

BIOL 487. Microbial Ecology.

(Dual-listed with EEOB 587). (Cross-listed with ENSCI, MICRO). (3-0) Cr. 3. F.

Prereq: Six credits in biology and 6 credits in chemistry

Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

BIOL 488. Identification of Aquatic Organisms.

(0-3) Cr. 1. F.S.

On line taxonomic and identification exercises to accompany 486. Instruction and practice in the identification of algae, aquatic macrophytes, zooplankton, and benthos.

BIOL 489. Population Ecology.

(Dual-listed with EEOB 589). (2-2) Cr. 3. F. Prereq: BIOL 312, STAT 101 or STAT 104, a course in calculus, or graduate standing

Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

BIOL 490. Independent Study.

Cr. 1. Repeatable, maximum of 9 credits. F.S.SS. Prereq: Permission of instructor.

Independent study opportunities for undergraduate students in the biological sciences. No more than 9 credits in Biol 490 may be counted toward graduation and, of those, only 2 credits may be applied toward the Biology advanced course requirement.

BIOL 491. Undergraduate Teaching Experience.

Cr. 1-2. Repeatable. Prereq: Permission of supervising staff

For students registering to be undergraduate teaching assistants. Offered on a satisfactory-fail basis only. A maximum of 2 credits of BIOL 491 may be applied toward the Biology advanced course requirement.

BIOL 492. Preparing for Graduate School in the Biological Sciences.

(1-0) Cr. 1. F. Prereq: For life science majors; Minimum requirement: sophomore standing.

For students considering pursuing a graduate degree in the biological sciences. Professional development topics including the defining of academic and career areas of interest, finding and evaluating appropriate programs of graduate study, the graduate school application process, and developing a curriculum vita. Exploration of learning opportunities at field stations, research internships, and independent research activities.

BIOL 494. Biology Internship.

Cr. 1-3. Repeatable. F.S.SS. Prereq: 8 credits in biology and permission of instructor

Intended to provide credit for significant professional experiences in biological sciences. A written proposal is required prior to registration. Intended for Biology majors. No more than 9 credits in BIOL 494 may be counted toward graduation and, of those, only 6 credits may be applied toward the Biology advanced course requirement.

BIOL 495. Undergraduate Seminar.

Cr. 1-3. Repeatable. F.S. Prereq: Permission of instructor

Content varies from year to year and may include detailed discussion of special topics in biology, current issues in biology, or careers in biology.

BIOL 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. Prereq: Permission of the Biology Program cooperative education coordinator

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

BIOL 499. Undergraduate Research Experience.

Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. Prereq: Permission of instructor.

Research opportunities for undergraduate students in the biological sciences. Intended for Biology majors. No more than 9 credits in Biol 499 may be counted toward graduation and, of those, only 6 credits may be applied toward the Biology advanced course requirement.

Biomedical Engineering (B M E)

Courses primarily for undergraduates:

B M E 220. Introduction to Biomedical Engineering.

(Cross-listed with CH E). (3-0) Cr. 3. S. Prereq: *BIOL 212, ENGR 160 or equiv, MATH 166, CHEM 167 or CHEM 178, PHYS 222*

Engineering analysis of basic biology and engineering problems associated with living systems and health care delivery. The course will illustrate biomedical engineering applications in such areas as: biotechnology, biomechanics, biomaterials and tissue engineering, and biosignal and image processing, and will introduce the basic life sciences and engineering concepts associated with these topics.

B M E 341. BioMEMS and Nanotechnology.

(3-0) Cr. 3. Prereq: *B M E 220*

Overview of Micro-Electro-Mechanical-System (MEMS) technologies for bioengineering, fundamentals of microfluidic device design, fabrication, and characterization, survey of microfluidic functional building blocks for lab-on-a-chip applications including mixers, valves, channels, and chambers. Topics of nanotechnology in bioengineering, nanoscale building block technologies for bioengineering including self-assembling, surface chemical treatment, nano-imprinting, nano-particles, nano-tubes, nano-wires, and stimuli-responsive biomaterials.

B M E 341L. BioMEMS and Nanotechnology Laboratory.

(0-3) Cr. 1. Prereq: *B M E 220, concurrent enrollment in B M E 341*

Introductory laboratory course accompanying B M E 341. Design, fabrication, and characterization of BioMEMS lab-on-a-chip devices and nanoscale techniques for bioengineering. Student group projects.

B M E 352. Molecular, Cellular and Tissue Biomechanics.

(3-0) Cr. 3. Prereq: *B M E 220, E M 324, MAT E 273*

Introduction to the anatomy of the musculoskeletal system and connective tissue. Range of movement, joint dislocation, bone deformity and fracture. Application of continuum mechanics to both living and non-living systems. Laws of motion, free-body diagrams and simple force analysis of musculoskeletal system. Biomechanical response of soft and hard tissues with emphasis on microstructure and mechanical properties. Applications to bioengineering design.

B M E 428. Image Processing with Biomedical Applications.

(3-0) Cr. 3. Prereq: *E E 324*

Review of signal processing, linear algebra, probability. Image sampling and quantization. Image transforms, image enhancement, image denoising/restoration. Tomographic reconstruction, segmentation and registration, recognition and shape analysis and applications in Computer Aided disease Detection (CAD).

B M E 440. Biomedical Applications of Chemical Engineering.

(Cross-listed with CH E). (3-0) Cr. 3. Alt. F., offered odd-numbered years. Prereq: *CH E 210, MATH 266, PHYS 222*

Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging.

B M E 450. Biosensing.

(3-0) Cr. 3. Prereq: *B M E 220*

Overview of biosensors and bioanalytical challenges; designing for performance including various analytical problems, ion-selective membranes, characteristics of enzymes and basics of bioaffinity sensing; fundamentals of bioselective layers including depositing films and membranes, surfaces for immobilization and bioselective agents; survey of different biosensing technologies including electroanalytical, biomembrane, optical, and acoustic-wave based sensors.

B M E 450L. Biosensing Laboratory.

(0-3) Cr. 1. Prereq: *B M E 220, concurrent enrollment in B M E 450*

Laboratory course accompanying B M E 450. Design, fabrication, and characterization of various electrical, chemical, polymer, optical and acoustic sensors.

B M E 456. Biomaterials.

(Cross-listed with MAT E). (3-0) Cr. 3. F. Prereq: *MAT E 216 or MAT E 273 or MAT E 392*

Presentation of the basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

B M E 490. Independent Study.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. Prereq: *permission of chair for the bioengineering minor*

Investigation of biomedical engineering topics of special interest to student and supervising faculty member with a final written report.

Biomedical Sciences (B M S)

Courses primarily for professional curriculum students:

B M S 329. Anatomy and Physiology of Domestic Animals.

(3-0) Cr. 3. S. *Prereq:* BIOL 212, BIOL 212L

Survey of body systems of domestic animals. Provides a medical science orientation particularly useful to students in a preveterinary medicine curriculum.

B M S 330. Principles of Morphology I.

(Dual-listed with B M S 530). (3-6) Cr. 5. F. *Prereq:* First-year classification in veterinary medicine

Anatomy of the dog.

B M S 331. Principles of Morphology II.

(Dual-listed with B M S 531). (2-6) Cr. 4. S. *Prereq:* First-year classification in veterinary medicine. B M S 330

Comparative and topographic anatomy of horse, ruminants, pig, and chicken.

B M S 333. Biomedical Sciences I.

(Dual-listed with B M S 533). (5-3) Cr. 6. F. *Prereq:* First-year classification in veterinary medicine

Microscopic anatomy and physiology of cells, tissues, cardiovascular system, respiratory system, and urinary system.

B M S 334. Biomedical Sciences II.

(Dual-listed with B M S 534). (5-3) Cr. 6. S. *Prereq:* First-year classification in veterinary medicine

Microscopic anatomy of the immune system and integument. Microscopic anatomy and physiology of the digestive system, endocrine system, and reproductive system.

B M S 335. Molecular and Cellular Basis of Disease.

(1-0) Cr. 1. F.

Descriptions of molecular and cellular biology especially as it pertains to veterinary medicine. Discussions of cellular components, cellular functions and anomalies thereof. Emphasis placed on divergences relevant to companion animals and livestock.

B M S 336. Veterinary Nutrition.

(Dual-listed with B M S 536). (2-0) Cr. 2. F.

Introduce basic biochemical aspects of metabolism and function of energy, protein, fat, minerals and vitamins in the diet. Determine nutrient requirements of food animals, pets, and horses under various physiological states. Understand fate of various nutrients in simple stomached animals, ruminants, and cecal fermenters. Discuss clinical nutrition problems specific to each species.

B M S 337. Neuroanatomy.

(Dual-listed with B M S 537). (2-2) Cr. 3. S. *Prereq:* First-year classification in veterinary medicine

Neuroanatomy of domestic animals.

B M S 339. Clinical Foundations I.

(Cross-listed with V C S). (0-2) Cr. 1. F. *Prereq:* First-year classification in veterinary medicine

Canine physical examination; basic behavior, animal handling and restraint; medical record keeping.

B M S 345. Case Study I.

(0-2) Cr. 1. F. *Prereq:* First-year classification in veterinary medicine

Clinical applications of basic sciences taught concurrently in the fall semester of the first year curriculum in veterinary medicine.

B M S 346. Case Study II.

(0-1) Cr. 1. S. *Prereq:* First-year classification in veterinary medicine

Clinical applications of basic sciences taught concurrently in the spring semester of the first year curriculum in veterinary medicine.

B M S 353. Topics in Molecular Veterinary Medicine.

(Dual-listed with B M S 553). (1-0) Cr. 1. S. *Prereq:* Enrollment in or completion of B M S 354

Receptor and signal transduction anomalies and their diagnosis in veterinary medicine.

B M S 354. General Pharmacology.

(Dual-listed with B M S 554). (Cross-listed with TOX). (3-0) Cr. 3. S. *Prereq:* B M S 549 and B M S 552; BBMB 404, BBMB 405

General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

B M S 401. Intro to Aquatic Animal Medicine.

(Cross-listed with A ECL). (1-2) Cr. 1. S.

8 week course. Introductory course with focus on fin fish production, health and medicine. Course content will help define future roles for veterinarians, producers, and service providers. Emphasis will be placed on anatomy, pathology, infectious diseases, nutrition, regulatory constraints in production, food safety, and current research. Field trip to aquaculture facility.

B M S 403. Behavior of Domestic Animals.

(1-0) Cr. 1. Alt. S., offered even-numbered years. *Prereq:* Classification in veterinary medicine

Normal and abnormal behavior of domestic animals.

B M S 415. Anatomy of Laboratory Animals.

(Dual-listed with B M S 515). (1-2) Cr. 2. Alt. S., offered even-numbered years. *Prereq:* One year of college biology

Gross and microscopic anatomy of laboratory animals.

B M S 416. Avian Anatomy.

(Dual-listed with B M S 516). (1-2) Cr. 2. Alt. S., offered odd-numbered years. *Prereq:* One year college biology

Gross and microscopic anatomy of domestic, exotic, and pet birds.

B M S 421. Special and Applied Anatomy of the Horse.

(1-3) Cr. 2. F. *Prereq:* B M S 330 or B M S 331 or AN S 316 or AN S 415, classification in veterinary medicine

Special and applied anatomy of the horse.

B M S 443. Pharmacology and Therapeutics.

(Dual-listed with B M S 543). (3-0) Cr. 3. F. *Prereq:* B M S 354

Pharmacology and therapeutic uses of fluids, antimicrobial and antiparasitic drugs, clinical use of veterinary drugs, and adverse drug reactions.

B M S 447. Principles of Anatomy.

(Dual-listed with B M S 547). (2.5-6) Cr. 4. F. *Prereq:* Instructor permission required for undergraduate students.

Examination of gross anatomy and neuroanatomy of human and dog.

Laboratories will include cadaveric and virtual dissection, clinical case studies, and problem based learning.

B M S 490. Independent Study.

Cr. 1-5. Repeatable. F.S.SS. *Prereq:* Permission of instructor

B M S 490H. Independent Study, Honors.

Cr. 1-5. Repeatable. F.S.SS. *Prereq:* Permission of instructor

B M S 496. International Preceptorship.

(0-40) Cr. 1-12. Repeatable. S. *Prereq:* Second-year classification in veterinary medicine

International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduates:

B M S 501. Selected Research Methods in Biomedical Sciences.

(0-8) Cr. 3. F.S.SS. *Prereq:* Graduate classification, permission of a BMS faculty member

Experience in biomedical techniques in selected BMS laboratories that include but is not limited to cytochemical methods, molecular biological techniques, extracellular and intracellular unit recording, microiontophoresis, microinjection, spectrophoto-fluorometric analysis of chemicals, use of radioisotopes, radioimmunoassay, Ca²⁺ imaging, confocal microscopy, fluorescence microscopy, and immunocytochemistry.

B M S 502. Methods in Biomedical Sciences.

(0-6) Cr. 3. S.

Provides laboratory experience in the application of methods in biomedical sciences, including animal physiology and pharmacology laboratory techniques; human physiology recordings and urinalysis; pharmacokinetics; basic techniques in analytical laboratory; basic pathology, immunology, bacteriology, and virology laboratory techniques.

B M S 515. Anatomy of Laboratory Animals.

(Dual-listed with B M S 415). (1-2) Cr. 2. Alt. S., offered even-numbered years.

Prereq: One year of college biology and graduate classification

Gross and microscopic anatomy of laboratory animals.

B M S 516. Avian Anatomy.

(Dual-listed with B M S 416). (1-2) Cr. 2. Alt. S., offered odd-numbered years.

Prereq: One year college biology

Gross and microscopic anatomy of domestic, exotic, and pet birds.

B M S 530. Principles of Morphology I.

(Dual-listed with B M S 330). (3-6) Cr. 5. F. *Prereq: 10 credits in biological science and permission of the instructor*
Anatomy of the dog.

B M S 531. Principles of Morphology II.

(Dual-listed with B M S 331). (2-6) Cr. 4. S. *Prereq: First-year classification in veterinary medicine. B M S 330*
Comparative and topographic anatomy of horse, ruminants, pig, and chicken.

B M S 533. Biomedical Sciences I.

(Dual-listed with B M S 333). (5-3) Cr. 6. F. *Prereq: First-year classification in veterinary medicine or graduate student status*
Microscopic anatomy and physiology of cells, tissues, cardiovascular system, respiratory system, and urinary system.

B M S 534. Biomedical Sciences II.

(Dual-listed with B M S 334). (5-3) Cr. 6. S. *Prereq: First-year classification in veterinary medicine or graduate student status*
Microscopic anatomy of the immune system and integument. Microscopic anatomy and physiology of the digestive system, endocrine system, and reproductive system.

B M S 536. Veterinary Nutrition.

(Dual-listed with B M S 336). (2-0) Cr. 2. F.
Introduce basic biochemical aspects of metabolism and function of energy, protein, fat, minerals and vitamins in the diet. Determine nutrient requirements of food animals, pets, and horses under various physiological states. Understand fate of various nutrients in simple stomached animals, ruminants, and cecal fermenters. Discuss clinical nutrition problems specific to each species.

B M S 537. Neuroanatomy.

(Dual-listed with B M S 337). (2-2) Cr. 3. S. *Prereq: 10 credits in biological science and permission of the instructor*
Neuroanatomy of domestic animals.

B M S 538. Principles of Physiology.

(4-0) Cr. 4. F.
Principles of neurophysiology, endocrine and reproductive physiology, muscle physiology, cardiovascular, respiratory, renal, and digestive physiology, and regulation of body fluid.

B M S 539. Principles of Pharmacology.

(4-0) Cr. 4. S.
General principles of drug actions; drug disposition; drug acting on cardiovascular, respiratory, renal, gastrointestinal, and endocrine systems; anti-inflammatory and antibiotic drug; anti-cancer drugs; anesthetics CNS stimulants; lifestyle drugs; drug addiction, abuse and dependence; drugs in sport; drugs for obesity; biopharmaceuticals and gene therapy; drug development.

B M S 542. Introduction to Molecular Biology Techniques.

(Cross-listed with EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.
Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

B M S 542A. Introduction to Molecular Biology Techniques: DNA Techniques.

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.
Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

B M S 542B. Introduction to Molecular Biology Techniques: Protein.

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.SS. *Prereq: Graduate classification*
Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

B M S 542C. Introduction to Molecular Biology Techniques: Cell Techniques.

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.
Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

B M S 542D. Introduction to Molecular Biology Techniques: Plant Transformation.

(Cross-listed with EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.
Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

B M S 542E. Introduction to Molecular Biology Techniques: Proteomics.

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.
Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

B M S 542F. Introduction to Molecular Biology Techniques: Metabolomics.

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.
Includes metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

B M S 542G. Introduction to Molecular Biology Techniques: Genomic.

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.
Offered on a satisfactory-fail basis only.

B M S 543. Pharmacology and Therapeutics.

(Dual-listed with B M S 443). (3-0) Cr. 3. F. *Prereq: B M S 354*
Pharmacology and therapeutic uses of fluids, antimicrobial and antiparasitic drugs, clinical use of veterinary drugs, and adverse drug reactions.

B M S 547. Principles of Anatomy.

(Dual-listed with B M S 447). (2.5-6) Cr. 4. F. *Prereq: Instructor permission required for undergraduate students.*
Examination of gross anatomy and neuroanatomy of human and dog. Laboratories will include cadaveric and virtual dissection, clinical case studies, and problem based learning.

B M S 553. Topics in Molecular Veterinary Medicine.

(Dual-listed with B M S 353). (1-0) Cr. 1. S. *Prereq: Enrollment in or completion of B M S 354*
Receptor and signal transduction anomalies and their diagnosis in veterinary medicine.

B M S 554. General Pharmacology.

(Dual-listed with B M S 354). (Cross-listed with TOX). (3-0) Cr. 3. S. *Prereq: B M S 549 and B M S 552; BBMB 404, BBMB 405*
General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

B M S 556. Cellular, Molecular and Developmental Neuroscience.

(Cross-listed with GDCB, NEURO). (3-0) Cr. 3. F. *Prereq: BIOL 335 or BIOL 436; physics recommended*
Fundamental principles of neuroscience including cellular and molecular neuroscience, nervous system development, sensory, motor and regulatory systems.

B M S 575. Cell Biology.

(Cross-listed with TOX). (3-0) Cr. 3. F. *Prereq: 10 credits in biological science and permission of instructor*
A multi-instructor course covering major topics in cell structure and function, including: universal features of prokaryotic and eukaryotic cells, types of utilization and conversion of energy, genetic control of cell shape and functionality, internal organization of cells, communication between cells and their environment, development of multicellular systems. Students have to write a term paper.

B M S 590. Special Topics.

Cr. 1-7. Repeatable. F.S.SS. *Prereq: Permission of instructor*

B M S 590A. Anatomy.

Cr. 1-7. Repeatable. F.S.SS. *Prereq: Permission of instructor*

B M S 590B. Physiology.

Cr. 1-7. Repeatable. F.S.SS. *Prereq: Permission of instructor*

B M S 590C. Pharmacology.

Cr. 1-7. Repeatable. F.S.SS. *Prereq: Permission of instructor*

B M S 590D. Cell biology.

Cr. 1-7. Repeatable. F.S.SS. *Prereq: Permission of instructor*

B M S 599. Creative Component.

Cr. 1-3. F.S.SS. *Prereq: Enrollment in BMS graduate program, and permission of instructor.*
Creative component for non-thesis Master of Science degree.

Courses for graduate students:

B M S 688. Research Review.

Cr. 1. Repeatable. F.S. *Prereq: Enrollment in BMS graduate program.*

A forum for B M S students to gain experience in the critical exchange of ideas through oral presentation and discussion of scientific information.

B M S 690. Advanced Topics.

Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of instructor*

B M S 690A. Anatomy.

Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of instructor*

B M S 690B. Physiology.

Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of instructor*

B M S 690C. Pharmacology.

Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of instructor*

B M S 690D. Cell biology.

Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of instructor*

B M S 698. Seminar.

Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in BMS graduate program.*

B M S 698A. Seminar: Attendance.

Cr. R. Repeatable. F.S. *Prereq: Enrollment in BMS graduate program.*

B M S 698B. Seminar: Attendance and Presentation.

(1-0) Cr. 1. Repeatable. F.S.SS. *Prereq: Enrollment in B M S graduate program.*

Attendance and presentation required. Offered on a satisfactory-fail basis only.

B M S 698C. Seminar: Attendance and Report.

Cr. 1. Repeatable. F.S. *Prereq: Enrollment in BMS graduate program.*

Attendance to all B M S seminars and written reports are required.

B M S 699. Research.

Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in BMS graduate program.*

B M S 699A. Research: Anatomy.

Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in BMS graduate program.*

B M S 699B. Research: Physiology.

Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in BMS graduate program.*

B M S 699C. Research: Pharmacology.

Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in BMS graduate program.*

B M S 699D. Research: Cell biology.

Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in BMS graduate program.*

Biorenewable Chemicals (BR C)

Courses primarily for graduate students, open to qualified undergraduates:

BR C 506. The Evolving Chemical Industry.

(1-0) Cr. 1.

An overview of the chemical industry including structure and its evolution. Discussion of the dynamics of recent introduction of biorenewable chemicals to the chemical industry.

BR C 507. Technology-Led Entrepreneurship in Biorenewables.

(Cross-listed with BRT). (1-0) Cr. 1. S. *Prereq: Graduate Standing or Permission of Instructor.*

Develop an understanding of the relationship between discovery research entrepreneurship and innovation in biorenewables. Understand critical techno-commercial analyses and intellectual property. Learn critical skills needed to found a company, including how to define key assets, write a business plan, leverage local resources, and secure funding.

BR C 590. Special Topics.

(2-0) Cr. 2.

Special topics in biorenewable chemicals.

BR C 590K. Special Topics: K-12 Science Education..

(2-0) Cr. 2. F.SS.

Understanding of Discovery Research for sixth through 12th grade science teachers. Design, methods and analysis of research associated with biorenewable energy systems. Science teachers will be introduced to the value of scientific inquiry, elements of engineering design, 21st century careers in science, technology, engineering and math (STEM) and how high school students need to be prepared for these careers.

Courses for graduate students:

BR C 688. Catalysis and Catalytic Processes.

(Cross-listed with CH E). (3-0) Cr. 3. *Prereq: CH E 382*

Principles and applications of heterogeneous and homogeneous catalysis. Adsorption. Reaction kinetics and mass transfer effects. Catalyst characterization. Industrial catalytic processes.

Biorenewable Resources and Technology (BRT)

Courses primarily for graduate students, open to qualified undergraduates:

BRT 501. Fundamentals of Biorenewable Resources.

(3-0) Cr. 3. S. *Prereq:* Previous coursework in introductory physics and chemistry is recommended.

Introduction to the science and engineering of converting biorenewable resources into bioenergy and biobased products. Survey of biorenewable resource base and properties; description of biofuels and biobased products; production of biorenewable resources; processing technologies for fuels, chemicals, materials, and energy; environmental impacts; technoeconomic analysis of production and processing; and biofuels policy.

BRT 506. Biobased Products Seminar.

Cr. arr. F.S. *Prereq:* Undergraduate training in an engineering or physical or biological discipline or degree in agriculture or economics

Continual in-depth view of the multi-disciplinary nature of biorenewables research, programs, and people involved in this field of study. Seminar and/or research poster presentations.

BRT 506B. Biobased Products Seminar: Seminars and Research Symposium Attendance.

Cr. R. Repeatable, maximum of 5 times. F.S. *Prereq:* Undergraduate training in an engineering or physical or biological discipline or degree in agriculture or economics

Attendance at approved seminars on-campus related to biorenewable resources and technology. Enrollment in BRT 506B is required every semester student is registered as BRT graduate student, and until student enrolls in BRT 506A. Offered on a satisfactory-fail basis only.

BRT 506C. Biobased Products Seminar: Research Presentations.

(1-0) Cr. 1. F.S. *Prereq:* BRT 506B

Research presentations throughout the semester as part of the course seminar series and during the course. Research Poster Symposium at the end of the semester. Typically taken in the last semester(s) when completing degree program. Offered on a satisfactory-fail basis only.

BRT 507. Technology-Led Entrepreneurship in Biorenewables.

(Cross-listed with BR C). (1-0) Cr. 1. S. *Prereq:* Graduate Standing or Permission of Instructor.

Develop an understanding of the relationship between discovery research entrepreneurship and innovation in biorenewables. Understand critical techno-commercial analyses and intellectual property. Learn critical skills needed to found a company, including how to define key assets, write a business plan, leverage local resources, and secure funding.

BRT 511. Bioprocessing and Bioproducts.

(Cross-listed with A B E, C E). (3-0) Cr. 3. F. *Prereq:* A E 216 or equivalent, MATH 160 or MATH 165, one of CHEM 167 or higher, BIOL 173 or BIOL 211 or higher or BRT 501, senior or graduate classification

Sustainability, cleaner production. Taxonomy, kinetics, metabolism, aerobic and anaerobic fermentation. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis. Term paper for graduate level only.

BRT 515. Biorenewables Law and Policy.

(Cross-listed with POL S). (3-0) Cr. 3. F.

Evaluation of the biorenewables field as it relates to the areas of law and policy. Primary emphasis on the following topics: concerns that motivated the development and expansion of the biorenewables field, a history of the interactions between biorenewable pathways. U.S. law and policy and controversies that have arisen from these interactions and their effects.

BRT 516. International Biorenewables Law & Policy.

(Cross-listed with POL S). (3-0) Cr. 3. S.

Evaluation of the international biorenewables field as it relates to the areas of law and policy. Primary emphasis on the following topics: concerns that motivated the development and expansion of the field by adopting countries, a history of the interactions between biorenewable pathways. Law and policy in adopting countries and international controversies that have arisen from these interactions and their effects.

BRT 535. Thermochemical Processing of Biomass.

(Cross-listed with M E). (3-0) Cr. 3. S. *Prereq:* Undergraduate course work in thermodynamics and transport phenomena

Introduction to thermal and catalytic processes for the conversion of biomass to biofuels and other biobased products. Topics include gasification, fast pyrolysis, hydrothermal processing, syngas to synfuels, and bio-oil upgrading. Application of thermodynamics, heat transfer, and fluid dynamics to bioenergy and biofuels.

BRT 590. Special Topics.

Cr. 1-3. Repeatable. F.S.SS. *Prereq:* Permission of instructor

Investigation of an approved topic on an individual basis. Course content and requirements to be designed and developed in consultation with the student's major professor or instructor, but in all cases a formal report should be written.

BRT 592L. Biorenewable Resources Laboratory.

(0-3) Cr. 1. F.S.SS. *Prereq:* Graduate student status. Undergraduates with instructor approval

An introduction to hands-on experimental laboratory techniques including laboratory safety, calibration, proper usage of chemistry apparatus, chemicals, analytical equipment, and fundamental techniques to ensure successful research.

Courses for graduate students:

BRT 610. Food & Bioprocessing Enzymology.

(Cross-listed with FS HN). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: FS HN 311 or FS HN 411 or FS HN 502 or BBMB 404

Properties and applications of industrial enzymes important in food, feed, and bioprocessing, including biofuels and bioproducts. Characterization of enzyme catalytic mechanisms, kinetics, isolation, mutagenesis, and operating conditions, including evaluation of substrates, products, immobilization, enzyme inhibitors, pH, pressure, and temperature.

BRT 699. Research.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Permission of student's major professor

Business Administration (BUSAD)

Courses primarily for undergraduates:

BUSAD 102. Business Learning Team Orientation.

(1-0) Cr. 1. F.S.

A required orientation for all College of Business Students involved with a Business Learning Team. Review of college and university requirements, transfer credits, academic planning, university policies and deadlines and registration procedures. Includes a consideration of various business majors and careers, tools for success in college including writing skills and presentations from employers, alumni and current students. Only one of BusAd 101, 102, or 103X may be counted towards graduation.

BUSAD 103. Orientation.

(1-0) Cr. 1. F.S.

A required orientation for all College of Business students. Review of college and university requirements, transfer credits, academic planning, university policies and deadlines, and registration procedures. Includes group advising for course selection and registration. Only one of BUSAD 101, 102, or 103 may be counted toward graduation.

BUSAD 203. Business Careers and Employment Preparation.

(1-0) Cr. 1. Prereq: BUSAD 101 or 102

Careers in business and issues relevant to the workplace. Discussion of diversity and ethics issues in the workplace. Developing and implementing a professional job search, functioning professionally in the workplace setting, resume and profession correspondence, interviewing, evaluating offers, business etiquette, networking and transitioning from student to employee.

BUSAD 250. Introduction to Business.

(3-0) Cr. 3. Prereq: COM S 113X

Introduction to the functional areas of business and how the functional areas are integrated for the purpose of implementing business strategy. Introduces students to decision making tools (spreadsheets and databases) that are integral to business decision making. Includes application exercises to all functional areas of business.

BUSAD 291. Experiential Learning.

Cr. 1-3. Repeatable. Prereq: Written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised work experience in a business related discipline. Offered on a satisfactory-fail basis only.

BUSAD 291A. Experiential Learning: Domestic Internship..

Cr. 1-3. Repeatable. Prereq: Written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised work experience in a business related discipline. Offered on a satisfactory-fail basis only.

BUSAD 291B. Experiential Learning: International Internship..

Cr. 1-3. Repeatable. Prereq: Written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised work experience in a business related discipline. Offered on a satisfactory-fail basis only.

BUSAD 291C. Experiential Learning: Domestic Travel and Study..

Cr. 1-3. Repeatable. Prereq: Written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised travel and study experience in a business related discipline. Offered on a satisfactory-fail basis only.

BUSAD 291D. Experiential Learning: International Travel and Study..

Cr. 1-3. Repeatable. Prereq: Written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised travel and study experience in a business related discipline. Offered on a satisfactory-fail basis only.

BUSAD 292. Entrepreneurship & Innovation Learning Community (ELC) Seminar.

(1-0) Cr. 1. Prereq: Current member of or have applied to be a member of Entrepreneurship and Innovation Learning Community (see www.isupjcenter.org/ ELC for more information)

Topics related to entrepreneurship and entrepreneurial thinking. Presentations by entrepreneurs and faculty, field trips, business concept development.

BUSAD 398. Cooperative Education.

Cr. R. Repeatable, maximum of 3 times. Prereq: Permission of department Required of all cooperative education students engaged in full-time internship/co-op. Students must register for this course prior to commencing each work period. No more than three credits may be taken in addition to BusAd 398 during any given semester. Offered on a satisfactory-fail basis only.

BUSAD 490. Independent Study.

Cr. 1-3. Repeatable. Prereq: Professional program in Business; permission of instructor; for 490H: Admission to the Business Honors Program

BUSAD 490A. Independent Study: International Business.

Cr. 1-3. Repeatable. Prereq: Professional program in Business; permission of instructor

BUSAD 490E. Independent Study: Entrepreneurship.

Cr. 1-3. Repeatable. Prereq: senior classification, permission of instructor

BUSAD 490G. Independent Study: General.

Cr. 1-3. Repeatable. Prereq: Professional program in Business; permission of instructor

Independent Study.

BUSAD 490H. Independent Study: Honors.

Cr. 1-3. Repeatable. Prereq: Admission to the Business Honors Program

BUSAD 491. Professional Experiential Learning.

Cr. 1-3. Repeatable. Prereq: Professional program, 12 credits from College of Business; written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised work experience in a business related discipline. Offered on a satisfactory-fail basis only.

BUSAD 491A. Professional Experiential Learning: Domestic Internship.

Cr. 1-3. Repeatable. Prereq: Professional program, 12 credits from College of Business; written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised work experience in a business related discipline. Offered on a satisfactory-fail basis only.

BUSAD 491B. Professional Experiential Learning: International Internship.

Cr. 1-3. Repeatable. Prereq: Professional program, 12 credits from College of Business; written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised work experience in a business related discipline. Offered on a satisfactory-fail basis only.

BUSAD 491C. Professional Experiential Learning: Domestic Travel and Study.

Cr. 1-3. Repeatable. Prereq: Professional program, 12 credits from College of Business; written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised travel and study in a business related discipline. Offered on a satisfactory-fail basis only.

BUSAD 491D. Professional Experiential Learning: International Travel and Study.

Cr. 1-3. Repeatable. Prereq: Professional program, 12 credits from College of Business; written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised travel and study in a business related discipline. Offered on a satisfactory-fail basis only.

BUSAD 491E. Professional Experiential Learning: Other Experiential Learning Experience.

Cr. 1-3. Repeatable. Prereq: Professional program, 12 credits from College of Business; written approval of supervising instructor and department chair on required form prior to the learning experience

Supervised work experience in a business related discipline.

Courses primarily for graduate students, open to qualified undergraduates:

BUSAD 501. Strategic Management.

(Cross-listed with STB). (2-0) Cr. 2. Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor

Critical analysis of current practice and case studies in strategic management with an emphasis on integrative decision making. Strategy formulation and implementation will be investigated in the context of complex business environments.

BUSAD 502. Quantitative Business Analysis and Decision Making.

(3-0) Cr. 3. *Prereq: Enrollment in MBA program or departmental permission*
Introduction to the sources and statistical analysis of data as well as optimization models for use in making business decisions. Data collection, descriptive and inferential statistics including hypothesis testing, analysis of variance, multiple regression, linear programming and simulation.

BUSAD 503. Information Systems.

(Cross-listed with STB). (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor*
Introduction to a broad variety of information systems (IS) topics, including current and emerging developments in information technology (IT), IT strategy in the context of corporate strategy, and IS planning and development of enterprise architectures. Cases, reading, and discussions highlight the techniques and tactics used by managers to cope with strategic issues within an increasingly technical and data-driven competitive environment.

BUSAD 504. Marketing and Logistics.

(Cross-listed with STB). (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor*
Integration of the business functions concerned with the marketing and movement of goods along the supply chain with the primary goal of creating value for the ultimate customer. Coordination of marketing, production, and logistics activities within the firm and with outside suppliers and customers in the supply chain.

BUSAD 507. Organizational Behavior.

(Cross-listed with STB). (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor*
Understanding human behavior in organizations, and the nature of organizations from a managerial perspective. Special emphasis on how individual differences, such as perceptions, personality, and motivation, influence individual and group behavior in organizations and on how behavior can be influenced by job design, leadership, groups, and the structure of organizations.

BUSAD 508. Accounting and Finance.

(Cross-listed with STB). (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor*
Survey of fundamental topics in accounting and finance. Financial statement reporting and analysis for agriculture firms, corporate governance issues related to financial reporting, (e.g., Sarbanes-Oxley). Basic tools and techniques used in financial management, including stock and bond valuation. How to assess and use capital budgeting methods to evaluate proposed firm investments.

BUSAD 509. Seed Trade, Policy and Regulation.

(Cross-listed with STB). (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor*
Cultural, financial, economic, political, legal/regulatory environments shaping an organization's international business strategy. Topics include entry (and repatriation) of people, firms, goods, services, and capital. Special attention to the institutions of seed regulation and policy. Ethical issues facing managers operating in an international context.

BUSAD 533. Economic and Business Decision Tools.

(Cross-listed with ECON). (3-0) Cr. 3. *Prereq: ECON 501 or ECON 532*
Team taught by faculty in the Department of Economics and the College of Business, this course focuses on applied economic and business tools for decision making. The topics include: Monte Carlo analysis with applications to option pricing and insurance mechanism design, portfolio analysis using existing standard spreadsheet software and add-ons, dynamic programming tools for inventory management and sequential decisions, discrete choice modeling and statistical bootstrapping, and financial performance evaluation using commercially available software.

BUSAD 590. Special Topics in Business.

(3-0) Cr. 3. Repeatable. *Prereq: Enrollment in MBA program or departmental permission.*
A special topics course covering contemporary issues in business. Topics vary by semester.

BUSAD 591. Professional Experiential Learning.

Cr. 1-3. Repeatable. *Prereq: Graduate standing; written approval of supervising instructor and department chair on required form prior to the learning experience*
Academically supervised travel and/or work experiences in a business related discipline.

BUSAD 592. MBA Professional Skills Development.

Cr. R. *Prereq: Admission to Full-time MBA Program*
Provides first-year MBA students with tools necessary to develop and implement a successful internship and career search, and to develop professional skills critical for success in the competitive business environment. Topics include career search strategy, resume and cover letter development, interviewing, strategic networking, salary negotiation, impression management, team skills development, presentation skills development, and business etiquette. Required for all full-time MBA students. Offered on a satisfactory-fail basis only.

BUSAD 594. MBA Professional Skills Development II.

Cr. R. *Prereq: BUSAD 592*
A second course designed to improve the professional skills of first-year MBA students. Emphasis on building effective communications and networking skills. Students will participate in professional workshops, company visits, executive speaker seminars, service learning projects, business case competitions, and related activities. Offered on a satisfactory-fail basis only.

BUSAD 598. Cooperative Education.

Cr. R. *Prereq: Permission of instructor*
Professional work experience. Students must register for this course prior to commencing work. Offered on a satisfactory-fail basis only.

BUSAD 599. Creative Component.

Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair*
Preparation and writing of creative component.

BUSAD 599A. Creative Component: Accounting.

Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair*
Preparation and writing of creative component.

BUSAD 599C. Creative Component: Finance.

Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair*
Preparation and writing of creative component.

BUSAD 599E. Creative Component: Management.

Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair*
Preparation and writing of creative component.

BUSAD 599F. Creative Component: Marketing.

Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair*
Preparation and writing of creative component.

BUSAD 599I. Creative Component: Agribusiness.

Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair*
Preparation and writing of creative component.

BUSAD 599J. Creative Component: General Business.

Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair*
Preparation and writing of creative component.

BUSAD 599K. Creative Component: Management Information Systems.

Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair*
Preparation and writing of creative component.

BUSAD 599M. Creative Component: Supply Chain Management.

Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair*
Preparation and writing of creative component.

Courses for graduate students:**BUSAD 644. Business Research Methods.**

(3-0) Cr. 3. F. *Prereq: In PhD program in the College of Business or consent of instructor*

A survey of the wide variety of research methods used in business. Methods will be presented and discussed with emphasis on applicability in different research situations.

BUSAD 699. Research.

Cr. 3-6. Repeatable. F.S.SS. *Prereq: Graduate classification, permission of major professor*
Research.

Chemical Engineering (CH E)

Courses primarily for undergraduates:

CH E 104. Chemical Engineering Learning Community.

Cr. R. F.S. *Prereq:* Enrollment in Chemical Engineering Learning Team
(1-0) Curriculum in career planning and academic course support for Freshmen learning team.

CH E 160. Chemical Engineering Problems with Computer Applications Laboratory.

(2-2) Cr. 3. F.S. *Prereq:* MATH 143 or satisfactory scores on mathematics placement examinations; credit or enrollment in MATH 165
Formulation and solution of engineering problems. Significant figures. Use of SI units. Graphing and curve-fitting. Flowcharting. Introduction to material balances, engineering economics, and design. Use of spreadsheet programs to solve and present engineering problems. Solution of engineering problems using computer programming languages. Chemical Engineering examples.

CH E 202. Chemical Engineering Seminar.

(1-0) Cr. 1. F. *Prereq:* Sophomore classification in chemical engineering; credit or enrollment in CH E 210

Professionalism in the context of the engineering/technical workplace. Introduction to chemical engineering career opportunities. Process and workplace safety. Development and demonstration of key workplace competencies: teamwork, professionalism and ethical responsibility, ability to engage in life-long learning, and knowledge of contemporary issues. Resumes; professional portfolios; preparation for internship experiences.

CH E 204. Chemical Engineering Continuing Learning Community.

Cr. R. F.S. *Prereq:* Corequisite-enrollment in Chemical Engineering Learning Team
Curriculum and career planning, academic course support for learning community.

CH E 210. Material and Energy Balances.

(3-0) Cr. 3. F.S. *Prereq:* Chem 178, Math 166, CH E 160
Introduction to chemical processes. Physical behavior of gases, liquids, and solids. Application of material and energy balances to chemical engineering equipment and processes.

CH E 220. Introduction to Biomedical Engineering.

(Cross-listed with B M E). (3-0) Cr. 3. S. *Prereq:* BIOL 212, ENGR 160 or equiv, MATH 166, CHEM 167 or CHEM 178, PHYS 222
Engineering analysis of basic biology and engineering problems associated with living systems and health care delivery. The course will illustrate biomedical engineering applications in such areas as: biotechnology, biomechanics, biomaterials and tissue engineering, and biosignal and image processing, and will introduce the basic life sciences and engineering concepts associated with these topics.

CH E 298. Cooperative Education.

Cr. R. F.S.SS. *Prereq:* Permission of department and Engineering Career Services
First professional work period in the cooperative education program. Students must register for this course before commencing work.

CH E 310. Computational Methods in Chemical Engineering.

(3-0) Cr. 3. F.S. *Prereq:* CH E 210 and CH E 160
Numerical methods for solving systems of linear and nonlinear equations, ordinary differential equations, numerical differentiation and integration, and nonlinear regression using chemical engineering examples.

CH E 325. Chemical Engineering Laboratory I.

(0-4) Cr. 2. F.S. *Prereq:* CH E 357, credit or enrollment in CH E 381
Experiments covering fundamental material and energy balances, momentum and energy transport operations, and thermodynamics. Computer applications.

CH E 356. Transport Phenomena I.

(3-0) Cr. 3. F.S. *Prereq:* CH E 210, PHYS 221, credit or enrollment in MATH 267
Momentum and mechanical energy balances. Incompressible and compressible fluid flow. Applications to fluid drag, piping system design, filtration, packed beds and settling.

CH E 357. Transport Phenomena II.

(3-0) Cr. 3. F.S. *Prereq:* Credit or enrollment in CH E 310; CH E 356
Conduction and diffusion, convective heat and mass transfer, boiling and condensation, radiation, and design of heat exchange equipment. Introduction to diffusion.

CH E 358. Separations.

(3-0) Cr. 3. F.S. *Prereq:* CH E 310, CH E 357
Diffusion and mass transfer in fluids. Analysis and design of continuous contacting and multistage separation processes. Binary and multicomponent distillation, absorption, extraction, evaporation, membrane processes, and simultaneous heat and mass transfer.

CH E 381. Chemical Engineering Thermodynamics.

(3-0) Cr. 3. F.S. *Prereq:* Credit or enrollment in CH E 310; MATH 267, PHYS 222, CHEM 325
Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of fluids, phase equilibria, and chemical reaction equilibria.

CH E 382. Chemical Reaction Engineering.

(3-0) Cr. 3. F.S. *Prereq:* Credit in CH E 310; CH E 381, credit or enrollment in CH E 357
Kinetics of chemical reactions. Design of homogeneous and heterogeneous chemical reactors.

CH E 391. Foreign Study Orientation.

(3-0) Cr. 3. *Prereq:* Credit in CH E 357 and CH E 381 or permission of instructor
Offered on a satisfactory-fail basis only. Credit for graduation allowable only upon completion of CH E 392.
Meets International Perspectives Requirement.

CH E 392. Foreign Study Program.

Cr. 4. SS. *Prereq:* CH E 391
Study of chemical engineering including laboratories and lectures at collaborating international universities. Comparative study of U.S. and international manufacturing facilities. Expenses required.
Meets International Perspectives Requirement.

CH E 396. Summer Internship.

Cr. R. Repeatable. SS. *Prereq:* Permission of department and Engineering Career Services
Summer professional work period. Students must register for this course prior to commencing work.

CH E 397. Engineering Internship.

Cr. R. Repeatable. F.S. *Prereq:* Permission of department and Engineering Career Services
One semester maximum per academic year professional work period. Students must register for this course prior to commencing work.

CH E 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq:* CH E 298, permission of department and Engineering Career Services
Second professional work period in the cooperative education program. Students must register for this course before commencing work.

CH E 406. Environmental Chemodynamics.

(Dual-listed with CH E 506). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* CH E 381, credit or enrollment in CH E 358
Examines the mechanisms and rates of chemical transport across air, water, and soil interfaces. Applications of transport and thermodynamic fundamentals to movement of chemicals in the environment.

CH E 408. Surface and Colloid Chemistry.

(Dual-listed with CH E 508). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* CH E 381 or equivalent
Examines the factors underlying interfacial phenomena, with an emphasis on the thermodynamics of surfaces, structural aspects, and electrical phenomena. Application areas include emulsification, foaming, detergency, sedimentation, fluidization, nucleation, wetting, adhesion, flotation, and electrophoresis.

CH E 415. Biochemical Engineering.

(Dual-listed with CH E 515). (3-0) Cr. 3. S. *Prereq:* CH E 357, CH E 382 recommended, CHEM 331
Application of basic chemical engineering principles in biochemical and biological process industries such as enzyme technology and fermentation.

CH E 420. Chemical Process Safety.

(3-0) Cr. 3. *Prereq:* CH E 357, CH E 381 (or equivalents); junior classification
Application of transport phenomena, thermodynamics, and chemical kinetics to the study of safety, health, and loss prevention. Government regulations, industrial hygiene, relief sizing, runaway reactions, toxic release, and dispersion models will be used. Fires, explosions, risk assessment, hazard identification, case studies, accident investigations, and design considerations will be studied.

CH E 421. Process Control.

(3-0) Cr. 3. F.S. *Prereq:* CH E 358, CH E 382, Math 267
Control of industrial chemical processes. Device applications and limitations. Dynamics of chemical process components and process control systems.

CH E 426. Chemical Engineering Laboratory II.(0-4) Cr. 2. F.S. *Prereq: CH E 325, CH E 358, CH E 382*

Experiments in heat and mass transfer, staged operations, chemical reactor performance, unit processes. Computer applications. Only one of Ch E 426 or 427 may count toward graduation.

CH E 427. Biological Engineering Laboratory.(0-4) Cr. 2. S. *Prereq: Credit in CH E 325, CH E 358, CH E 382, and BBMB 301*

Experiments on biological applications in chemical engineering. Only one of CH E 426 or CH E 427 may count toward graduation.

CH E 430. Process and Plant Design.(2-6) Cr. 4. F.S. *Prereq: CH E 358, CH E 382*

Synthesis of chemical engineering processes, equipment and plants. Cost estimation and feasibility analysis.

CH E 440. Biomedical Applications of Chemical Engineering.(Dual-listed with CH E 540). (Cross-listed with B M E). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: CH E 210, MATH 266, PHYS 222*

Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging.

CH E 447. Polymers and Polymer Engineering.(Dual-listed with CH E 547). (3-0) Cr. 3. S. *Prereq: CH E 382 and CHEM 331 or MATE 351*

Chemistry of polymers, addition and condensation polymerization. Physical and mechanical properties, polymer rheology, production methods. Applications of polymers in the chemical industry.

CH E 490. Undergraduate Research/Independent Study.(0-18) Cr. 1-6. Repeatable, maximum of 6 credits. *Prereq: Permission of Department*

Investigation of topics of special interest to student and faculty with a final written report. Election of course and topic must be approved in advance by Department with completion of Study Proposal. No more than 6 credits of ChE 490 may be counted towards technical electives.

CH E 490H. Undergraduate Research/Independent Study, Honors.(0-18) Cr. 1-6. Repeatable, maximum of 6 credits. *Prereq: Permission of Department*

Investigation of topics of special interest to student and faculty with a final written report. Election of course and topic must be approved in advance by Department with completion of Study Proposal. No more than 6 credits of ChE 490 may be counted towards technical electives.

CH E 498. Cooperative Education.Cr. R. Repeatable. F.S.SS. *Prereq: CH E 398, permission of department and Engineering Career Services*

Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduates:**CH E 506. Environmental Chemodynamics.**

(Dual-listed with CH E 406). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: CH E 381, credit or enrollment in CH E 358

Examines the mechanisms and rates of chemical transport across air, water, and soil interfaces. Applications of transport and thermodynamic fundamentals to movement of chemicals in the environment.

CH E 508. Surface and Colloid Chemistry.

(Dual-listed with CH E 408). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: CH E 381 or equivalent

Examines the factors underlying interfacial phenomena, with an emphasis on the thermodynamics of surfaces, structural aspects, and electrical phenomena. Application areas include emulsification, foaming, detergency, sedimentation, fluidization, nucleation, wetting, adhesion, flotation, and electrophoresis.

CH E 515. Biochemical Engineering.(Dual-listed with CH E 415). (3-0) Cr. 3. S. *Prereq: CH E 357, CH E 382 recommended, CHEM 331*

Application of basic chemical engineering principles in biochemical and biological process industries such as enzyme technology and fermentation.

CH E 540. Biomedical Applications of Chemical Engineering.

(Dual-listed with CH E 440). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: CH E 210, MATH 266, PHYS 222

Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging.

CH E 542. Polymeric Biomaterials.(3-0) Cr. 3. *Prereq: CHEM 331 or a polymers class*

Polymeric biomaterials, overview of biomaterial requirements, different classes of polymers used as biomaterials, specific bioapplications of polymers.

CH E 545. Analytical and Numerical Methods.(3-0) Cr. 3. F. *Prereq: CH E 358, MATH 267*

Analysis of equipment and processes by analytic and/or numerical solution of descriptive differential equations. Operational and series techniques, boundary value problems, numerical interpolation and approximation, integration techniques.

CH E 547. Polymers and Polymer Engineering.(Dual-listed with CH E 447). (3-0) Cr. 3. S. *Prereq: CH E 382 and CHEM 331 or MATE 351*

Chemistry of polymers, addition and condensation polymerization. Physical and mechanical properties, polymer rheology, production methods. Applications of polymers in the chemical industry.

CH E 554. Integrated Transport Phenomena.(4-0) Cr. 4. F. *Prereq: CH E 357, CH E 381, Math 267, credit or enrollment in CH E 545*

Conservation equations governing diffusive and convective transport of momentum, thermal energy and chemical species. Transport during laminar flow in conduits, boundary layer flow, creeping flow. Heat and mass transport coupled with chemical reactions and phase change. Scaling and approximation methods for mathematical solution of transport models. Diffusive fluxes; conservation equations for heat and mass transfer; scaling and approximation techniques; fundamentals of fluid mechanics; unidirectional flow; creeping flow; laminar flow at high Reynolds number; forced-convection heat and mass transfer in confined and unconfined laminar flows.

CH E 562. Bioseparations.(3-0) Cr. 3. *Prereq: CH E 357 or advanced standing in a science major*

Principles and techniques for separation and recovery of biologically-produced molecules, especially proteins. Relationship between the chemistry of biological molecules and efficient separation and preservation of biological activity. Includes centrifugation and filtration, membrane processing, extraction, precipitation and crystallization, chromatography, and electrophoresis.

CH E 572. Turbulence.(Cross-listed with AER E). (3-0) Cr. 3. *Prereq: AER E 541 or M E 538*

Qualitative features of turbulence. Statistical representation of turbulent velocity fields: averages, moments, correlations, length and time scales and the energy cascade. Averaged equations of motion, closure requirements, Reynolds averaged models. Homogeneous shear flows, free shear flows, boundary layers. Numerical simulation of turbulence: DNS, LES, DES.

CH E 583. Advanced Thermodynamics.(3-0) Cr. 3. F. *Prereq: CH E 381*

Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of non-ideal fluids and solutions; phase and chemical-reaction equilibria/stability.

CH E 587. Advanced Chemical Reactor Design.(3-0) Cr. 3. S. *Prereq: CH E 382*

Analysis of complex reactions and kinetics. Fixed bed, fluidized bed, and other industrial reactors. Analysis and design of non-ideal flow mixing, and residence times. Heterogeneous reactors.

CH E 590. Independent Study.

Cr. 2-6. Repeatable.

Investigation of an approved topic on an individual basis.

CH E 595. Special Topics.

Cr. 2-3. Repeatable.

CH E 595A. Special Topics: Separations.

Cr. 2-3. Repeatable.

CH E 595B. Special Topics: Advanced Control Theory.

Cr. 2-3. Repeatable.

CH E 595C. Special Topics: Crystallization.

Cr. 2-3. Repeatable.

CH E 595D. Special Topics: Thermodynamics.

Cr. 2-3. Repeatable.

CH E 595E. Special Topics: Protein Engineering/Bioseparations.

Cr. 2-3. Repeatable.

CH E 595F. Special Topics: Biological Engineering.

Cr. 2-3. Repeatable.

CH E 595G. Special Topics: Materials and Biomaterials.

Cr. 2-3. Repeatable.

CH E 595H. Special Topics: Surfaces.

Cr. 2-3. Repeatable.

CH E 595I. Special Topics: Combinatorial Design.

Cr. 2-3. Repeatable.

CH E 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:**CH E 601. Seminar.**

Cr. R. Repeatable. F.S.

Offered on a satisfactory-fail basis only.

CH E 625. Metabolic Engineering.(3-0) Cr. 3. *Prereq: CH E 382, CHEM 331*

Principles of metabolic engineering. Emphasis on emerging examples in biorenewables and plant metabolic engineering. Overview of biochemical pathways, determination of flux distributions by stoichiometric and labeling techniques; kinetics and thermodynamics of metabolic networks; metabolic control analysis; genetic engineering for overexpression, deregulation, or inhibition of enzymes; directed evolution; application of bioinformatics, genomics, and proteomics.

CH E 632. Multiphase Flow.(Cross-listed with M E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: M E 538*

Single particle, multiparticle and two-phase fluid flow phenomena (gas-solid, liquid-solid and gas-liquid mixtures); particle interactions, transport phenomena, wall effects; bubbles, equations of multiphase flow. Dense phase (fluidized and packed beds) and ducted flows; momentum, heat and mass transfer. Computer solutions.

CH E 642. Principles and Applications of Molecular Simulation.(3-0) Cr. 3. *Prereq: CH E 545*

Principles of statistical physics. General features of molecular simulations including Monte Carlo (MC) methods, molecular mechanics (MM), and molecular dynamics (MD). Overview of intermolecular and interatomic potentials. Evaluation of phase equilibria, free energies, and surface/interfacial properties. Coarse-grained methods.

CH E 652. Advanced Transport.(3-0) Cr. 3. *Prereq: CH E 552 and CH E 553*

Advanced topics in momentum transport, fluid mechanics, and mass transport including study of recent literature.

CH E 688. Catalysis and Catalytic Processes.(Cross-listed with BR C). (3-0) Cr. 3. *Prereq: CH E 382*

Principles and applications of heterogeneous and homogeneous catalysis. Adsorption. Reaction kinetics and mass transfer effects. Catalyst characterization. Industrial catalytic processes.

CH E 692. Independent Study.

Cr. 2-6. Repeatable.

Investigation of an approved topic on an individual basis. Election of course and topic must be approved in advance by Program of Study Committee.

CH E 695. Advanced Topics.

Cr. arr. Repeatable.

CH E 695A. Advanced Topics: Separations.

Cr. arr. Repeatable.

CH E 695B. Advanced Topics: Advanced Statistical Modeling and Control.

Cr. arr. Repeatable.

CH E 695C. Advanced Topics: Crystallization.

Cr. arr. Repeatable.

CH E 695D. Advanced Topics: Thermodynamics.

Cr. arr. Repeatable.

CH E 695E. Advanced Topics: Protein Engineering/Bioseparations.

Cr. arr. Repeatable.

CH E 695F. Advanced Topics: Biological Engineering.

Cr. arr. Repeatable.

CH E 695G. Advanced Topics: Materials and Biomaterials.

Cr. arr. Repeatable.

CH E 695H. Advanced Topics: Surfaces.

Cr. arr. Repeatable.

CH E 695I. Advanced Topics: Combinatorial Design.

Cr. arr. Repeatable.

CH E 697. Engineering Internship.Cr. R. Repeatable. F.S.SS. *Prereq: Permission of major professor, graduate classification*

One semester and one summer maximum per academic year professional work period.

CH E 698. Chemical Engineering Teaching Practicum.(1-0) Cr. 1. F.S. *Prereq: Graduate student classification and permission of instructor*

Discussions intended to foster the development of graduate students as teaching assistants and future chemical engineering instructors. Topics include classroom and laboratory instruction, grading, and developing a teaching philosophy. Offered on a satisfactory-fail basis only.

CH E 699. Research.

Cr. arr. Repeatable.

Advanced topic for thesis/dissertation.

Chemistry (CHEM)

Courses primarily for undergraduates:

CHEM 050. Preparation for College Chemistry.

(3-0) Cr. 0. F.S. Prereq: 1 year high school algebra

An in-depth active learning experience designed to impart the fundamental concepts and principles of chemistry, with an emphasis on mathematics skills and logical thinking. For students intending to enroll in general chemistry and who have not taken high school chemistry or who have not had a high school college preparatory chemistry course who need a review of chemical problem solving and chemical concepts. Credit for Chem 50 does not count toward graduation.

CHEM 101. Chemistry Learning Community Orientation.

(1-0) Cr. 1. F.S. Prereq: Member of the Chemistry Learning Community.

Integration of first year and transfer students into the chemistry program. Introduction and overview of degree requirements and support services on campus, assistance with transition to college and community life, and team-building and leadership activities. Offered on a satisfactory-fail basis only.

CHEM 102L. Physical Sciences for Elementary Education.

(Cross-listed with PHYS). (1-5) Cr. 3. S. Prereq: MATH 195 or MATH 140

Introduction to physics and chemistry via weekly, guided-inquiry laboratories. Topics to include states of matter and changes in states of matter, sound, light, electricity, magnetism, heat, forces and how they are related to an object's motion.

CHEM 110. Cutting-Edge Chemistry: Research and Career Opportunities.

(1-0) Cr. 1. F.

Overview of careers in chemistry: industrial, governmental, and academic careers; literature and compound search instruction; professional ethics; and an introduction to joining a research lab. For students majoring or minoring in chemistry or chemistry-related fields. Offered on a satisfactory-fail basis only.

CHEM 160. Chemistry in Modern Society.

(3-0) Cr. 3. F.S.

Aspects of chemistry visible to a non-scientist in our society. A survey of selected areas of chemistry with emphasis on the interface between chemistry and other fields of human activity.

CHEM 163. College Chemistry.

(4-0) Cr. 4. F.S.SS. Prereq: 1 year of high school algebra and geometry and Chem 50 or 1 year of high school chemistry; and credit or enrollment in CHEM 163L

A general survey of chemistry with an emphasis on conceptual problems for those who are not physical and biological science or engineering majors. Nomenclature, chemical reactions, stoichiometry, atomic structure, periodic properties, chemical bonding, states of matter, solutions, thermochemistry, acid-base theory, oxidation-reduction reactions, basic chemical kinetics, and chemical equilibrium. Only one of Chem 163, 167, 177, or 201 may count toward graduation.

CHEM 163L. Laboratory in College Chemistry.

(0-3) Cr. 1. F.S.SS. Prereq: Credit or enrollment for credit in CHEM 163

Laboratory to accompany CHEM 163. Must be taken with CHEM 163. Only one of Chem 163L, CHEM 167L, and CHEM 177L may count toward graduation.

CHEM 167. General Chemistry for Engineering Students.

(4-0) Cr. 4. F.S. Prereq: MATH 140 or high school equivalent and 1 year of high school chemistry or CHEM 50

Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. Only one of Chem 163, 167, 177, or 201 may count toward graduation.

CHEM 167L. Laboratory in General Chemistry for Engineering.

(0-3) Cr. 1. F.S. Prereq: Credit or enrollment for credit in CHEM 167

Laboratory to accompany 167. Only one of Chem 163L, 167L, and 177L may count toward graduation.

CHEM 177. General Chemistry I.

(4-0) Cr. 4. F.S.SS. Prereq: MATH 140 or high school equivalent, and CHEM 50 or 1 year high school chemistry, and credit or enrollment in CHEM 177L. Chemistry and biochemistry majors may consider taking CHEM 201

The first semester of a two semester sequence which explores chemistry at a greater depth and with more emphasis on concepts, problems, and calculations than 163. Recommended for physical and biological science majors, chemical engineering majors, and all others intending to take 300-level chemistry courses. Principles and quantitative relationships, stoichiometry, chemical equilibrium, acid-base chemistry, thermochemistry, rates and mechanism of reactions, changes of state, solution behavior, atomic structure, periodic relationships, chemical bonding. Only one of Chem 163, 167, 177, or 201 may count toward graduation.

CHEM 177L. Laboratory in General Chemistry I.

(0-3) Cr. 1. F.S.SS. Prereq: Credit or enrollment for credit in CHEM 177

Laboratory to accompany 177. 177L must be taken with 177. Only one of Chem 163L, 167L, and 177L may count toward graduation.

CHEM 177N. Laboratory in General Chemistry I.

(0-3) Cr. 1. F. Prereq: Credit or enrollment for credit in CHEM 177. For chemistry and biochemistry majors

Laboratory to accompany CHEM 177. CHEM 177N must be taken with CHEM 177. Only one of Chem 163L, CHEM 167L, and CHEM 177N may count toward graduation.

CHEM 178. General Chemistry II.

(3-0) Cr. 3. F.S.SS. Prereq: CHEM 177, CHEM 177L

Continuation of 177. Recommended for physical or biological science majors, chemical engineering majors, and all others intending to take 300-level chemistry courses.

CHEM 178L. Laboratory in College Chemistry II.

(0-3) Cr. 1. F.S.SS. Prereq: CHEM 177L and credit or enrollment for credit in CHEM 178

Laboratory to accompany 178. 178L is not a necessary co-requisite with 178.

CHEM 201. Advanced General Chemistry.

(5-0) Cr. 5. F. Prereq: Co-enrollment in MATH 165 or credit, one year of high school chemistry, and one year high school physics or advanced chemistry. Co-enrollment in CHEM 201L.

A one-semester course in general chemistry designed to give students an in-depth, broad-based view of modern chemistry, and, in part, to facilitate participation in independent undergraduate research. Topics include stoichiometry, atomic and molecular structure, chemical bonding, kinetics, chemical equilibria, and thermodynamics. Discussion of current trends in various chemical disciplines, which may be given by guest experts in chemistry, biochemistry, and chemical engineering, will help the student appreciate the scope of the chemical sciences and how research is carried out. Only one of Chem 163, 167, 177, or 201 may count toward graduation.

CHEM 201L. Laboratory in Advanced General Chemistry.

(0-3) Cr. 1. F. Prereq: Credit or enrollment for credit in CHEM 201

Laboratory to accompany 201. Introductory lab experience in synthesis and analysis to prepare students for research activities. 201L must be taken with 201. Only one of 163L, 167L, 177L, 177N or 201L may count toward graduation.

CHEM 211. Quantitative and Environmental Analysis.

(2-0) Cr. 2. F.S. Prereq: CHEM 163 and CHEM 163L, CHEM 201 and CHEM 201L; or credit or enrollment in CHEM 178; and concurrent enrollment in CHEM 211L

Theory and practice of elementary volumetric, chromatographic, electrochemical and spectrometric methods of analysis. Chemical equilibrium, sampling, and data evaluation. Emphasis on environmental analytical chemistry; the same methods are widely used in biological and materials sciences as well.

CHEM 211L. Quantitative and Environmental Analysis Laboratory.

(0-6) Cr. 2. F.S. Prereq: Credit or enrollment for credit in CHEM 211

Introductory laboratory experience in volumetric, spectrometric, electrochemical and chromatographic methods of chemical analysis.

CHEM 231. Elementary Organic Chemistry.

(3-0) Cr. 3. F.S.SS. Prereq: CHEM 163, CHEM 163L, or CHEM 177, CHEM 177L; credit or enrollment in CHEM 231L

A survey of modern organic chemistry including nomenclature, structure and bonding, and reactions of hydrocarbons and important classes of natural and synthetic organic compounds. For students desiring only an elementary course in organic chemistry. Students in physical or biological sciences and premedical or preveterinary curricula should take the full year sequence 331 and 332 (with the accompanying laboratories 331L and 332L). Only one of Chem 231 and 331 or BBMB 221 may count toward graduation.

CHEM 231L. Laboratory in Elementary Organic Chemistry.

(0-3) Cr. 1. F.S.SS. Prereq: Credit or enrollment for credit in CHEM 231; CHEM 163L or CHEM 177L

Laboratory to accompany 231. 231L must be taken with 231. Only one of Chem 231L and 331L may count toward graduation.

CHEM 298. Cooperative Education.

Cr. R. F.S.SS. Prereq: Permission of the Department cooperative education coordinator; sophomore classification

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

CHEM 299. Undergraduate Research (for Freshmen and Sophomores).

Cr. arr. Repeatable, maximum of 6 credits. Prereq: Permission of staff member with whom student proposes to work

CHEM 301. Inorganic Chemistry.(2-0) Cr. 2. S. *Prereq:* CHEM 324

Atomic and molecular structure and bonding principles; molecular shapes and symmetry; acids and bases; solid-state structures and properties; inorganic chemistry of H, B, C.

CHEM 316. Instrumental Methods of Chemical Analysis.(2-0) Cr. 2. F. *Prereq:* CHEM 211, CHEM 211L, Math 166, and concurrent enrollment in CHEM 316L; PHYS 222 recommended

Quantitative and qualitative instrumental analysis. Operational theory of instruments, atomic and molecular absorption and emission spectroscopy, electroanalysis, mass spectrometry, liquid and gas chromatography, electrophoresis, literature of chemical analysis.

CHEM 316L. Instrumental Analysis Laboratory.(0-6) Cr. 2. F. *Prereq:* Credit or enrollment in CHEM 316

Advanced laboratory experience in UV-visible spectrophotometry, atomic absorption and emission spectrometry, electrochemistry, gas and liquid chromatography, electrophoresis, mass spectrometry, and other instrumental methods.

CHEM 321L. Laboratory in Physical Chemistry.(1-3) Cr. 2. S. *Prereq:* Credit or enrollment in CHEM 324 or CHEM 325.

Error analysis; use of computers for interfacing to experiments and for data analysis; thermodynamics, infrared and optical spectroscopy, lasers. Not applicable towards the B.S. degree in Chemistry. Only one of Chem 321L and 322L may count toward graduation.

CHEM 322L. Laboratory in Physical Chemistry.(1-6) Cr. 3. S. *Prereq:* CHEM 324 or CHEM 325.

Error analysis; use of computers for interfacing to experiments and for data analysis; thermodynamics, surface science, infrared and optical spectroscopy, lasers. Only one of Chem 321L and 322L may count toward graduation.

CHEM 324. Introductory Quantum Mechanics.(3-0) Cr. 3. F.S. *Prereq:* CHEM 178, MATH 166; PHYS 222 recommended.

Quantum mechanics, atomic and molecular structure, spectroscopy, kinetic theory of gases, chemical kinetics.

CHEM 325. Chemical Thermodynamics.(3-0) Cr. 3. F.S. *Prereq:* CHEM 178, MATH 166; PHYS 222 recommended

Classical thermodynamics 1st, 2nd, and 3rd laws with applications to gases and interfacial systems, multicomponent, multiphase equilibrium of reacting systems, surface chemistry, and electrochemical cells. Students taking a two-semester physical chemistry sequence are advised to take 324 first; in the spring semester, a molecular-based section of this course, stressing statistical thermodynamics, is offered for which knowledge of 324 is useful.

CHEM 331. Organic Chemistry I.(3-0) Cr. 3. F.S.SS. *Prereq:* CHEM 178 or CHEM 201, enrollment in CHEM 331L highly recommended

The first half of a two semester sequence. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms. For students majoring in physical and biological sciences, premedical and pre-veterinary curricula, chemistry and biochemistry. Students desiring only one semester of organic chemistry should take 231 and 231L, not 331. Only one of Chem 231 and 331 may count toward graduation.

CHEM 331L. Laboratory in Organic Chemistry I.(0-3) Cr. 1. F.S.SS. *Prereq:* CHEM 177L; credit or enrollment for credit in CHEM 331

Laboratory to accompany 331. Chemistry and biochemistry majors are encouraged to take 333L. Only one of Chem 231L and 331L may count toward graduation.

CHEM 332. Organic Chemistry II.(3-0) Cr. 3. F.S.SS. *Prereq:* CHEM 331; enrollment in CHEM 332L highly recommended

Continuation of 331. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms, natural products, carbohydrates and proteins. For students majoring in physical and biological sciences, premedical and pre-veterinary curricula, chemistry and biochemistry.

CHEM 332L. Laboratory in Organic Chemistry II.(0-3) Cr. 1. F.S.SS. *Prereq:* CHEM 331L; credit or enrollment for credit in CHEM 332

Laboratory to accompany 332. Chemistry and biochemistry majors are encouraged to take 334L.

CHEM 333L. Laboratory in Organic Chemistry I (for Chemistry and Biochemistry Majors).(0-6) Cr. 2. F. *Prereq:* Credit or enrollment for credit in CHEM 331

Laboratory to accompany 331 for chemistry and biochemistry majors.

CHEM 334L. Laboratory in Organic Chemistry II (for Chemistry and Biochemistry Majors).(0-6) Cr. 2. S. *Prereq:* CHEM 333L, credit or enrollment for credit in CHEM 332 Laboratory to accompany 332 for chemistry and biochemistry majors.**CHEM 398. Cooperative Education.**Cr. R. F.S.SS. *Prereq:* Permission of the Department cooperative education coordinator; junior classification

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

CHEM 399. Undergraduate Research.Cr. arr. *Prereq:* Permission of instructor with whom student proposes to work and junior or senior classification

Undergraduate research. No more than six total credits of Chem 399 and Chem 499 may count toward graduation. Credits earned in 399/499/490 may only be used to meet one of the advanced course requirements for the B.S. degree.

CHEM 401L. Inorganic Chemistry Laboratory.(0-3) Cr. 1. S. *Prereq:* CHEM 402

Preparation and characterization of inorganic and organometallic compounds by modern techniques. For students majoring in chemistry or biochemistry.

CHEM 402. Advanced Inorganic Chemistry.(3-0) Cr. 3. F. *Prereq:* CHEM 301; CHEM 331 recommended

Chemistry of the d and f metals. Structure, bonding, electronic spectra, and reaction mechanisms. Aspects of organometallic solid state and bioinorganic chemistry.

CHEM 490. Independent Study.Cr. arr. *Prereq:* Completion of 6 credits in chemistry at the 300 level or higher and permission of instructor

No more than 9 credits of Chem 490 may count toward graduation.

CHEM 498. Cooperative Education.Cr. R. F.S.SS. *Prereq:* Permission of the Department cooperative education coordinator; senior classification

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

CHEM 499. Senior Research.Cr. 2-3. Repeatable, maximum of 6 credits. *Prereq:* Permission of instructor with whom student proposes to work; B average in all chemistry, physics, and mathematics courses

Research in chosen area of chemistry, with final written report as senior thesis. This course should be elected for two consecutive semesters. For students majoring in chemistry. No more than six total credits for Chem 399 and 499 may count toward graduation.

Courses primarily for graduate students, open to qualified undergraduates:**CHEM 501L. Inorganic Preparations.**(0-3) Cr. 1. F. *Prereq:* CHEM 402

Preparation and characterization of inorganic and organometallic compounds by modern research techniques.

CHEM 502. Advanced Inorganic Chemistry.(3-0) Cr. 3. F. *Prereq:* CHEM 402; CHEM 331 recommended

Chemistry of the main group (s, p) and transition (d, f) metals. Structure, bonding, electronic spectra, and reaction mechanisms. Aspects of organometallic, solid state, bioinorganic, and nano chemistry.

CHEM 503. Bioinorganic Chemistry.

(Cross-listed with BBMB). (2-0) Cr. 2. Alt. S., offered even-numbered years.

Prereq: CHEM 402 or BBMB 405

Essential elements: transport and storage of ions and of oxygen; metalloenzymes and metallocoenzymes; electron-transfer processes in respiration and photosynthesis; metabolism of nonmetals and redox processes involved in it; medicinal aspects of inorganic chemistry.

CHEM 505. Physical Inorganic Chemistry.(3-0) Cr. 3. F. *Prereq:* CHEM 402 or CHEM 502 and CHEM 324

Elementary group theory and molecular orbital theory applied to inorganic chemistry. Spectroscopic methods of characterization of inorganic compounds and organometallic compounds.

CHEM 511. Advanced Analytical Chemistry.(3-0) Cr. 3. F. *Prereq:* CHEM 316 and CHEM 316L

General methods of quantitative inorganic and organic analysis. Aqueous and nonaqueous titrimetry; selective reagents; sampling and sample dissolution; modern instrumentation; sensors; atomic and molecular microscopy; bioanalytical methods; data evaluation; chemometrics; and analytical literature.

CHEM 512. Electrochemical Methods of Analysis.

(3-0) Cr. 3. F. *Prereq:* CHEM 316 and CHEM 316L, CHEM 324, and CHEM 322L
Principles of convective-diffusional mass transport in electroanalysis. Applications of potentiometry, voltammetry, and coulometry. Introduction to heterogeneous and homogeneous kinetics in electroanalysis. Analog and digital circuitry. Interfacing.

CHEM 513. Analytical Molecular and Atomic Spectroscopy.

(3-0) Cr. 3. S. *Prereq:* CHEM 316 and CHEM 316L, CHEM 324, CHEM 322L
Introduction to physical optics and design of photometric instruments. Principles of absorption, emission, fluorescence, and Raman spectroscopy. Error and precision of optical methods. Ultraviolet, visible, and infrared methods of qualitative and quantitative organic and inorganic analysis.

CHEM 516. Analytical Separations.

(3-0) Cr. 3. F. *Prereq:* CHEM 316 and CHEM 316L, CHEM 324, CHEM 322L
Principles and examples of inorganic and organic separation methods applied to analytical chemistry. Solvent extraction, volatilization, ion exchange, liquid and gas chromatography, and electrophoresis.

CHEM 531. Organic Synthesis I.

(2-0) Cr. 2. S. *Prereq:* CHEM 332
Survey of organic functional group transformations.

CHEM 532. Organic Synthesis II.

(2-0) Cr. 2. F. *Prereq:* CHEM 531
Synthesis of complex organic compounds including natural products.

CHEM 537. Physical Organic Chemistry I.

(3-0) Cr. 3. F. *Prereq:* CHEM 332
Survey of reactive intermediates including cations, anions, carbenes, and radicals.

CHEM 538. Physical Organic Chemistry II.

(3-0) Cr. 3. S. *Prereq:* CHEM 537
Molecular structure, stereochemistry, introduction to reaction mechanisms, thermodynamic and kinetic data, linear free energy relationships, isotope effects, orbital symmetry.

CHEM 550. Safety in the Chemical Laboratory.

(1-0) Cr. 1. S. *Prereq:* CHEM 332L
Introduction to laboratory safety and chemical hygiene. Use of engineering controls and personal protective equipment. Chemical storage and waste disposal practices. Handling hazardous chemicals. Radiation safety and laser safety. Offered on a satisfactory-fail basis only.

CHEM 555. Teaching College Chemistry.

(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq:* Graduate or senior classification.
Methods of instruction, strategies and techniques for effective teaching and learning along with practice teaching in undergraduate chemistry recitation and laboratory courses. Cooperative learning, guided-inquiry, learning cycles, conceptual change, models and modeling, concept maps, visualization, computer simulations, web-based delivery systems, and learning theories.

CHEM 561. Fundamentals of Quantum Mechanics.

(4-0) Cr. 4. F. *Prereq:* CHEM 324
Schrodinger equation and exact solutions; square wells and barriers; harmonic oscillator; the hydrogen atom; atomic orbitals; operators including angular momenta; time-independent and time-dependent perturbation theory; Schrodinger and Heisenberg representations; unitary operators; interaction picture, density matrix.

CHEM 562. Fundamentals of Atomic and Molecular Quantum Mechanics.

(3-0) Cr. 3. S. *Prereq:* CHEM 561, credit or enrollment in CHEM 583
Variational method, many electron atoms; addition of angular momentum, self-consistent field method for open and closed shells, linear combinations of atomic orbitals, origin of chemical bonding, many-electron diatomic and polyatomic molecules, treatments of electron correlation, approximation methods.

CHEM 563. Statistical Mechanics.

(3-0) Cr. 3. S. *Prereq:* CHEM 325
Microscopic and macroscopic properties, laws of thermodynamics, ensembles and distribution functions, applications to gases, solids, and chemical equilibrium.

CHEM 564. Molecular Spectroscopy and Structure.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* CHEM 505 or CHEM 562
Maxwell's field equations, interaction of light with matter including time-dependent perturbation theory, microwave, vibrational (infra-red, Raman) and electronic spectroscopies, symmetry derived selection rules, special lineshapes and introduction to nonlinear and coherent laser spectroscopies.

CHEM 571. Solid-State Chemistry.

(2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq:* CHEM 301, CHEM 324
Structural principles, synthetic strategies, analytical methods, and chemical bonding issues applied to solids. Atomic packings and networks, short-range vs. long-range order, defects; phase diagrams, reactive fluxes, chemical transport; diffraction, spectroscopy; energy bands and their bonding interpretations.

CHEM 572. Spectrometric Identification of Organic Compounds.

(2-3) Cr. 3. F. *Prereq:* CHEM 332
Principles of infrared, ultraviolet, nuclear magnetic resonance, and mass spectroscopy as applied to organic chemistry.

CHEM 574. Organometallic Chemistry of the Transition Metals.

(2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq:* CHEM 301, CHEM 332
Transition metal complexes with ligands such as cyclopentadienyl, olefins, acetylenes, benzenes, and carbon monoxide. Coverage of structure, bonding, reactivity, fundamental mechanisms, and homogeneous catalysis.

CHEM 576. Surface Chemistry.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* CHEM 324
Gas-surface interactions and techniques of characterization. Idealized surface lattices, surface tension, Wulff plots, work function, adsorbate-adsorbate interactions, 2D phase diagrams, diffusion, thin film growth, adsorption and desorption mechanisms/energetics/kinetics, adsorption isotherms, vacuum techniques, electron- and ion-based spectroscopies for surface analysis (including AES, FIM, XPS, UPS, EXAFS, EELS, SIMS, LEED and STM).

CHEM 577. Mass Spectrometry.

(3-0) Cr. 3. S.
Basic physics, instrumentation, chemical and biological applications of mass spectrometry.

CHEM 578. Chemical Kinetics and Mechanisms.

(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq:* CHEM 324
Rates and mechanisms; reversible, consecutive, and competing reactions; chain mechanisms; kinetic isotope effects; very rapid reactions; acid-base catalysis, theories of unimolecular reactions; transition state and Marcus theories.

CHEM 579. Introduction to Research in Chemistry.

Cr. R. F.
Introduction to the various areas of research in chemistry at Iowa State University.

CHEM 580. Introduction to Computational Quantum Chemistry.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* CHEM 324
Basic principles of quantum mechanics, schrodinger equation. Hartree-Fock/molecular orbital theory, introduction to group theory, introduction to modern methods of computational chemistry; applications include molecular structure, potential energy surfaces and their relation to chemical reactions; molecular spectroscopy, photochemistry, solvent effects and surface chemistry.

CHEM 581. Principles of Lasers and Optics.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* CHEM 324, Phys 222
Students with weak background should take Chem 580. For students working with lasers and optics; stimulated adsorption and emission based on the classical electron oscillator model; population inversion, laser amplification; laser pumping; oscillation and cavity modes; laser beam characterization; linear propagation; design of laser resonators, ray and wave optics; nonlinear optics.

CHEM 583. Chemical Group Theory.

(1-0) Cr. 1. F. *Prereq:* CHEM 324
Basic concepts and theorems, representation theory; point groups, molecular orbitals, molecular states, molecular vibrations, rotation group and angular momenta; space groups and crystals; permutation group, antisymmetry, and spin states.

CHEM 599. Nonthesis Research.

Cr. arr. *Prereq:* Permission of instructor concerned

Courses for graduate students:**CHEM 600. Seminar in Inorganic Chemistry.**

(1-0) Cr. 1. Repeatable, maximum of 3 times. F.S. *Prereq:* Permission of instructor

CHEM 601. Selected Topics in Inorganic Chemistry.

(2-0) Cr. 1-2. F.S. *Prereq:* Permission of instructor
Topics such as molecular structure and bonding; organometallic compounds; physical techniques of structure determination; nonaqueous solutions; Zintl phases; transition-metal oxides; free-radical reactions; electron transfer reactions; metal-metal bonding; and bioinorganic chemistry of nucleic acids.

CHEM 611. Seminar in Analytical Chemistry.

(1-0) Cr. 1. Repeatable. F.S. *Prereq:* Permission of instructor

CHEM 619. Special Topics in Analytical Chemistry.

(2-0) Cr. 1-2. Repeatable. F.S. *Prereq: Permission of instructor*
Raman spectroscopy, sensors, spectroelectrochemistry, capillary electrophoresis, analytical plasmas, chemometrics and bioanalytical chemistry.

CHEM 631. Seminar in Organic Chemistry.

(1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor*

CHEM 632. Selected Topics in Organic Chemistry.

(2-0) Cr. 1-2. Repeatable. F.S. *Prereq: CHEM 537*
Topics of current interest in organic chemistry such as spectroscopy, physical organic chemistry, photochemistry, organometallic chemistry, mechanisms of oxidations and reductions, modern organic synthesis, reactive intermediates, bioorganic chemistry, and polymers.

CHEM 660. Seminar in Physical Chemistry.

(1-0) Cr. 1. Repeatable. S. *Prereq: Permission of instructor*

CHEM 667. Special Topics in Physical Chemistry.

(2-0) Cr. 1-2. F.S. *Prereq: Permission of instructor*
Advanced and recent developments in physical chemistry are selected for each offering.

CHEM 699. Research.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

Chinese (CHIN)

Courses primarily for undergraduates:

CHIN 101. Elementary Mandarin Chinese I.

(5-0) Cr. 5. F.

Introduction to spoken and written colloquial Mandarin through pinyin and simplified characters.

CHIN 102. Elementary Mandarin Chinese II.

(5-0) Cr. 5. S. *Prereq:* CHIN 101

Introduction to spoken and written colloquial Mandarin through pinyin and simplified characters.

Meets International Perspectives Requirement.

CHIN 201. Intermediate Mandarin Chinese I.

(5-0) Cr. 5. F. *Prereq:* CHIN 102

Development of speaking, writing, reading, and listening skills. Review and expansion of grammar skills, intensification of character acquisition.

Meets International Perspectives Requirement.

CHIN 202. Intermediate Mandarin Chinese II.

(5-0) Cr. 5. S. *Prereq:* CHIN 201

Development of speaking, writing, reading, and listening skills. Review and expansion of grammar skills, intensification of character acquisition.

Meets International Perspectives Requirement.

CHIN 272. Introduction to Chinese Culture.

(3-0) Cr. 3. S.

Interdisciplinary introduction to Chinese society and culture from earliest times to the present. Topics include ancient literature, philosophy, religion, art, architecture, customs, transition to a modern society, social changes, urban life, popular culture, and contemporary values and ideas.

Meets International Perspectives Requirement.

CHIN 301. Advanced Mandarin Chinese I.

(3-0) Cr. 3. F. *Prereq:* CHIN 202 or equivalent

Continuing development of speaking, writing, reading, and listening skills beyond intermediate level. Expansion of cultural literacy through a variety of texts from the humanities, social sciences, mass media and business.

Meets International Perspectives Requirement.

CHIN 302. Advanced Mandarin Chinese II.

(3-0) Cr. 3. S. *Prereq:* CHIN 301 or equivalent

Continuing development of speaking, writing, reading, and listening skills beyond intermediate level. Expansion of cultural literacy through a variety of texts from the humanities, social sciences, mass media and business.

Meets International Perspectives Requirement.

CHIN 304. Chinese for Business and Professions.

(4-0) Cr. 4. S. *Prereq:* CHIN 202 or equivalent

Introduction to professional language and culture in China and Chinese-speaking regions in Asia. Development of all four language skills, focusing on practical applications in the professional contexts. Development of global awareness and cross-cultural understanding. Preparation for internships.

Meets International Perspectives Requirement.

CHIN 370. Chinese Literature in English Translation.

(3-0) Cr. 3. F. *Prereq:* ENGL 150 or equivalent

Topics may include traditional prose, poetry, novel and drama; twentieth-century fiction and film. All readings and class discussions in English.

Meets International Perspectives Requirement.

CHIN 375. China Today.

(3-2) Cr. 3-4. S. *Prereq:* ENGL 250 or equivalent

Focusing on contemporary society, culture, literature and the arts. All readings, discussions, and papers in English. Topics vary from year to year.

Meets International Perspectives Requirement.

CHIN 403. Seminar in Chinese Language and Culture.

(3-0) Cr. 3. *Prereq:* CHIN 302 or equivalent

Critical understanding of authentic texts at the advanced level through reading, translation, and/or application in professional contexts; consolidation of existing language skills, in-depth analysis of cultural issues, and development of professional language proficiency. Taught in Chinese.

Meets International Perspectives Requirement.

CHIN 403A. Seminar in Chinese Language and Culture: Translating Contemporary Chinese Texts.

(3-0) Cr. 3. *Prereq:* CHIN 302

Critical understanding of authentic texts at the advanced level through reading, translation, and/or application in professional contexts; consolidation of existing language skills, in-depth analysis of cultural issues, and development of professional language proficiency. Taught in Chinese.

Meets International Perspectives Requirement.

CHIN 403B. Seminar in Chinese Language and Culture: Topics on Business and Professions.

(3-0) Cr. 3. *Prereq:* CHIN 302 or equivalent

Critical understanding of authentic texts at the advanced level through reading, translation, and/or application in professional contexts; consolidation of existing language skills, in-depth analysis of cultural issues, and development of professional language proficiency. Taught in Chinese.

Meets International Perspectives Requirement.

CHIN 403C. Seminar in Chinese Language and Culture: Reading Chinese Texts.

(3-0) Cr. 3. *Prereq:* CHIN 302 or equivalent

Critical understanding of authentic texts at the advanced level through reading, translation, and/or application in professional contexts; consolidation of existing language skills, in-depth analysis of cultural issues, and development of professional language proficiency. Taught in Chinese.

Meets International Perspectives Requirement.

CHIN 490. Independent Study.

Cr. 1-6. Repeatable. *Prereq:* 6 credits in Chinese and permission of department chair

Designed to meet student needs in areas beyond current course offerings or to accommodate the desire to integrate a study of literature or language with special issues in major fields..

Civil Engineering (C E)

Courses primarily for undergraduates:

C E 105. Introduction to the Civil Engineering Profession.

(1-0) Cr. 1. F.S.

Overview of the nature and scope of the civil engineering profession. Exploration of the various specialty areas within civil engineering. Bloom's Taxonomy and creativity. Departmental rules, student services operations, degree requirements, educational objectives, program of study planning, career options, and student organizations.

C E 111. Fundamentals of Surveying I.

(2-3) Cr. 3. F.S. Prereq: C E 160, credit or enrollment in ENGR 170 or C E 170, MATH 165, credit or enrollment in C E 105 for C E majors

Introduction to error theory. Fundamentals of observing distances, elevations, and angles. Traversing. Irregular areas. Circular and parabolic curves. Earthwork including mass diagrams. Construction staking. Computer applications and introduction to photogrammetry, geographic information systems and global positioning systems technology.

C E 120. Civil Engineering Learning Community.

Cr. R. Repeatable.

Integration of first-year students into the Civil Engineering program. Assignments and activities involving teamwork, academic preparation, study skills, and preparation for entry into the Civil Engineering profession. Completed both individually and in learning teams under the direction of faculty and peer mentors. Offered on a satisfactory-fail basis only.

C E 160. Engineering Problems with Computational Laboratory.

(2-2) Cr. 3. F.S. Prereq: MATH 141, MATH 142 or satisfactory scores on mathematics placement assessments; credit or enrollment in MATH 165

Formulation of engineering problems using spreadsheets and Visual Basic for Application for solution. Presenting results using word processing, tables, and graphs. Introduction to engineering economics and statics. Civil engineering examples.

C E 170. Graphics for Civil Engineering.

(0-4) Cr. 2. F.S. Prereq: MATH 165, credit or enrollment in C E 105

Fundamental graphics. Introduction to computer aided drafting and modeling. Civil engineering applications.

C E 206. Engineering Economic Analysis and Professional Issues in Civil Engineering.

(3-0) Cr. 3. F.S. Prereq: MATH 166, ENGL 250; C E 105; ECON 101 recommended

Engineering/managerial analysis of the economic aspects of project proposals. Alternative sources of funds; time value of money; expenditure of capital funds and methods of evaluating alternative projects. Professionalism, licensure, liability, ethics, leadership, social responsibility, creative and critical thinking, and applications/impacts of regulations in civil engineering.

C E 298. Cooperative Education.

Cr. R. F.S.SS. Prereq: Permission of department and Engineering Career Services

First professional work period in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

C E 306. Project Management for Civil Engineers.

(2-3) Cr. 3. F.S. Prereq: C E 206, Credit or enrollment in a technical communication elective from the approved department list

Project management, including work breakdown structures, cost estimating, scheduling, and project control. Civil engineering project life cycle, including planning, design, construction, and maintenance processes. Techniques in interpretation of contract documents, plan reading, and in estimating quantities.

C E 326. Principles of Environmental Engineering.

(2-2) Cr. 3. F.S. Prereq: CHEM 177 or CHEM 178, MATH 166, credit or enrollment in E M 378

Introduction to environmental problems, water quality indicators and requirements, potable water quality and quantity objectives, water sources and treatment methods; water pollution control objectives and treatment methods; survey of solid and hazardous waste management and air pollution control.

C E 332. Structural Analysis I.

(2-2) Cr. 3. F.S. Prereq: E M 324

Loads, shear, moment, and deflected shape diagrams for beams and framed structures. Deformation calculations. Approximate methods. Application of consistent deformation methods to frames and continuous beams. Application of displacement methods to continuous beams and frames. Influence lines for determinate and indeterminate beams using Muller-Breslau principle. Computer applications to analyze beams and frames. Validation of computer results.

C E 333. Structural Steel Design I.

(2-2) Cr. 3. F.S. Prereq: C E 332, E M 327

AISC design methods for structural steel buildings. Emphasis on load and Resistance Factor Design. Introduction to theoretical behavior with a focus on applications. Analysis and design of structural steel members subject to tension, compression, flexure, and combined axial force and bending. Analysis and design of axially loaded column base plates and bolted and welded shear-type connections. Strength and serviceability limit states. Effective Length Method and Direct Analysis Method of design. Approximate Second-Order Analysis.

C E 334. Reinforced Concrete Design I.

(2-2) Cr. 3. F.S. Prereq: C E 332, E M 327

ACI analysis and design of beams (singly reinforced, doubly reinforced, and T-section), one-way slabs, short columns, and isolated footings. Analysis and design for shear, flexure, axial force, and deflections. Bond, anchorage, and development of reinforcement. Application of the ACI shear and moment coefficients.

C E 350. Introduction to Transportation Planning.

(3-0) Cr. 3. S. Prereq: 3 credits in statistics, junior classification

An introductory course for planning urban and regional transportation systems within government. Applications and impacts of legislation, financing, four-step planning process, population trends, land use, societal impacts, public transportation, master plans and traffic impact studies. Organization and coordination of the transportation planning function. Not available for graduation credit for students in civil engineering.

C E 355. Principles of Transportation Engineering.

(3-0) Cr. 3. F.S. Prereq: C E 111, C E 206, PHYS 221, a course in statistics from the approved departmental list

Introduction to planning and operations of transportation facilities. Vehicle/operation/infrastructure characteristics. Technological, economic and environmental factors. Travel demand modeling and capacity analysis.

C E 360. Geotechnical Engineering.

(2-3) Cr. 3. F.S. Prereq: E M 324, credit or enrollment in GEOL 201

Introduction to geotechnical engineering and testing. Identification and classification tests, soil water systems, principles of settlement, stresses in soils, and shear strength testing; slope stability, retaining walls, bearing capacity.

C E 372. Engineering Hydrology and Hydraulics.

(3-0) Cr. 3. F.S. Prereq: E M 378, a course in statistics from the approved department list

The hydrologic cycle: precipitation, infiltration, runoff, evapotranspiration, groundwater, and streamflow. Hydrograph analysis, flood routing, frequency analysis and urban hydrology. Applied hydraulics including pipe and channel flow with design applications in culverts, pumping, water distribution, storm and sanitary sewer systems. Design project required.

C E 382. Design of Concretes.

(2-3) Cr. 3. F.S. Prereq: Credit or enrollment in C E 360

Physical and chemical properties of bituminous, portland, and other cements; aggregate properties and blending; mix design and testing of concretes; admixtures, mixing, handling, placing and curing; principles of pavement thickness design.

C E 383. Design of Portland Cement Concrete.

(0-2) Cr. 1. F.S. Prereq: Credit or enrollment in C E 360

For Con E students only. Physical and chemical properties of portland cement and p.c. concrete. Mix design and testing of p.c. concrete.

C E 388. Sustainable Engineering and International Development.

(Cross-listed with A B E, E E). (2-2) Cr. 3. F. Prereq: Junior classification in engineering

Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernment organizations (NGOs). Course readings, final project/design report. Meets International Perspectives Requirement.

C E 396. Summer Internship.

Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services, completion of two terms in residence in civil engineering, employment in civil engineering or related field*

Summer professional work period. Students must register for this course prior to commencing work. Offered on a satisfactory-fail basis only.

C E 397. Engineering Internship.

Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services*

One semester maximum per academic year professional work period. Students must register for this course prior to commencing work. Offered on a satisfactory-fail basis only.

C E 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq: C E 298, permission of department and Engineering Career Services*

Second professional work period in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

C E 403. Program and Outcome Assessment.

Cr. R. F.S. *Prereq: Verification of undergraduate application for graduation by the end of the first week of class. Permission of instructor for students who are scheduled for summer graduation*

Assessment of C E Curriculum and educational objectives. Assessments to be reviewed by the CE Department to incorporate potential improvements. Offered on a satisfactory-fail basis only.

C E 417. Land Surveying.

(2-3) Cr. 3. S. *Prereq: C E 111*

Legal principles affecting the determination of land boundaries, public domain survey systems. Locating sequential and simultaneous conveyances. Record research, plat preparation, and land description. Study of selected court cases.

C E 420. Environmental Engineering Chemistry.

(Dual-listed with C E 520). (Cross-listed with ENSCI). (2-3) Cr. 3. F. *Prereq: C E 326, CHEM 177 and CHEM 178, MATH 166*

Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilibria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions, and mass transfer principles. Individual laboratory practicals and group projects required.

C E 421. Environmental Biotechnology.

(Dual-listed with C E 521). (2-2) Cr. 3. F. *Prereq: C E 326*

Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens and parasites, and disinfection. Term paper and oral presentation.

C E 424. Air Pollution.

(Dual-listed with C E 524). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 424A. Air Pollution: Air quality and effects of pollutants.

(Dual-listed with C E 524A). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 424B. Air Pollution: Climate change and causes.

(Dual-listed with C E 524B). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 424C. Air Pollution: Transportation Air Quality.

(Dual-listed with C E 524C). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq: C E 524A; PHYS 221 or CHEM 178; MATH 166 or 3 credits in statistics. Senior classification or above.*

C E 424D. Air Pollution: Off-gas treatment technology.

(Dual-listed with C E 524D). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 424E. Air Pollution: Agricultural sources of pollution.

(Dual-listed with C E 524E). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 428. Water and Wastewater Treatment Plant Design.

(2-2) Cr. 3. S. *Prereq: C E 326*

Physical, chemical and biological processes for the treatment of water and wastewater including coagulation and flocculation, sedimentation, filtration, adsorption, chemical oxidation/disinfection, fixed film and suspended growth biological processes and sludge management.

C E 436. Masonry and Timber Design.

(Dual-listed with C E 536). (2-2) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: C E 334*

Behavior and design of clay and concrete masonry beams, columns, walls, and structural systems. Behavior and design of timber and laminated timber beams, columns, connections, and structural systems.

C E 440. Bioprocessing and Bioproducts.

(Dual-listed with C E 540). (Cross-listed with FS HN). (3-0) Cr. 3. F. *Prereq: C E 326 or equivalent, MATH 160 or MATH 165, CHEM 167 or higher, BIOL 173 or BIOL 211 or higher, senior or graduate classification*

Sustainability, cleaner production. Taxonomy, kinetics, metabolism, microbial cultivation, aerobic and anaerobic fermentation. Antibiotics, food supplements, fermented foods, vitamin production. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

C E 446. Bridge Design.

(Dual-listed with C E 546). (2-2) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: C E 333, C E 334

Bridge design in structural steel and reinforced concrete. Application of AASHTO Bridge Design Specifications. Analysis techniques for complex structures. Preliminary designs include investigating alternative structural systems and materials. Final designs include preparation of design calculations and sketches.

C E 448. Building Design.

(Dual-listed with C E 548). (2-2) Cr. 3. Alt. S., offered even-numbered years.

Prereq: C E 333, C E 334

Building design in structural steel and reinforced concrete. Investigation of structural behavior. Gravity and lateral load resisting systems. Application of current building codes and design specifications. In-depth analysis of gravity and wind loads on buildings. Review of building designs. Preliminary designs include investigating alternative structural systems. Approximate methods of structural analysis for gravity and lateral loads. Final designs include preparation of design calculations and sketches.

C E 449. Structural Health Monitoring.

(Dual-listed with C E 549). (Cross-listed with MAT E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Senior classification in Engineering or permission of instructor*

Every third semester. Introductory and advanced topics in structural health monitoring (SHM) of aeronautical, civil, and mechanical systems. Topics include sensors, signal processing in time and frequency domains, data acquisition and transmission systems, design of integrated SHM solutions, nondestructive evaluation techniques, feature extraction methods, and cutting edge research in the field of SHM. Graduate students will have a supervisory role to assist students in 449 and an additional design project or more in-depth analysis and design.

C E 451. Urban Transportation Planning Models.

(Dual-listed with C E 551). (3-0) Cr. 3. F. *Prereq: C E 350 or C E 355, STAT 101 or STAT 105*

Urban transportation planning context and process. Project planning and programming. Congestion, mitigation, and air quality issues. Transportation data sources. Travel demand and network modeling. Use of popular travel demand software and applications of geographic information systems.

C E 453. Highway Design.

(2-2) Cr. 3. F.S. *Prereq: C E 306, C E 355, C E 372, C E 382*

Introduction to highway planning and design. Design, construction, and maintenance of highway facilities; earthwork, drainage structures; pavements. Design project, oral reports and written reports. Computer applications.

C E 460. Foundation Engineering.

(3-0) Cr. 3. F.S. *Prereq: C E 360*

Fundamentals of foundation engineering. Exploration, sampling, and in-situ tests. Shallow and deep foundations. Settlement and bearing capacity analyses. Stability of excavations and earth retaining structures.

C E 467. Geomaterials Stabilization.

(Dual-listed with C E 567). (2-2) Cr. 3. F. Prereq: C E 360, C E 382 or C E 383
Soil and aggregate physical, chemical and biological stabilization procedures. Stabilization analysis and design. Ground modification and compaction methods. Geosynthetics application and design.

C E 473. Groundwater Hydrology.

(Dual-listed with C E 573). (3-0) Cr. 3. F. Prereq: C E 372
Principles of groundwater flow, hydraulics of wells, superposition, slug and pumping tests, streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Design project. Extra assignments required for graduate students.

C E 483. Pavement Analysis and Design.

(Dual-listed with C E 583). (3-0) Cr. 3. S. Prereq: C E 360 and C E 382
Analysis, behavior, performance, and structural design of pavement systems. Topics include climate factors, rehabilitation, life cycle design economics, material and system response, pavement foundations and traffic loadings. Development of models for and analysis of pavement systems. Use of transfer functions relating pavement response to pavement performance. Evaluation and application of current and evolving pavement design practices and procedures. Mechanistic-based pavement design techniques and concepts. Analysis of the effects of maintenance activities on pavement performance and economic evaluation of pavement systems.

C E 484. Advanced Design of Concretes.

(Dual-listed with C E 584). (2-2) Cr. 3. Alt. S., offered even-numbered years. Prereq: C E 382
Asphalt binder characterization, fundamentals of asphalt rheology, asphalt materials behavior under loading and temperature effects. High-strength, light-weight, fiber-reinforced, and self-consolidating portland cement concretes, mix design, properties, advanced performance testing. A term project is required for graduate level only.

C E 485. Civil Engineering Design.

(2-2) Cr. 3. F.S. Prereq: C E 306, C E 326, C E 333 or C E 334, C E 355, C E 360, C E 372, C E 382, SP CM 212. Course enrollment limited to final graduating semester.
The civil engineering design process, interacting with the client, identification of the engineering problems, development of a technical proposal, identification of design criteria, cost estimating, planning and scheduling, codes and standards, development of feasible alternatives, selection of best alternative, and oral presentation.

C E 488. Sustainable Horizontal Civil Infrastructure Systems.

(Dual-listed with C E 588). (3-0) Cr. 3. F. Prereq: Junior or higher classification in engineering of science
Sustainable planning, life cycle analysis, appropriate engineering design, and overall rating assessment of horizontal civil infrastructure (i.e., versus 'vertical building') systems, including highway, bridge, airport, rail, and port facilities. Course readings and final project/design report.

C E 490. Independent Study.

Cr. 1-3. Repeatable. F.S.SS. Prereq: Permission of instructor
Independent study in any phase of civil engineering. Pre-enrollment contract required.

C E 490H. Independent Study: Honors.

Cr. 1-3. Repeatable. F.S.SS. Prereq: Permission of instructor
Independent study in any phase of civil engineering. Pre-enrollment contract required.

C E 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. Prereq: C E 398, permission of department and Engineering Career Services
Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

C E 501. Preconstruction Project Engineering and Management.

(3-0) Cr. 3. Prereq: Credit or enrollment in CON E 421
Application of engineering and management control techniques to construction project development from conceptualization to notice to proceed. Emphasis is on managing complex projects using 5-dimensional project management theory.

C E 502. Construction Project Engineering and Management.

(3-0) Cr. 3. Prereq: Credit or enrollment in CON E 421
Application of engineering and management control techniques to complex construction projects. Construction project control techniques, stochastic estimating and scheduling, equipment selection and utilization, project administration, construction process simulation, Quality Management, and productivity improvement programs.

C E 503. Construction Finance and Business Management.

(3-0) Cr. 3. Prereq: Credit or enrollment in CON E 421
Fundamental theories and applied methods for financial management of construction companies. Construction accounting, cash flow analysis, financial planning and management, and risk analysis. Case studies.

C E 505. Design of Construction Systems.

(3-0) Cr. 3. Prereq: C E 334, C E 360, CON E 322 and CON E 340
Advanced design of concrete formwork and falsework systems. Design for excavation and marine construction including temporary retaining structures and cofferdams. Aggregate production operations, including blasting, crushing, and conveying systems. Rigging system design.

C E 506. Case Histories in Construction Documents.

(3-0) Cr. 3. Prereq: CON E 221, credit or enrollment in CON E 421
Study of cases involving disputes, claims, and responsibilities encountered by management in construction contract documents. Analysis of methods of resolving differences among the owner, architect, engineer, and construction contractor for a project.

C E 510. Information Technologies for Construction.

(3-0) Cr. 3. Prereq: CON E 421, ENGR 160 or C E 160 or equivalent
Information technologies including microcomputer based systems, management information systems, automation technologies, computer-aided design, and expert systems and their application in the construction industry. Overview of systems acquisition, communications, and networking.

C E 511. Bioprocessing and Bioproducts.

(3-0) Cr. 3. F. Prereq: A B E 216, C E 326 or equivalent, MATH 160 or MATH 165, CHEM 167 or higher, BIOL 173 or BIOL 211 or higher, senior or graduate classification
Sustainability, cleaner production. Taxonomy, kinetics, metabolism, microbial cultivation, aerobic and anaerobic fermentation. Antibiotics, food supplements, fermented foods, vitamin production. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis. Term paper for graduate level only.

C E 520. Environmental Engineering Chemistry.

(Dual-listed with C E 420). (Cross-listed with ENSCI). (2-3) Cr. 3. F. Prereq: C E 326, CHEM 177 and CHEM 178, MATH 166
Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilibria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions, and mass transfer principles. Individual laboratory practicals and group projects required.

C E 521. Environmental Biotechnology.

(Dual-listed with C E 421). (Cross-listed with ENSCI). (2-2) Cr. 3. F. Prereq: C E 326
Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens and parasites, and disinfection. Term paper and oral presentation.

C E 522. Water Pollution Control Processes.

(Cross-listed with ENSCI). (2-2) Cr. 3. Prereq: C E 521
Fundamentals of biochemical processes, aerobic growth in a single CSTR, multiple events in complex systems, and techniques for evaluating kinetic parameters; unit processes of activated sludge system, attached growth systems, stabilization and aerated lagoon systems, biosolids digestion and disposal, nutrient removal, and anaerobic treatment systems.

C E 523. Physical-Chemical Treatment Process.

(Cross-listed with ENSCI). (2-2) Cr. 3. Prereq: C E 520
Material and energy balances. Principles and design of physical-chemical unit processes; including screening, coagulation, flocculation, chemical precipitation, sedimentation, filtration, lime softening and stabilization, oxidation, adsorption, membrane processes, ion exchange and disinfection; recovery of resources from residuals and sludges; laboratory exercises and demonstrations; case studies in mineral processing and secondary industries.

C E 524. Air Pollution.

(Dual-listed with C E 424). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq:* Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

C E 524A. Air Pollution: Air quality and effects of pollutants.

(Dual-listed with C E 424A). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq:* Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above

C E 524B. Air Pollution: Climate change and causes.

(Dual-listed with C E 424B). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq:* C E 524A; Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above

C E 524C. Air Pollution: Transportation Air Quality.

(Dual-listed with C E 424C). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq:* C E 524A; PHYS 221 or CHEM 178; MATH 166 or 3 credits in statistics. Senior classification or above.

C E 524D. Air Pollution: Off-gas treatment technology.

(Dual-listed with C E 424D). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq:* C E 524A, C E 524B; Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above

C E 524E. Air Pollution: Agricultural sources of pollution.

(Dual-listed with C E 424E). (Cross-listed with A B E, ENSCI). (1-0) Cr. 1. *Prereq:* C E 524A, C E 524B; Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above

C E 528. Solid and Hazardous Waste Management.

(Cross-listed with ENSCI). (3-0) Cr. 0. *Prereq:* C E 326 or background courses in both environmental chemistry and microbiology; junior or higher standing
Evaluation, characterization, assessment, planning and design of solid and hazardous waste management systems, regulatory requirements, material characterization and collection, minimization and recycling, energy and materials recovery, composting, off-gas treatment, incineration, stabilization, and landfill design. Design of treatment and disposal systems, including physical, chemical, and biological treatment, solidification, incineration, secure landfill design, and final disposal site closure plus restoration.

C E 532. Structural Analysis II.

(3-0) Cr. 3. F. *Prereq:* C E 332
Analysis of indeterminate structural problems by the consistent deformation and generalized direct displacement methods. Direct stiffness method for 2-D frames, grids, 3-D frames. Special topics for the stiffness method.

C E 533. Structural Steel Design II.

(3-0) Cr. 3. *Prereq:* C E 333
Every third semester, offered F 2015. Theoretical background and development of AISC Specification equations. In-depth analysis and design of tension members, columns, beams, beam-columns, and plate girders. Emphasis on Load and Resistance Factor Design. Elastic and inelastic buckling of members and member elements. Investigation of amplification factors for members subject to combined bending and axial load and to combined bending and torsion. Effective Length Method and Direct Analysis Method of design. Approximate Second-Order Analysis. Biaxial bending. Torsion and combined bendin and torsion of W-shapes.

C E 534. Reinforced Concrete Design II.

(2-2) Cr. 3. *Prereq:* C E 334
Every third semester, offered S 2015. Advanced topics in reinforced concrete analysis and design. Moment-curvature and load-deflection behavior. Design of reinforced concrete long columns, two-way floor slabs, and isolated and combined footings. Design and behavior considerations for torsion, biaxial bending, and structural joints. Strut-and-tie modeling.

C E 535. Prestressed Concrete Structures.

(3-0) Cr. 3. *Prereq:* C E 334
Every third semester, offered S 2014. Design of prestressed concrete structures, review of hardware, stress calculations, prestress losses, section proportioning, flexural design, shear design, deflections, and statically indeterminate structures.

C E 536. Masonry and Timber Design.

(Dual-listed with C E 436). (2-2) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* C E 334
Behavior and design of clay and concrete masonry beams, columns, walls, and structural systems. Behavior and design of timber and laminated timber beams, columns, connections, and structural systems.

C E 540. Bioprocessing and Bioproducts.

(Dual-listed with C E 440). (Cross-listed with FS HN). (3-0) Cr. 3. F. *Prereq:* C E 326 or equivalent, MATH 160 or MATH 165, CHEM 167 or higher, BIOL 173 or BIOL 211 or higher, senior or graduate classification
Sustainability, cleaner production. Taxonomy, kinetics, metabolism, microbial cultivation, aerobic and anaerobic fermentation. Antibiotics, food supplements, fermented foods, vitamin production. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

C E 541. Dynamic Analysis of Structures.

(3-0) Cr. 3. *Prereq:* E M 345 and credit or enrollment in C E 532
Every third semester, offered F2014. Single and multi-degree-of-freedom systems. Free and forced vibrations. Linear and nonlinear response. Modal analysis. Response spectra. Seismic analysis.

C E 542. Structural Analysis by Finite Elements.

(3-0) Cr. 3. S. *Prereq:* C E 532
Use of the finite element method for the analysis of complex structural configurations. Plane stress, plate and shell finite elements. General purpose finite element programs.

C E 545. Seismic Design.

(3-0) Cr. 3. *Prereq:* C E 333, C E 334
Every third semester, offered S 2105. Seismic hazard in the United States. Engineering characteristics of ground motions. Structural damage in past earthquakes. Capacity design philosophy for seismic resistant design. Conceptual design of structures. Capacity design process including design of structural members.

C E 546. Bridge Design.

(Dual-listed with C E 446). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* C E 333, C E 334
Bridge design in structural steel and reinforced concrete. Application of AASHTO Bridge Design Specifications. Analysis techniques for complex structures. Preliminary designs include investigating alternative structural systems and materials. Final designs include preparation of design calculations and sketches.

C E 547. Analysis and Design of Plate and Slab Structures.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* C E 334, E M 514, MATH 266
Bending and buckling of thin plate components in structures utilizing classical and energy methods. Analysis of shell roofs by membrane and bending theories.

C E 548. Building Design.

(Dual-listed with C E 448). (2-2) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* C E 333, C E 334
Building design in structural steel and reinforced concrete. Investigation of structural behavior. Gravity and lateral load resisting systems. Application of current building codes and design specifications. In-depth analysis of gravity and wind loads on buildings. Review of building designs. Preliminary designs include investigating alternative structural systems. Approximate methods of structural analysis for gravity and lateral loads. Final designs include preparation of design calculations and sketches.

C E 549. Structural Health Monitoring.

(Dual-listed with C E 449). (Cross-listed with M S E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* Senior classification in Engineering or permission of instructor
Every third semester. Introductory and advanced topics in structural health monitoring (SHM) of aeronautical, civil, and mechanical systems. Topics include sensors, signal processing in time and frequency domains, data acquisition and transmission systems, design of integrated SHM solutions, nondestructive evaluation techniques, feature extraction methods, and cutting edge research in the field of SHM. Graduate students will have a supervisory role to assist students in 449 and an additional design project or more in-depth analysis and design.

C E 551. Urban Transportation Planning Models.

(Dual-listed with C E 451). (3-0) Cr. 3. F. *Prereq:* C E 350 or C E 355, STAT 101 or STAT 105
Urban transportation planning context and process. Project planning and programming. Congestion, mitigation, and air quality issues. Transportation data sources. Travel demand and network modeling. Use of popular travel demand software and applications of geographic information systems.

C E 552. Traffic Safety, Operations, and Maintenance.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* C E 355
Engineering aspects of highway traffic safety. Reduction of crash incidence and severity through highway design and traffic control. Accident analysis. Safety in highway design, maintenance, and operation.

C E 553. Traffic Engineering.(3-0) Cr. 3. F. *Prereq:* C E 355

Driver, pedestrian, and vehicular characteristics. Traffic characteristics; highway capacity; traffic studies and analyses. Principles of traffic control for improved highway traffic service. Application of appropriate computing software and tools.

C E 556. Transportation Data Analysis.(3-0) Cr. 3. *Prereq:* C E 355, a *Statistics course at the 300 level or higher*

Analysis of transportation data, identification of data sources and limitations. Static and dynamic data elements such as infrastructure characteristics, flow and operations-related data elements. Spatial and temporal extents data for planning, design, operations, and management of transportation systems. Summarizing, analyzing, modeling, and interpreting data. Use of information technologies for highways, transit, and aviation systems.

C E 557. Transportation Systems Analysis.(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* C E 355, 3 credits in *statistics or probability*

Travel studies and analysis of data. Transportation systems forecasts and analyses. Statewide, regional, and local transportation system planning. Network level systems planning and operations. Optimization of systems.

C E 558. Transportation Systems Development and Management.(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* C E 350 or C E 355

Study of designated problems in traffic engineering, transportation planning, and development. Forecasting and evaluation of social, economic, and environmental impacts of proposed solutions; considerations of alternatives. Formulation of recommendations and publication of a report. Presentation of recommendations in the host community.

C E 559. Transportation Infrastructure/Asset Management.(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* C E 355 or C E 453, C E 382

Engineering management techniques for maintaining and managing infrastructure assets. Systematic approach to management through value engineering, engineering economics, and life cycle cost analysis. Selection and scheduling of maintenance activities. Analysis of network-wide resource needs. Project level analysis.

C E 560. Fundamentals of Soil Mechanics.(3-0) Cr. 3. *Prereq:* C E 360

Nature of soil deposits, seepage, settlement and secondary compression, consolidation theories and analysis, failure theories, stress paths, introduction to critical state soil mechanics, constitutive models, soil strength under various drainage conditions, liquefaction of soil, pore pressure parameters, selection of soil parameters.

C E 561. Applied Foundation Engineering.(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* C E 460

Analysis and design of shallow and deep foundations, lateral earth pressure theories and retaining structures, field investigations, in-situ testing, and foundations on problematic soils. Foundation engineering reports.

C E 562. Site Evaluations for Civil Engineering Projects.(2-2) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* C E 360

Identification and mapping of engineering soils from airphotos, maps, and soil surveys. Planning subsurface investigations, geomaterials prospecting, geotechnical hazards, geomorphology, in situ testing and sampling, geophysical site characterization, instrumentation and monitoring, interpretation of engineering parameter values for design.

C E 563. Experimental Methods in Geo-Engineering.(2-2) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* C E 360

Principles of geo-engineering laboratory testing including the conduct, analysis, and interpretation of permeability, consolidation, triaxial, direct and ring shear, and direct simple shear tests. Issues regarding laboratory testing versus field testing and acquisition, transport, storage, and preparation of samples for geotechnical testing. Field and laboratory geotechnical monitoring techniques, including the measurements of deformation, strain, total stress and pore water pressure.

C E 564. Application of Numerical Methods to Geotechnical Design.(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* C E 560

Application of numerical methods to analysis and design of foundations, underground structures, and soil-structure interaction. Application of slope stability software. Layered soils, bearing capacity and settlement for complex geometries, wave equation for piles, and foundation vibrations.

C E 565. Fundamentals of Geomaterials Behavior.(2-3) Cr. 3. S. *Prereq:* C E 382

Atoms and molecules, crystal chemistry, clay minerals, structure of solids, phase transformations and phase equilibria. Surfaces and interfacial phenomena, colloidal chemistry, mechanical properties. Applications to soils and civil engineering materials. Overview of state-of-the-art instrumental techniques for analysis of the physicochemical properties of soils and civil engineering materials.

C E 567. Geomaterials Stabilization.(Dual-listed with C E 467). (2-2) Cr. 3. F. *Prereq:* C E 360, C E 382 or C E 383

Soil and aggregate physical, chemical and biological stabilization procedures. Stabilization analysis and design. Ground modification and compaction methods. Geosynthetics application and design.

C E 568. Dynamics of Soils and Foundations.(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* C E 360, E M 345

Dynamic soil properties and their measurement. Foundation dynamics and soil-structure interaction. Sources and characteristics of dynamic loads. Vibration of single- and multi-degree-of-freedom systems. Vibration of continuous systems; 1D, 2D, and 3D analyses, wave propagation. Liquefaction concepts and analysis methods. Introduction to geotechnical earthquake engineering.

C E 569. Ground Improvement.(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* C E 360

Classification of ground improvement methods. Dynamic compaction, vibrocompaction, preloading using fill surcharge, vacuum or a combination of both and prefabricated vertical drains, vibro replacement or stone columns, dynamic replacement, sand compaction piles, geotextile confined columns, rigid inclusion, column supported embankment, microbial methods, particulate and chemical grouting, lime and cement columns, jet grouting, and deep cement mixing.

C E 570. Applied Hydraulic Design.(2-2) Cr. 3. *Prereq:* C E 372

Flow characteristics in natural and constructed channels; principles of hydraulic design of culverts, bridge waterway openings, spillways, hydraulic gates and gated structures, pumping stations, and miscellaneous water control structures; pipe networks, mathematical modeling. Design project.

C E 571. Surface Water Hydrology.(Cross-listed with ENSCI). (3-0) Cr. 3. *Prereq:* C E 372

Analysis of hydrologic data including precipitation, infiltration, evapotranspiration, direct runoff and streamflow; theory and use of frequency analysis; theory of streamflow and reservoir routing; use of deterministic and statistical hydrologic models. Fundamentals of surface water quality modeling, point and non-point sources of contamination. Design project.

C E 572. Analysis and Modeling Aquatic Environments.(Cross-listed with ENSCI). (3-0) Cr. 3. *Prereq:* C E 372

Principles of surface water flows and mixing. Introduction to hydrologic transport and water quality simulation in natural water systems. Advection, diffusion and dispersion, chemical and biologic kinetics, and water quality dynamics. Applications to temperature, dissolved oxygen, primary productivity, and other water quality problems in rivers, lakes and reservoirs. Deterministic vs. stochastic models.

C E 573. Groundwater Hydrology.(Dual-listed with C E 473). (Cross-listed with ENSCI). (3-0) Cr. 3. F. *Prereq:* C E 372

Principles of groundwater flow, hydraulics of wells, superposition, slug and pumping tests, streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Design project. Extra assignments required for graduate students.

C E 576. Environmental Flows.(3-0) Cr. 3. *Prereq:* E M 378 or equivalent

Analysis and applications of flows in civil engineering, environmental engineering, and water resources. Primary topics include conservation laws, laminar flow, turbulence, mixing, diffusion, dispersion, water waves, and boundary layers. Associated applications include particle settling, transfer at air-water and water-sediment boundaries, flow and friction in pipes and open channels, contaminant transport, waves in lakes, jets, plumes, and salt wedges.

C E 581. Geotechnical and Materials Engineering Seminar.Cr. R. Repeatable. *Prereq:* Graduate classification

(1-0) Students and outside/invited speakers give weekly presentations about the ongoing research work and Geotechnical and Materials Engineering issues. Offered on a satisfactory-fail basis only.

C E 583. Pavement Analysis and Design.

(Dual-listed with C E 483). (3-0) Cr. 3. S. *Prereq: C E 360 and C E 382*
 Analysis, behavior, performance, and structural design of pavement systems. Topics include climate factors, rehabilitation, life cycle design economics, material and system response, pavement foundations and traffic loadings. Development of models for and analysis of pavement systems. Use of transfer functions relating pavement response to pavement performance. Evaluation and application of current and evolving pavement design practices and procedures. Mechanistic-based pavement design techniques and concepts. Analysis of the effects of maintenance activities on pavement performance and economic evaluation of pavement systems.

C E 584. Advanced Design of Concretes.

(Dual-listed with C E 484). (2-2) Cr. 3. Alt. S., offered even-numbered years.
Prereq: C E 382

Asphalt binder characterization, fundamentals of asphalt rheology, asphalt materials behavior under loading and temperature effects. High-strength, light-weight, fiber-reinforced, and self-consolidating portland cement concretes, mix design, properties, advanced performance testing. A term project is required for graduate level only.

C E 586. Advanced Asphalt Materials.

(2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq: C E 382*
 Advanced asphalt concrete (SUPERPAVE) mix designs. Aggregates. Admixtures. Production and construction, quality control and inspection. Nondestructive testing. Pavement thickness design. Materials engineering reports.

C E 587. Advanced Portland Cement Concretes.

(2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: C E 382 or C E 383*
 Hydraulic cements, aggregates, admixtures, and mix design; concrete production, quality control, early-age properties and durability. Concrete distress examination, identification, prevention, and nondestructive testing; advanced concrete technology, high-strength and high performance concrete.

C E 588. Sustainable Horizontal Civil Infrastructure Systems.

(Dual-listed with C E 488). (3-0) Cr. 3. F. *Prereq: Junior or higher classification in engineering of science*

Sustainable planning, life cycle analysis, appropriate engineering design, and overall rating assessment of horizontal civil infrastructure (i.e., versus 'vertical building') systems, including highway, bridge, airport, rail, and port facilities. Course readings and final project/design report.

C E 590. Special Topics.

Cr. 1-5. Repeatable. F.S.SS.
 Pre-enrollment contract required.

C E 591. Seminar in Environmental Engineering.

Cr. R. Repeatable. F.S. *Prereq: Graduate classification*
 (1-0) Contemporary environmental engineering issues. Outside speakers. Review of ongoing research in environmental engineering. Offered on a satisfactory-fail basis only.

C E 594. Special Topics in Construction Engineering and Management.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594A. Special Topics Construction Engineering and Mgt.: Planning and Scheduling.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594B. Special Topics Construction Engineering and Mgt.: Computer Applications for Planning and Scheduling.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594C. Special Topics Construction Engineering and Mgt.: Cost Estimating.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594D. Special Topics Construction Engineering and Mgt.: Computer Applications for Cost Estimating.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594E. Special Topics Construction Engineering and Mgt.: Project Controls.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594F. Special Topics Construction Engineering and Mgt.: Computer Applications for Project Controls.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594G. Special Topics Construction Engr and Mgt: Integration of Planning, Scheduling and Project Controls.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594J. Special Topics Construction Engineering and Mgt.: Trenchless Technologies.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594K. Special Topics Construction Engineering and Mgt.: Electrical and Mechanical Construction.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594L. Special Topics Construction Engineering and Mgt.: Advanced Building Construction Topics.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594M. Special Topics Construction Engineering and Mgt.: Design Build Construction.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594N. Special Topics Construction Engineering and Mgt.: Industrial Construction.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594O. Special Topics Construction Engineering and Mgt.: Highway and Heavy Construction.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594P. Special Topics Construction Engineering and Mgt.: Advanced Technologies.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594Q. Special Topics Construction Engineering and Mgt.: Construction Quality Control.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594R. Special Topics Construction Engineering and Mgt.: Risk Management.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 594S. Special Topics Construction Engineering and Mgt.: Building Information Modeling.

Cr. 1-3. Repeatable. *Prereq: CON E 322, CON E 340 or C E 306, and permission of instructor*

Some topics have a set number of credits and some topics have the number of credits vary. Emphasis for a particular offering will be selected from the following topics:.

C E 595. Research Methods in Construction Engineering and Management.

(1-0) Cr. 1. *Prereq: Credit or enrollment in C E 501, C E 502, C E 503, or C E 505*

Assigned readings and reports on research methods to solve construction engineering and management problems such as alternative project delivery methods, asset management, data mining, construction procurement, robotics, project controls, automation, construction visualization, etc. Identification of research methods and priorities, selection and development of research design, and critique of research in construction engineering and management.

C E 595A. Research Methods Seminar in Construction Engineering and Management: Qualitative Methods.

(1-0) Cr. 1. *Prereq: Credit or enrollment in C E 501, C E 502, C E 503, or C E 505*

Assigned readings and reports on research methods to assess and solve qualitative construction engineering and management problems.

C E 595B. Research Methods Seminar in Construction Engineering and Management: Quantitative Methods.

(1-0) Cr. 1. *Prereq: Credit or enrollment in C E 501, C E 502, C E 503, or C E 505*

Assigned readings and reports on research methods to assess and solve quantitative construction engineering and management problems.

C E 595C. Research Methods Seminar in Construction Engineering and Management: Technical Reporting.

(1-0) Cr. 1. *Prereq: Credit or enrollment in C E 501, C E 502, C E 503, or C E 505*

Assigned readings and reports on research methods for planning and preparation of technical reports with construction engineering and management projects.

C E 596. Special Topics in Transportation Engineering.

Cr. arr. Repeatable. *Prereq: C E 355*

C E 596A. Special Topics in Transportation Engineering: Intelligent Transportation Systems.

Cr. arr. Repeatable. *Prereq: C E 355*

C E 596B. Special Topics in Transportation Engineering: Geographic Information Systems in Transportation.

Cr. arr. Repeatable. *Prereq: C E 355*

C E 596C. Special Topics in Transportation Engineering: Hazardous Materials Transportation.

Cr. arr. Repeatable. *Prereq: C E 355*

C E 596D. Special Topics in Transportation Engineering: Transportation and Public Works.

Cr. arr. Repeatable. *Prereq: C E 355*

C E 596E. Special Topics in Transportation Engineering: Sustainable Transportation.

Cr. arr. Repeatable. *Prereq: C E 355*

C E 596F. Special Topics in Transportation Engineering: Freight Transportation.

Cr. arr. Repeatable. *Prereq: C E 355*

C E 599. Creative Component.

Cr. 1-3. Repeatable.

Pre-enrollment contract required. Advanced topic for creative component report in lieu of thesis.

Courses for graduate students:**C E 622. Advanced Topics in Environmental Engineering.**

(2-0) Cr. 2. Repeatable. *Prereq: Permission of environmental engineering graduate faculty*

Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:.

C E 622A. Advanced Topics in Environmental Engineering: Water Pollution Control.

(2-0) Cr. 2. Repeatable. *Prereq: Permission of environmental engineering graduate faculty*

Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:.

C E 622B. Advanced Topics in Environmental Engineering: Water Treatment.

(2-0) Cr. 2. Repeatable. *Prereq: Permission of environmental engineering graduate faculty*

Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:.

C E 622C. Advanced Topics in Environmental Engineering: Solid and Hazardous Waste.

(2-0) Cr. 2. Repeatable. *Prereq: Permission of environmental engineering graduate faculty*

Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:.

C E 622D. Advanced Topics in Environmental Engineering: Water Resources.

(2-0) Cr. 2. Repeatable. *Prereq: Permission of environmental engineering graduate faculty*

Advanced concepts in environmental engineering. Emphasis for a particular offering will be selected from the following topics:.

C E 650. Advanced Topics in Transportation Engineering.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of Transportation Engineering graduate faculty*

C E 650A. Advanced Topics in Transportation Engineering: Highway Design.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of Transportation Engineering graduate faculty*

C E 650B. Advanced Topics in Transportation Engineering: Traffic Operations.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of Transportation Engineering graduate faculty*

C E 690. Advanced Topics.

Cr. 1-3. Repeatable. F.S.SS.

Pre-enrollment contract required.

C E 697. Engineering Internship.

Cr. R. Repeatable. *Prereq: Permission of coop advisor, graduate classification*
One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

C E 699. Research.

Cr. 1-30. Repeatable. *Prereq: Pre-enrollment contract required*

Advanced topic for thesis/dissertation.

Classical Studies (CL ST)

Courses primarily for undergraduates:

CL ST 201. Technical Terminologies in the Professions.

(3-0) Cr. 3. F.S.

Essential vocabulary and concepts in English that are derived from Latin and Ancient Greek. Formation and usage of technical terminology. Cultural influence of the classical languages. Analysis of technical writing.

CL ST 273. Greek and Roman Mythology.

(3-0) Cr. 3. F.SS.

Survey of the legends, myths of the classical world with emphasis on the principal gods, and heroes, and their relation to ancient social, psychological, and religious practices; some attention may be given to important modern theories.

Meets International Perspectives Requirement.

CL ST 273H. Greek and Roman Mythology: Honors.

(4-0) Cr. 4. F.SS.

Survey of the legends, myths of the classical world with emphasis on the principal gods, and heroes, and their relation to ancient social, psychological, and religious practices; some attention may be given to important modern theories.

Meets International Perspectives Requirement.

CL ST 275. The Ancient City.

(3-0) Cr. 3. F.S.

Examination of ancient urban life, including historical context, physical space, material culture, religion, literature, and art; examination of civic identity (the "polis"). Contrast between the concepts of urban and rural. Examples drawn from specific ancient cities; some attention to modern methods of recovering the conditions of ancient urban life and the fundamental concept of the city in European history.

Meets International Perspectives Requirement.

CL ST 275H. The Ancient City: Honors.

(4-0) Cr. 4. F.S.

Examination of ancient urban life, including historical context, physical space, material culture, religion, literature, and art; examination of civic identity (the "polis"). Contrast between the concepts of urban and rural. Examples drawn from specific ancient cities; some attention to modern methods of recovering the conditions of ancient urban life and the fundamental concept of the city in European history.

Meets International Perspectives Requirement.

CL ST 304. Cultural Heritage of the Ancient World.

(Cross-listed with HIST). (3-0) Cr. 3. *Prereq: Sophomore classification*

Historical examination of art, literature, thought, and religious beliefs of major civilizations of the ancient Mediterranean countries until the end of the 8th century.

CL ST 310. Ancient Philosophy.

(Cross-listed with PHIL). (3-0) Cr. 3. F. *Prereq: PHIL 201*

Survey of ancient Greek philosophy, focusing on the pre-Socratics, Plato, and Aristotle. Questions concerning being, knowledge, language, and the good life are treated in depth.

CL ST 350. Rhetorical Traditions.

(Cross-listed with ENGL, SP CM). (3-0) Cr. 3. S. *Prereq: ENGL 250*

Ideas about the relationship between rhetoric and society in contemporary and historical contexts. An exploration of classical and contemporary rhetorical theories in relation to selected topics that may include politics, gender, race, ethics, education, science, or technology.

CL ST 353. World Literature: Western Foundations through Renaissance.

(Cross-listed with ENGL). (3-0) Cr. 3. F.S. *Prereq: ENGL 250*

Representative works from the drama, epics, poetry, and prose of the Ancient World through the late sixteenth century. May include Homer, Aeschylus, Sappho, Catullus, Dante, Marie de France, Boccaccio, Christine de Pizan, Cervantes, and others.

Meets International Perspectives Requirement.

CL ST 367. Christianity in the Roman Empire.

(Cross-listed with RELIG). (3-0) Cr. 3.

An historical introduction to the rise of Christianity in the Roman empire, with special attention to the impact of Greco-Roman culture on the thought and practice of Christians and the interaction of early Christians with their contemporaries.

CL ST 372. Greek and Roman Tragedy and Comedy.

(3-0) Cr. 3. S. *Prereq: CL ST 273 or CL ST 275 or one course in Latin or Greek or ENGL 250*

Greek and Roman drama from the beginnings until today. Readings in English from authors such as Aeschylus, Sophocles, Euripides, Aristophanes, Menander, Plautus, Terence, Seneca. Course may cover performance, theories of comedy and tragedy, recent and current expressions of the comic and tragic in film and other media.

Meets International Perspectives Requirement.

CL ST 372H. Greek and Roman Tragedy and Comedy: Honors.

(4-0) Cr. 4. S. *Prereq: CL ST 273 or CL ST 275 or one course in Latin or Greek or ENGL 250*

Greek and Roman drama from the beginnings until today. Readings in English from authors such as Aeschylus, Sophocles, Euripides, Aristophanes, Menander, Plautus, Terence, Seneca. Course may cover performance, theories of comedy and tragedy, recent and current expressions of the comic and tragic in film and other media.

Meets International Perspectives Requirement.

CL ST 373. Heroes of Greece, Rome, and Today.

(3-0) Cr. 3. F. *Prereq: CL ST 273 or CL ST 275 or one course in Latin or Greek or ENGL 250.*

Cultural and political significance of ancient epic, especially in Greece and Rome. Course may include study of the heroic code in antiquity and its modern expressions including in film. Readings in English from authors such as Homer and Vergil.

Meets International Perspectives Requirement.

CL ST 373H. Heroes of Greece, Rome, and Today: Honors.

(4-0) Cr. 4. F. *Prereq: CL ST 273 or CL ST 275 or one course in Latin or Greek or ENGL 250.*

Cultural and political significance of ancient epic, especially in Greece and Rome. Course may include study of the heroic code in antiquity and its modern expressions including in film. Readings in English from authors such as Homer and Vergil.

Meets International Perspectives Requirement.

CL ST 374. Sex, Gender, and Culture in the Ancient Mediterranean World.

(Cross-listed with HIST, W S). (3-0) Cr. 3. S. *Prereq: Any one course in Cl St, W S, Latin, or Greek*

Chronological and topical survey of the status of women and men, focusing on sex and gender issues in the Ancient Mediterranean world; study of constructs of the female and the feminine. Readings from ancient and modern sources. Emphasis on ancient Greece, Rome, and Egypt.

Meets International Perspectives Requirement.

CL ST 376. Classical Archaeology.

(Cross-listed with ANTHR, RELIG). (3-0) Cr. 3. S.

Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.

Meets International Perspectives Requirement.

CL ST 376A. Classical Archeology: Bronze Age and Early Iron Age Greece.

(Cross-listed with ANTHR, RELIG). (3-0) Cr. 3. S.

Bronze Age (Minoan and Mycenaean palatial cultures) and Early Iron Age Greece. (ca 3000-700 BCE). Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.

Meets International Perspectives Requirement.

CL ST 376B. Classical Archeology: Archaic through Hellenistic Greece (ca 700-30 BCE).

(Cross-listed with ANTHR, RELIG). (3-0) Cr. 3. S.

Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.

Meets International Perspectives Requirement.

CL ST 376C. Classical Archaeology: Roman Archaeology (ca 1000 BCE-400 CE).

(3-0) Cr. 3. S.

Chronological survey of the material culture of the ancient Roman world and the role of archaeological context in understanding the varied aspects of ancient Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.

Meets International Perspectives Requirement.

CL ST 383. Greek and Roman Art.

(Cross-listed with ART H). (3-0) Cr. 3.

Greek art from Neolithic to Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West.

CL ST 383H. Greek and Roman Art: Honors.

(Cross-listed with ART H). (3-0) Cr. 3-4.

Greek art from Neolithic to Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West.

CL ST 394. The Archaeology of Greece: An Introduction.

(2-0) Cr. 2. Repeatable, maximum of 4 credits. S.

Introduction to the topography, history, archaeology, monuments and art of Greece from the Bronze Age through the Ottoman period; attention given to the culture of modern Greece, preparatory to study abroad in Greece (Cl St 395). Meets International Perspectives Requirement.

CL ST 395. Study Abroad: The Archaeology of Greece.

Cr. 2-6. Repeatable, maximum of 9 credits. SS. *Prereq: CL ST 394*

Supervised on-site instruction in the archaeology, monuments, and art of Greece from the Bronze Age through the Ottoman period; attention given to the culture of modern Greece.

Meets International Perspectives Requirement.

CL ST 402. Greek Civilization.

(Cross-listed with HIST). (3-0) Cr. 3. *Prereq: Sophomore classification*

Ancient Greece from the Bronze Age to the Hellenistic period; evolution of the Greek polis and its cultural contributions, with a particular emphasis on the writings of Herodotus and Thucydides.

CL ST 403. Roman Civilization.

(Cross-listed with HIST). (3-0) Cr. 3. *Prereq: Sophomore classification*

Ancient Rome from the Regal Period to the fall of the Western Empire; evolution of Roman institutions and Rome's cultural contributions studied through original sources.

CL ST 430. Foundations of Western Political Thought.

(Cross-listed with POL S). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European history*

Study of original texts in political thought ranging from the classical period to the renaissance. Topics such as justice, freedom, virtue, the allocation of political power, the meaning of democracy, human nature, and natural law.

CL ST 480. Seminar in Classical Studies.

(3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 30 credits in Classical Studies or related courses, permission of Program Chair*

Advanced study of a selected topic in Classical Studies. Research paper or project selected by the student.

CL ST 490. Independent Study.

Cr. 1-6. Repeatable, maximum of 9 credits. *Prereq: 7 credits in classical studies at the 200 level or higher; permission of the Program Chair*

Designed to meet the needs of students who wish to study specific topics in classical civilization in areas where courses are not offered, or to pursue such study beyond the limits of existing courses.

Courses primarily for graduate students, open to qualified undergraduates:**CL ST 512. Proseminar in European History.**

(3-0) Cr. 3. *Prereq: Permission of instructor.*

Readings in European history.

CL ST 512A. Proseminar in European History, Ancient.

(Cross-listed with HIST). (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

Readings in European history.

CL ST 583. Greek and Roman Art.

(3-0) Cr. 3. *Prereq: Graduate classification and permission of instructor*

Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West.

CL ST 594. Seminar in European History.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

Topics vary each time offered.

CL ST 594A. Seminar in European History: Ancient.

(Cross-listed with HIST). (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

Topics vary each time offered.

Communication Disorders (CMDIS)

Courses primarily for undergraduates:

CMDIS 170. Speech Improvement for Nonnative Speakers.

(2-0) Cr. 2.

For nonnative speakers of English only. Development of effective English vowel and consonant productions, accommodation processes that occur in context, intelligibility in conversational English, and appropriate stress patterns. Offered on a satisfactory-fail basis only.

CMDIS 275. Introduction to Communication Disorders.

(Cross-listed with LING). (3-0) Cr. 3.

Survey of nature, causes, and types of major communication disorders including phonological, adult and child language, voice, cleft palate, fluency, and hearing disorders.

CMDIS 286. Communicating with the Deaf.

(Cross-listed with LING). (3-0) Cr. 3.

Learn to communicate with the deaf using Signed English and Signed Pidgin English. Other topics covered include types, causes, and consequences of hearing loss, hearing technology (hearing aids, assistive listening devices, and cochlear implants), education of hearing-impaired children, Deaf culture, and the history of manual communication.

Meets U.S. Diversity Requirement

CMDIS 371. Phonetics and Phonology.

(Cross-listed with LING). (3-0) Cr. 3. *Prereq: ENGL 219*

Analysis of speech through study of individual sounds, their variations, and relationships in context; English phonology; practice in auditory discrimination and transcription of sounds of American English; description of speech sounds in terms of their production, transmission, and perception.

CMDIS 471. Language and Reading Development in Children.

(Cross-listed with LING). (3-0) Cr. 3. *Prereq: CMDIS 275 or PSYCH 230 or ENGL 219 or LING 219*

Theories and developmental processes related to the components of language (semantics, syntax, morphology, phonology, and pragmatics); the development of metalinguistic knowledge; theories and developmental processes of reading.

CMDIS 480. Topics in Communication Disorders.

(3-0) Cr. 3. F.S. *Prereq: CMDIS/LING 275, CMDIS/LING 371, and BIOL 255; permission of instructor.*

Guided examination of topics in preparation for graduate work in Speech-Language Pathology or Audiology. Primary course delivery by WWW.

CMDIS 480A. Topics in Communication Disorders: Anatomy and Physiology of Speech and Hearing.

(Cross-listed with LING). (3-0) Cr. 3. F.S. *Prereq: CMDIS/LING 275, CMDIS/LING 371, and BIOL 255; permission of instructor.*

Guided examination of topics in preparation for graduate work in Speech-Language Pathology or Audiology. Primary course delivery by WWW.

CMDIS 480B. Topics in Communication Disorders: Articulation and Phonological Disorders.

(Cross-listed with LING). (3-0) Cr. 3. F.S. *Prereq: CMDIS/LING 275, CMDIS/LING 371, and BIOL 255; permission of instructor.*

Guided examination of topics in preparation for graduate work in Speech-Language Pathology or Audiology. Primary course delivery by WWW.

CMDIS 480C. Topics in Communication Disorders: Evaluation and diagnosis of communication disorders.

(Cross-listed with LING). (3-0) Cr. 3. F.S. *Prereq: CMDIS/LING 275, CMDIS/LING 371, and BIOL 255; permission of instructor.*

Guided examination of topics in preparation for graduate work in Speech-Language Pathology or Audiology. Primary course delivery by WWW.

Communication Studies (COMST)

Courses primarily for undergraduates:

COMST 101. Introduction to Communication Studies.

(3-0) Cr. 3.

An introduction to communication theory, the development and functions of communication, and a survey of verbal, nonverbal, interpersonal, small group, organizational, and intercultural communication.

COMST 101L. Introduction to Communication Studies: Laboratory.

(0-1) Cr. 1. *Prereq: Concurrent enrollment in COMST 101.*

Laboratory component of COMST 101. Skill building, experiential activities, and in-depth discussions relevant to the study of communication.

COMST 102. Introduction to Interpersonal Communication.

(3-0) Cr. 3.

Application of communication principles, theory, and research to the process of interpersonal communication; includes verbal and nonverbal communication, listening, and conflict management. Particular emphasis given to using communication to manage interpersonal relationships.

COMST 104. Orientation to Communication Studies.

(1-0) Cr. 1. *Prereq: Available only for Communication Studies majors.*

Orientation to Communication Studies discipline, program requirements and career opportunities. Required of communication studies majors. Offered on a satisfactory-fail basis only.

COMST 203. Introduction to Communication Research Methods.

(3-0) Cr. 3.

An introduction to analyzing and conducting communication research. Provides an overview of quantitative and qualitative approaches to communication research.

COMST 214. Professional Communication.

(3-0) Cr. 3.

Communication theory and skill development in organizational settings. Emphasis on interpersonal skill development, team and meeting facilitation, informational interviewing, individual and team presentations, and self-assessment.

COMST 218. Conflict Management.

(3-0) Cr. 3.

Exploration of communication theories, principles and methods associated with effective conflict management.

COMST 301. Human Communication Theory.

(3-0) Cr. 3. *Prereq: COMST 101*

Examination of the major theories related to human communication; with particular emphasis on theories underlying interpersonal, small group, organizational, and intercultural communication.

COMST 310. Intercultural Communication.

(3-0) Cr. 3. *Prereq: COMST 101, COMST 102, COMST 203, COMST 301*

Examines the theories, principles and research on intercultural communication to enhance cultural sensitivity and to recognize, accept, and adapt to cultural diversity. Interactive assignments.

Meets International Perspectives Requirement.

COMST 311. Studies in Interpersonal Communication.

(3-0) Cr. 3. *Prereq: COMST 101, COMST 102, COMST 203, COMST 301*

This class focuses on studies of contemporary interpersonal communication concepts and theories. Emphasis on research that examines issues central to communication in interpersonal relationships.

COMST 313. Leadership Communication Theories.

(3-0) Cr. 3. F.S. *Prereq: COMST 101, COMST 102, COMST 203, COMST 301*

Investigation of theories, research and principles of leadership communication. Exploration of the contexts in which leadership and communication occurs, with emphasis on the connection between communication and leadership and the dyadic linkage of leader and follower.

COMST 314. Organizational Communication.

(3-0) Cr. 3. *Prereq: COMST 101, COMST 102, COMST 203, COMST 301*

Theory and research in organizational communication. Provides strategies for assessing and improving individual and organizational communication effectiveness. Addresses issues such as technology, diversity, work-life negotiation, emotional labor, conflict, socialization, and socially responsible organizations. Explores how organizational meaning is created and sustained through human communication.

COMST 317. Small Group Communication.

(3-0) Cr. 3. *Prereq: COMST 101, COMST 102, COMST 203, COMST 301*

Theory and research in small group communication; application to group decision-making and leadership. Includes communication analyses of groups and teams.

COMST 319. Communication Training and Development.

(3-0) Cr. 3. *Prereq: COMST 101, COMST 102, COMST 203, COMST 301*

Theories and approaches to communication training and development; includes adult learning theory. Emphasis on the design, presentation and assessment of communication skills in organizational contexts.

COMST 325. Nonverbal Communication.

(3-0) Cr. 3. *Prereq: COMST 101, COMST 102, COMST 203, COMST 301*

Approaches to studying nonverbal communication. Foci include topics such as emotion, gestures, gaze, use of space, and parsing intention in social interaction.

COMST 330. Computer Mediated Communication.

(3-0) Cr. 3. *Prereq: COMST 101, COMST 102, COMST 203, COMST 301*

Theories and approaches related to mediated communication in interpersonal and organizational settings. Focus on how new technology impacts human interaction and relationships.

COMST 384. Applied Organizational Communication.

(3-0) Cr. 3. *Prereq: COMST 101, COMST 102 or equivalent course.*

Theory and research of micro-level organizational communication, including interpersonal and small group interactions taking place in a professional setting. Topics include interpersonal dynamics in such areas as conflict, generational communication, negotiation, superior/subordinate communication, external communication, and virtual communication. Not available for major credit.

COMST 404. Research Seminar.

(Dual-listed with COMST 504). (3-0) Cr. 3. Repeatable, maximum of 9 credits.

Prereq: COMST 301 plus 3 additional communication studies classes from the following list: COMST 310, COMST 311, COMST 313, COMST 314, COMST 317, COMST 319, COMST 325, or COMST 330.

Capstone communication studies course. Students develop an original research study linked to the study of communication. Data are collected and analyzed. Results are presented in a final research paper and a presentation.

COMST 450. Special Topics in Communication Studies.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. F.S.

Research and theory related to special topics and issues in communication studies.

COMST 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 6 credits. *Prereq: 9 credits in communication studies and junior classification*

Application must be submitted for approval the semester prior to the independent study.

COMST 491. Research Practicum.

Cr. arr. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: COMST 203, COMST 301 plus permission of instructor.*

Providing research assistance on projects conducted by Communication Studies faculty.

COMST 497. Professional Internship.

Cr. 1-3. Repeatable, maximum of 6 credits. *Prereq: 12 hours in Communication Studies including COMST 203, COMST 301, and one other 300-level COMST class. Junior Classification. Application required.*

100 hours of on-site professional work per credit hour plus completion of the academic requirement set by the internship committee. Application should be submitted in the term prior to the term in which the internship will be served. Internship cannot be used to meet degree requirement in Communication Studies.

Courses primarily for graduate students, open to qualified undergraduates:

COMST 504. Research Seminar.

(Dual-listed with COMST 404). (3-0) Cr. 3. Repeatable, maximum of 9 credits.

Prereq: COMST 301 plus 3 additional communication studies classes from the following list: COMST 310, COMST 311, COMST 313, COMST 314, COMST 317, COMST 319, COMST 325, or COMST 330.

Capstone communication studies course. Students develop an original research study linked to the study of communication. Data are collected and analyzed. Results are presented in a final research paper and a presentation.

COMST 590. Special Topics.

Cr. 1-4. Repeatable.

Application must be submitted for approval the semester prior to the independent study.

Community Development (C DEV)

Courses primarily for graduate students, open to qualified undergraduates:

C DEV 502. Community and Natural Resource Management.

(3-0) Cr. 3.

Detailed introduction to community resource management. Theoretical frameworks, methodological investigation, applied practices. Enhancement of ability of community development professionals to work with communities to plan, develop and monitor conversation and development of natural resources with multiple functions.

C DEV 503. Community Development I: Principles and Strategies of Community Change.

(3-0) Cr. 3.

Analysis of principles and practices of community change and development. Use of case studies to relate community development approaches to conceptual models from diverse disciplines. Exploration of professional practice principles, and student construction of their personal framework for practicing community development.

C DEV 504. Community Analysis: Introduction to Methods.

(3-0) Cr. 3.

Introduction to research methods relevant to community development. Formulate and begin a research effort, methods of data collection and how conceptual frameworks are used to develop the questions and analyze data. Emphasis on strategies for reporting findings and applying findings in community action and methods of evaluating the entire research process. Significant attention paid to issues of research ethics and inclusiveness.

C DEV 505. Community Development II: Organizing for Community Change.

(3-0) Cr. 3.

Examines role of civil society in community planning efforts. Comparative approach to planning theories and approaches. Focus on change within communities and the roles of government, planners, and citizens in reacting to or shaping change. Dimensions of social capital and the context of change covered.

C DEV 506. Community and Regional Economic Analysis I.

(3-0) Cr. 3.

Introduction to concepts of communities and regions, theories of economic growth, drivers of economic growth, the economic base of a community, sources of growth or decline in the community, roles of local government and institutions, and analytical tools. Strategies for local economic development will also be explored.

C DEV 507. Introduction to Native Communities.

(3-0) Cr. 3.

A base knowledge course. For students currently working within, in partnership with, or considering working with Native communities. Basic understanding within the context of community development of the diversity of the tribal structures and cultures and the unique history and jurisdictional considerations of these nations. Working with tribes, Federal and Indian relations, and governance and cultural issues.

C DEV 508. Ecological Economics.

(3-0) Cr. 3.

Approaches economy and community by looking at the inherent interdependence, jointness, and potential complementarity between ecology and economy (utility) of a place.

C DEV 509. Building Native Community and Economic Capacity.

(3-0) Cr. 3.

Focus on non-western approaches to helping Native communities build their capacity. Students will learn to take a participatory, culture-centered, and strength-based approach to development.

C DEV 510. Indian Country Agriculture and Natural Resources.

(3-0) Cr. 3.

Introduction to the historical and contemporary issues related to natural resource management on Native American lands. Philosophical and economic arguments concerning natural resource conservation, preservation and extraction will be explored.

C DEV 512. Sustainable Communities.

(3-0) Cr. 3.

Students will learn the conceptual relationships among Community and Sustainable Development and Sustainable Communities and examine the social, environmental, and economic aspects of sustainable communities. The course includes analysis of public policy impacts on community sustainability, practical actions for enhancing sustainability, and changing power dynamics and reward structures involved in incorporating sustainability into Community Development.

C DEV 513. Economic Development Strategies and Programs.

(3-0) Cr. 3.

Course explores theories of local economic development and addresses the development issues faced by communities in the 21st century. Students will understand and apply concepts from economic development planning, economic analysis, business development, human resource development, community-based development, and high-technology development.

C DEV 520. Orientation in Community Development.

(1-0) Cr. 1.

Introduction to the Community Development program. Focus on on-line delivery methods, graduate level research and writing, technology skills.

C DEV 521. Housing and Development.

Cr. 3. S. Prereq: None.

Review and evaluation of historical and current housing issues, production, and financial systems, including consideration of racial, ethnic, income, and gender issues as they relate to the role of housing developments and programs in community development.

C DEV 522. Community Leadership and Capacity Building.

(3-0) Cr. 3.

Defining leadership and applying it to the workplace. Understanding of potential link between leadership and community capacity. Identifying strategies for leadership development in communities.

C DEV 523. Grantwriting for Community Development Professionals.

(3-0) Cr. 3.

Basic Grant Development and Management will introduce students to the grant-getting process and provide an overview of what happens after a project is funded. The following topics will be covered: researching funding sources, generating cutting edge ideas, assessing needs, planning a project, establishing credibility, formulating a sustainable budget, designing an evaluation plan, managing the funded project, and disseminating project results.

C DEV 524. Non-Profit Management in Community Development.

(3-0) Cr. 3.

Understanding of how non-profit organizations are run in order that they may participate more fully in community development efforts. Learning skills necessary to assist organizations to manage community development projects and programs, such as, budgeting, planning, personnel, facilities, volunteer management, and fundraising.

C DEV 525. Role of Tribal Colleges in Economic Development.

(3-0) Cr. 3.

Focus on role of tribally-chartered colleges and universities in economic development within Native communities. Social capital analytic framework to examine and evaluate tribal college model of economic development.

C DEV 526. Immigration and Community Inclusion.

(3-0) Cr. 3.

Mechanisms for community inclusion and exclusion in relation to immigration will be examined. Aspects of ethnicity, religion, occupation and transnationalism are addressed in terms of community mechanism for incorporating immigrants as community assets.

C DEV 527. Public and Non-Profit Budgeting.

Cr. 3. SS.

Introduction to the fundamental theories and practices of budgeting in the public and non-profit sectors. Topics covered include overview of budgeting and budget reform, taxation, expenditures, budget preparation and adoption, budget implementation, and performance budgeting.

C DEV 528. Evaluation of Organizations and Programs.

(3-0) Cr. 3. Prereq: C DEV 504 with grade of C or better

Introduction to the philosophy, techniques, and methodologies of organizational and program evaluation. Overview of program evaluation and theory, techniques to evaluate program processes and performance, evaluation designs, assessing program efficiency, models to diagnose organizations, and methods to assess organizational performance.

C DEV 530. Toward Ethical Engagement.

(3-0) Cr. 3.

Understanding what ethics are and identify ethical dimensions of a problem. Ability to employ ethical analysis and engagement strategies in public problem-solving.

C DEV 532. Community and Regional Economic Analysis II.

(3-0) Cr. 3. *Prereq: C DEV 506*

Substantive grounding in the theories and practice of measuring community economic dynamics; build solid foundation skills for applied community economic analysis.

C DEV 542. The Policy and Politics of Coastal Areas.

(Cross-listed with POL S). (3-0) Cr. 3.

Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, tradeoffs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

C DEV 590. Special Topics in Community Development.

Cr. 1-3. F.S.SS.

Special topics in Community Development. Independent Study, must get instructor approval.

C DEV 599. Creative Component.

Cr. arr.

Students work with major professor to conduct research and carry out work on their creative component. Instructor permission required.

Courses for graduate students:**C DEV 699. Thesis Research.**

Cr. 1-6. F.S.SS.

Thesis Research.

Community Leadership and Public Service (CL PS)

Courses primarily for undergraduates:

CL PS 122. Leading with Purpose.

(1-0) Cr. 1. F.S.

Designed for emerging student leaders, this course will provide students with basic leadership skills covering strengths identification, personal skills development, goal achievement, values-based behaviors, and mission statement development.

CL PS 270. Campus Leadership Development.

(3-0) Cr. 3. F.S.

Theory and practice of effective leadership in a campus context. Study of effective leadership models and leadership in complex systems. Expectation of engagement in campus activities.

CL PS 322. Leadership Styles and Strategies in a Diverse Society.

(3-0) Cr. 3. *Prereq: Sophomore classification*

Developing and practicing leadership skills through understanding personal leadership styles, leadership theory and communication theory, including how they relate to gender issues and cultural diversity; exploring personality types, communication styles, and leadership styles, networking and developing mentoring relationships; setting goals and participating in leadership opportunities and service.

Meets U.S. Diversity Requirement

CL PS 333. Women and Leadership.

(Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification*

This course will examine historical and contemporary barriers to and opportunities for women's leadership in a variety of contexts, including professions and public service. It will examine theories of women's leadership, gender differences in leadership styles, and the perceptions and expectations about women's leadership. Multiple perspectives of women's leadership will be highlighted through lectures, readings, videos, guest speakers and group work.

Meets U.S. Diversity Requirement

CL PS 488. Research on Women and Leadership.

(Cross-listed with W S). (3-0) Cr. 3.

Research on women and leadership in selected content areas (e.g., business, education, politics and public service, and popular culture). Following an overview of quantitative and qualitative methods and critical analyses of journal articles on women and leadership, students will work in groups in selected content areas to research, write and present paper.

Community and Regional Planning (C R P)

Courses primarily for undergraduates:

C R P 201. Making the Metropolis.

(3-0) Cr. 3. F.S.

Examination of the evolution of American urban centers from the colonial era to the present. Considers the demographic changes and social movements underway in urban America and explores how an understanding of the history of cities provides us with knowledge that we can use to improve our cities today. Meets U.S. Diversity Requirement

C R P 291. World Cities and Globalization.

(3-0) Cr. 3. F.

World cities and globalization in developed and developing countries. Topics include globalization, world cities and regions, uneven economic development, the international division of labor, multinational corporations, international environmentalism, tourism, popular culture and place-based identity. Meets International Perspectives Requirement.

C R P 293. Environmental Planning.

(Cross-listed with ENV S). (3-0) Cr. 3. F.

Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water.

C R P 301. Planning Methods Studio.

(3-2) Cr. 4. S.

An introduction to the methods and analytical techniques used by planners to study community change. Course includes identification of key sources of planning information and data. Students learn to use quantitative methods for analysis of population, land use, economic and transportation data. Students learn to apply basic analytic methods to community problems and learn the art of effective written, graphic, and oral presentation of data.

C R P 320. Urban Form.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: C R P 253 or C R P 270, or permission of instructor*

Examines how urban form is shaped, what constitutes good urban form, and what are the trends in emerging urban forms. Descriptive, explanatory and normative theories of urban form, and the relationships between urban form and social, economic, political, cultural, and institutional forms.

C R P 330. Practicum.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Major in community and regional planning*

Structured work experience under close supervision of a professional planner. Practical planning experience; relationships between theory and practice, professional responsibilities, and the scope of various planning roles.

C R P 331. Professional Practice Seminar.

(Dual-listed with C R P 531). (1-0) Cr. 1. S. *Prereq: Major in community and regional planning*

Preparation for working in a planning office; discussion of expectation of employer; presentations from planning professionals, and discussion of differences/similarities between public and private planning offices. Offered on a satisfactory-fail basis only.

C R P 376. Rural, Urban and Regional Economics.

(Cross-listed with ECON). (3-0) Cr. 3. *Prereq: ECON 101*

Firm location with respect to regional resources, transport, scale economies, externalities, and policies. Measures of local comparative advantage and specialization. Spatial markets. Population location considering jobs, wages, commuting, and local amenities. Business, residential, and farm land use and value. Migration. Other topics may include market failure, regulation, the product cycle, theories of rural and urban development, developmental policy, firm recruiting, local public goods and public finance, schools, poverty, segregation, and crime.

C R P 383. Theory of the Planning Process.

(3-0) Cr. 3. S. *Prereq: C R P 253 and Junior classification*

The nature of planning and its relation to social and economic planning; levels of planning, place of planning in decision making; steps in the planning process, uses and limitation of knowledge in planning, relation of facts and values.

C R P 391. Field Travel.

Cr. 1-2. Repeatable. F.S. *Prereq: CRP major and permission of instructor*
Observation of professional practice and community or regional problems and issues. Offered on a satisfactory-fail basis only.

C R P 410. Professional Work Experience.

Cr. R. F.S.SS. *Prereq: Permission of department chair*
Approved professional work experience.

C R P 416. Urban Design and Practice.

(Dual-listed with C R P 516). (3-6) Cr. 6. S. *Prereq: C R P 253 or C R P 270*
Principles of urban design and their application to residential and commercial development in studio projects.

C R P 417. Urban Revitalization.

(Dual-listed with C R P 517). (3-0) Cr. 3. S.

Planning methods available to further revitalization and preservation efforts, with particular attention to housing and neighborhoods. Relationship between neighborhood change and urban development process; public policy implications.

C R P 425. Growth Management.

(Dual-listed with C R P 525). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: Junior classification

Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban, suburban and rural relationships; and land preservation.

C R P 429. Planning in Developing Countries.

(Dual-listed with C R P 529). (3-0) Cr. 3. S. *Prereq: Graduate classification*

Introduction to issues in planning and governance in an international setting. Problems and strategies may include population movement and change, economic globalization, urban growth, rural development, and housing.

C R P 432. Community Planning Studio.

(1-6) Cr. 4-6. F.S. *Prereq: C R P 201, C R P 301, or permission of instructor.*
Integration of planning methods and theory in dealing with a community planning problem. Analysis of problem and formulation of strategies for implementation. Preparation of a community planning report.

C R P 435. Planning in Small Towns.

(Dual-listed with C R P 535). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: C R P 253, C R P 270, or Junior classification

Contemporary planning problems in small towns and the design of viable strategies to enhance their social and economic position in today's society.

C R P 436. Community Economic Development.

(Dual-listed with C R P 536). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: Graduate classification

The nature and process of economic development in the context of community development. Recent changes and trends and their implications for local and regional development. Selected case studies and applications. Contemporary community economic development issues.

C R P 442. Site Development.

(Dual-listed with C R P 542). (3-0) Cr. 3. S.

Introduction to site development including site review. Studio project integrating concept, finance, selection, analysis, and design.

C R P 445. Transportation Policy and Planning.

(Dual-listed with C R P 545). (3-0) Cr. 3. F. *Prereq: C E 350 or equivalent., Note:*

CRP 545 prerequisite: Graduate Classification

Comprehensive overview of key policy issues related to transportation planning and investment in the United States and abroad. Policy issues explored include safety, environmental impact, sustainable communities, and economic development. Policy analysis and planning are studied in conjunction with each policy issue explored. Issues of concern to state, metropolitan, and local governments.

C R P 451. Introduction to Geographic Information Systems.

(2-2) Cr. 3. F.S.SS.

Introduction to geographic information systems, including discussions of GIS hardware, software, data structures, data acquisition, data conversion, data presentation, analytical techniques, and implementation procedures. Laboratory emphasizes practical applications and uses of GIS.

C R P 452. Geographic Data Management and Planning Analysis.

(Dual-listed with C R P 552). (2-2) Cr. 3. F.S. *Prereq: C R P 451 or equivalent*

Extensive coverage of geo-relational database concept and design, GIS database creation and maintenance, geographic data manipulation and analysis. GIS output generation and geographic data presentation. Laboratory emphasizes practical applications and uses of GIS.

C R P 456. GIS Programming and Automation.

(Dual-listed with C R P 556). (3-0) Cr. 3. F. *Prereq:* CRP 451/551 or NREM 345 or NREM 546 or GEOL 552

Introduction to automated geoprocessing in Geographic Information Systems. Focus on learning scripting language and object-oriented programming, automation of custom-designed geoprocessing scripts, and application toward student research and/or interests.

C R P 475. Grant Writing.

(Dual-listed with C R P 575). (1-0) Cr. 1. F.

A short introduction to effective grant writing for the public and non-profit sectors. Includes identifying appropriate funding sources for an organization, identifying goals and objectives, and budgeting.

C R P 481. Regional and State Planning.

(Dual-listed with C R P 581). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* C R P 253 or C R P 270

Analysis of theories, policies, and functions at the metropolitan, regional, and state levels with emphasis on area-wide governance structures and strategies for guiding development.

C R P 484. Sustainable Communities.

(Dual-listed with C R P 584). (Cross-listed with ENV S). (3-0) Cr. 3. S. *Prereq:* Junior classification

The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

C R P 490. Independent Study.

Cr. 1-3. Repeatable. F.S.SS. *Prereq:* Written approval of instructor and department chair on required form

Investigation of an approved topic commensurate with student's interest and ability. Offered on a satisfactory-fail basis only.

C R P 490H. Independent Study: Honors.

Cr. 1-3. Repeatable. F.S.SS. *Prereq:* Written approval of instructor and department chair on required form

Investigation of an approved topic commensurate with student's interest and ability. Offered on a satisfactory-fail basis only.

C R P 491. Environmental Law and Planning.

(Dual-listed with C R P 591). (Cross-listed with ENV S, L A). (3-0) Cr. 3. S. *Prereq:* 6 credits in natural sciences

Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

C R P 492. Planning Law, Administration and Implementation.

(3-0) Cr. 3. F. *Prereq:* C R P 383

The basis in constitutional, common, and statutory law for the powers of plan implementation. Problems of balancing public and private interests as revealed in the study of leading court cases. Administration of planning agencies and programs.

C R P 494. Senior Seminar in Planning.

Cr. 1-3. Repeatable, maximum of 2 times. F.S. *Prereq:* Senior classification; C R P 332 should be taken prior to or concurrently.

An advanced forum for seniors that focuses upon recent trends and important issues affecting planning today. Topics addressed will vary. A demonstration of understanding of current issues and their effects upon planning applications is expected.

C R P 498. Portfolio Development and Review.

(1-0) Cr. 1. F.S.

Should be taken in the final semester of the planning program. Preparation of a portfolio of student work that represents student learning throughout the entire planning program.

Courses primarily for graduate students, open to qualified undergraduates:**C R P 510. Professional Work Experience.**

Cr. R. F.S.SS. *Prereq:* Permission of department chair
Approved professional work experience.

C R P 516. Urban Design and Practice.

(Dual-listed with C R P 416). (3-6) Cr. 6. S. *Prereq:* C R P 253 or C R P 270
Principles of urban design and their application to residential and commercial development in studio projects.

C R P 517. Urban Revitalization.

(Dual-listed with C R P 417). (3-0) Cr. 3. S.

Planning methods available to further revitalization and preservation efforts, with particular attention to housing and neighborhoods. Relationship between neighborhood change and urban development process; public policy implications.

C R P 519. Middle Eastern Cities.

(Cross-listed with ARCH). (3-0) Cr. 3. *Prereq:* Graduate or Senior classification

Introduction to basic academic writings on Middle Eastern cities in addition to other contemporary cultural productions of the region. Study of various aspects of Middle Eastern life and the built environments that this life produces. Meets International Perspectives Requirement.

C R P 525. Growth Management.

(Dual-listed with C R P 425). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* Junior classification

Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban, suburban and rural relationships; and land preservation.

C R P 529. Planning in Developing Countries.

(Dual-listed with C R P 429). (3-0) Cr. 3. S. *Prereq:* Graduate classification

Introduction to issues in planning and governance in an international setting. Problems and strategies may include population movement and change, economic globalization, urban growth, rural development, and housing.

C R P 530. Practicum.

Cr. 1-3. Repeatable. F.S.SS. *Prereq:* Graduate classification in Community and Regional Planning

Practical planning experience. Structured work in range of tasks under close supervision of a professional planner. Relationships between theory and practice, exposure to variety of roles in functioning specialties. Offered on a satisfactory-fail basis only.

C R P 531. Professional Practice Seminar.

(Dual-listed with C R P 331). (1-0) Cr. 1. S. *Prereq:* Major in community and regional planning

Preparation for working in a planning office; discussion of expectation of employer; presentations from planning professionals, and discussion of differences/similarities between public and private planning offices. Offered on a satisfactory-fail basis only.

C R P 532. Community Planning Studio.

(1-4) Cr. 3. F. *Prereq:* C R P 564 or equivalent

Comprehension and analysis of various geographic contexts pertinent to community planning and the use of planning theory, tools and techniques in an applied setting. Process of making a community plan: historical patterns, current conditions and strategies for planning.

C R P 535. Planning in Small Towns.

(Dual-listed with C R P 435). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: C R P 253, C R P 270, or Junior classification

Contemporary planning problems in small towns and the design of viable strategies to enhance their social and economic position in today's society.

C R P 536. Community Economic Development.

(Dual-listed with C R P 436). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* Graduate classification

The nature and process of economic development in the context of community development. Recent changes and trends and their implications for local and regional development. Selected case studies and applications. Contemporary community economic development issues.

C R P 542. Site Development.

(Dual-listed with C R P 442). (3-0) Cr. 3. S.

Introduction to site development including site review. Studio project integrating concept, finance, selection, analysis, and design.

C R P 545. Transportation Policy and Planning.

(Dual-listed with C R P 445). (3-0) Cr. 3. F. *Prereq:* C E 350 or equivalent., *Note:* CRP 545 prerequisite: Graduate Classification

Comprehensive overview of key policy issues related to transportation planning and investment in the United States and abroad. Policy issues explored include safety, environmental impact, sustainable communities, and economic development. Policy analysis and planning are studied in conjunction with each policy issue explored. Issues of concern to state, metropolitan, and local governments.

C R P 551. Introduction to Geographic Information Systems.

(2-2) Cr. 3. F.S.SS.

Introduction to geographic information systems, including discussions of GIS hardware, software, data structures, data acquisition, data conversion, data presentation, analytical techniques, and implementation procedures. Laboratory emphasizes practical applications and uses of GIS.

C R P 552. Geographic Data Management and Planning Analysis.(Dual-listed with C R P 452). (2-2) Cr. 3. F.S. *Prereq: C R P 451 or equivalent*

Extensive coverage of geo-relational database concept and design, GIS database creation and maintenance, geographic data manipulation and analysis. GIS output generation and geographic data presentation. Laboratory emphasizes practical applications and uses of GIS.

C R P 553. Analytical Planning/GIS.(2-2) Cr. 3. F. *Prereq: C R P 451/C R P 551*

Integration of exploratory, participatory and predictive spatial analyses and 3D visualization into the planning process. GIS tools and techniques are used to automate decision analysis and facilitate future planning in analyzing and visualizing planning actions. Laboratory emphasizes practical uses of GIS tools and techniques.

C R P 556. GIS Programming and Automation.(Dual-listed with C R P 456). (3-0) Cr. 3. F. *Prereq: CRP 451/551 or NREM 345 or NREM 546 or GEOL 552*

Introduction to automated geoprocessing in Geographic Information Systems. Focus on learning scripting language and object-oriented programming, automation of custom-designed geoprocessing scripts, and application toward student research and/or interests.

C R P 561. Planning Theory for Practice.

(3-0) Cr. 3. S.

Use and development of theory/action relationship in planning practice. Competing normative theories of planning and their evolution, key components and fundamental critiques. Exploration of planning frameworks and approaches, including comprehensive planning; incrementalism; advocacy; communicative rationality; and others.

C R P 563. Planning the American Metropolis.

(3-0) Cr. 3. F.

Focus on the historical role of planning in the shaping of American cities and regions, from the beginning of the Republic to the present. Examine the legacy of planning by exploring the intersection of design, politics and policy. Investigate the factors and the processes that produce the built environment.

C R P 564. Introduction to Analytical Methods for Planning.

(3-0) Cr. 3. F.

Applications of analytical methods in planning with emphasis on the collection, description, analysis, presentation, and interpretation of planning data. Introduction to descriptive statistics. Sources of planning information and data including primary and secondary data types and sources. Demographic analysis, population projection techniques for planning at local and regional levels.

C R P 566. Values and Decision Making.

(3-0) Cr. 3. F.

Principles and methods for analyzing communities and regions as social political, economic, and ecological systems. Exploration of relationships between individuals and institutions, the economy and governance. Examination of social values and their manifestation in decision making methods used in planning. Application of decision making tools for planning problems involving economic analysis, power relations, environmental impacts and social impacts. Project evaluation methods.

C R P 568. Planning and Development.(3-0) Cr. 3. S. *Prereq: C R P 564 or equivalent*

Exploration and evaluation of the techniques, processes, and professional skills required to effectively manage land use change at various scales. Land classification systems; land supply and needs inventory for residential uses and commercial and employment centers; capacity and needs analysis for public infrastructure. Includes land use planning project(s) designed to apply the methods explored in this and other courses.

C R P 575. Grant Writing.

(Dual-listed with C R P 475). (1-0) Cr. 1. F.

A short introduction to effective grant writing for the public and non-profit sectors. Includes identifying appropriate funding sources for an organization, identifying goals and objectives, and budgeting.

C R P 581. Regional and State Planning.

(Dual-listed with C R P 481). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: C R P 253 or C R P 270

Analysis of theories, policies, and functions at the metropolitan, regional, and state levels with emphasis on area-wide governance structures and strategies for guiding development.

C R P 584. Sustainable Communities.(Dual-listed with C R P 484). (3-0) Cr. 3. S. *Prereq: Junior classification*

The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

C R P 590. Special Topics.Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590A. Special Topics: Planning Law, Administration and Implementation.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590B. Special Topics: Economic Development.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590C. Special Topics: Urban Design.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590D. Special Topics: Housing and Urban Revitalization.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590H. Special Topics: Environmental Planning.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590I. Special Topics: Land Use and Transportation Planning.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590N. Special Topics: International Planning.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590O. Special Topics: Spatial Analytical Methods.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590P. Special Topics: Planning in Small Towns.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590Q. Special Topics: Diversity and Equity in Planning.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 590R. Special Topics: Geographic Information Systems.**Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form***C R P 591. Environmental Law and Planning.**(Dual-listed with C R P 491). (Cross-listed with L A). (3-0) Cr. 3. S. *Prereq: 6 credits in natural sciences*

Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

C R P 592. Land Use and Development Regulation Law.

(3-0) Cr. 3. F.

An in-depth analysis of the legal constructs that shape the practice of planning and plan implementation in the United States. An exploration of how land use regulations are applied to reconcile the competing needs and diverse uses of land. The positive and negative consequences of developing and implementing regulatory controls will be addressed.

C R P 595. Seminar in GIS Applications/Research.(1-0) Cr. 1. F.S. *Prereq: 9 credits in GIS Certificate program*

Discussion and demonstration of current GIS applications and research in multiple disciplines. Offered on a satisfactory-fail basis only.

C R P 599. Professional Planning Report.

Cr. arr. Repeatable.

Independent planning project with practical application, including research element.

Courses for graduate students:

C R P 698. Capstone Studio.

(1-6) Cr. 4. S. *Prereq: Permission of instructor.*

Synthesis and integration of core planning knowledge into professional work in a team setting.

C R P 699. Research.

Cr. arr. Repeatable.

Complex Adaptive Systems (CAS)

Courses primarily for graduate students, open to qualified undergraduates:

CAS 502. Complex Adaptive Systems Seminar.

(Cross-listed with COM S). (1-0) Cr. 1. F.S. *Prereq: Admission to CAS minor*

Understanding core techniques in artificial life is based on basic readings in complex adaptive systems. Techniques of complex system analysis methods including: evolutionary computation, neural nets, agent based simulations (agent based computational economics). Large-scale simulations are to be emphasized, e.g. power grids, whole ecosystems.

CAS 503. Complex Adaptive Systems Concepts and Techniques.

(Cross-listed with COM S). (3-0) Cr. 3. S. *Prereq: Admission to CAS minor or related field*

Survey of complex systems and their analysis. Examples are drawn from engineering, computer science, biology, economics and physics.

Computer Engineering (CPR E)

Courses primarily for undergraduates:

CPR E 131. Introduction to Computer Security Literacy.

(Cross-listed with INFAS). (1-0) Cr. 1.

Basic concepts of practical computer and Internet security: passwords, firewalls, antivirus software, malware, social networking, surfing the Internet, phishing, and wireless networks. This class is intended for students with little or no background in information technology or security. Basic knowledge of word processing required. Offered on a satisfactory-fail basis only.

CPR E 166. Professional Programs Orientation.

(Cross-listed with E E). Cr. R. F.S.

(1-0) Overview of the nature and scope of electrical engineering and computer engineering professions. Overview of portfolios. Departmental rules, advising center operations, degree requirements, program of study planning, career options, and student organizations.

CPR E 185. Introduction to Computer Engineering and Problem Solving I.

(2-2) Cr. 3. Prereq: Credit or enrollment in MATH 141

Introduction to Computer Engineering. Project based examples from computer engineering. Individual interactive skills for small and large groups. Computer-based projects. Solving engineering problems and presenting solutions through technical reports. Solution of engineering problems using a programming language.

CPR E 186. Introduction to Computer Engineering and Problem Solving II.

(0-2) Cr. 1. S. Prereq: CPR E 185

Project based examples from computer engineering. Group skills needed to work effectively in teams. Group problem solving. Computer based projects. Technical reports and presentations. Students will work on 2 or 3 self-directed team based projects that are representative of problems faced by computer engineers.

CPR E 261. Transfer Orientation.

(Cross-listed with E E). Cr. R.

Introduction to the College of Engineering and the engineering profession specifically for transfer students. Information concerning university and college policies, procedures, and resources. Offered on a satisfactory-fail basis only.

CPR E 281. Digital Logic.

(3-3) Cr. 4. F.S. Prereq: sophomore classification

Number systems and representation. Boolean algebra and logic minimization. Combinational and sequential logic design. Arithmetic circuits and finite state machines. Use of programmable logic devices. Introduction to computer-aided schematic capture systems, simulation tools, and hardware description languages. Design of simple digital systems.

CPR E 288. Embedded Systems I: Introduction.

(3-2) Cr. 4. F.S. Prereq: CPR E 281, COM S 207 or COM S 227 or E E 285

Embedded C programming. Interrupt handling. Memory mapped I/O in the context of an application. Elementary embedded design flow/methodology. Timers, scheduling, resource allocation, optimization, state machine based controllers, real time constraints within the context of an application. Applications laboratory exercises with embedded devices.

CPR E 294. Program Discovery.

(Cross-listed with E E). Cr. R. Prereq: CPR E 166 or E E 166

The roles of professionals in computer and electrical engineering. Relationship of coursework to industry and academic careers. Issues relevant to today's world. Offered on a satisfactory-fail basis only.

CPR E 298. Cooperative Education.

Cr. R. F.S.SS. Prereq: Permission of department and Engineering Career Services

First professional work period in the cooperative education program. Students must register for this course before commencing work.

CPR E 308. Operating Systems: Principles and Practice.

(3-3) Cr. 4. F.S. Prereq: CPR E 381, CPR E 310

Operating system concepts, processes, threads, synchronization between threads, process and thread scheduling, deadlocks, memory management, file systems, I/O systems, security, Linux-based lab experiments.

CPR E 310. Theoretical Foundations of Computer Engineering.

(3-0) Cr. 3. F.S. Prereq: Credit or enrollment in CPR E 288, COM S 228

Propositional logic and methods of proof; set theory and its applications; mathematical induction and recurrence relations; functions and relations; and counting; trees and graphs; applications in computer engineering.

CPR E 315. Applications of Algorithms in Computer Engineering.

(3-0) Cr. 3. F.S.SS. Prereq: CPR E 310

Solving computer engineering problems using algorithms. Emphasis on problems related to the core focus areas in computer engineering. Real world examples of algorithms used in the computer engineering domain. Algorithm engineering. Prototyping of algorithms.

CPR E 329. Software Project Management.

(Cross-listed with S E). (3-0) Cr. 3. Prereq: COM S 309

Process-based software development. Capability Maturity Model (CMM). Project planning, cost estimation, and scheduling. Project management tools. Factors influencing productivity and success. Productivity metrics. Analysis of options and risks. Version control and configuration management. Inspections and reviews. Managing the testing process. Software quality metrics. Modern software engineering techniques and practices.

CPR E 330. Integrated Electronics.

(Cross-listed with E E). (3-3) Cr. 4. Prereq: E E 201, credit or enrollment in E E 230, CPR E 281

Semiconductor technology for integrated circuits. Modeling of integrated devices including diodes, BJTs, and MOSFETs. Physical layout. Circuit simulation. Digital building blocks and digital circuit synthesis. Analysis and design of analog building blocks. Laboratory exercises and design projects with CAD tools and standard cells.

CPR E 332. Cyber Defense Competition.

(Cross-listed with INFAS). (0-2) Cr. 1. Repeatable. S.

Participation in cyber defense competition driven by scenario-based network design. Includes computer system setup, risk assessment and implementation of security systems, as well as defense of computer and network systems against trained attackers. Team based. Offered on a satisfactory-fail basis only.

CPR E 339. Software Architecture and Design.

(Cross-listed with S E). (3-0) Cr. 3. Prereq: S E 319

Modeling and design of software at the architectural level. Architectural styles. Basics of model-driven architecture. Object-oriented design and analysis. Iterative development and unified process. Design patterns. Design by contract. Component based design. Product families. Measurement theory and appropriate use of metrics in design. Designing for qualities such as performance, safety, security, reliability, reusability, etc. Analysis and evaluation of software architectures. Introduction to architecture definition languages. Basics of software evolution, reengineering, and reverse engineering. Case studies. Introduction to distributed system software.

CPR E 370. Toying with Technology.

(Cross-listed with MAT E). (2-2) Cr. 3. F.S. Prereq: C I 201 or C I 202

A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on laboratory experiences based upon simple systems constructed out of LEGO's and controlled by small microcomputers. Future K-12 teachers will leave the course with complete lesson plans for use in their upcoming careers.

CPR E 381. Computer Organization and Assembly Level Programming.

(3-2) Cr. 4. F.S. Prereq: CPR E 288

Introduction to computer organization, evaluating performance of computer systems, instruction set design. Assembly level programming: arithmetic operations, control flow instructions, procedure calls, stack management. Processor design. Datapath and control, scalar pipelines, introduction to memory and I/O systems.

CPR E 388. Embedded Systems II: Mobile Platforms.

(Cross-listed with S E). (3-2) Cr. 4. Prereq: CPR E 288

Contemporary programming techniques for event driven systems. Mobile platforms and operating systems. Location and motion sensors based user interfaces. Threading and scheduling. Resource management - measurement and control techniques - for memory and energy. Client-server application design. Distributed applications. Laboratory includes exercises based on a mobile platform.

CPR E 394. Program Exploration.

(Cross-listed with E E). Cr. R. Prereq: CPR E 294 or E E 294

Exploration of academic and career fields for electrical and computer engineers. Examination of professionalism in the context of engineering and technology with competencies based skills. Introduction to professional portfolio development and construction. Offered on a satisfactory-fail basis only.

CPR E 396. Summer Internship.

Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services*

Summer professional work period.

CPR E 397. Engineering Internship.

Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department and Engineering Career Services*

One semester maximum per academic year professional work period.

CPR E 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq: CPR E 298, permission of department and Engineering Career Services*

Second professional work period in the cooperative education program. Students must register for this course before commencing work.

CPR E 412. Formal Methods in Software Engineering.

(Cross-listed with COM S, S E). (3-0) Cr. 3. S. *Prereq: COM S 330 or CPR E 310; COM S 311, STAT 330*

A study of formal techniques for model-based specification and verification of software systems. Topics include logics, formalisms, graph theory, numerical computations, algorithms, and tools for automatic analysis of systems. Graduate credit requires in-depth study of concepts.

CPR E 416. Software Evolution and Maintenance.

(Cross-listed with S E). (3-0) Cr. 3. *Prereq: COM S 309*

Practical importance of software evolution and maintenance, systematic defect analysis and debugging techniques, tracing and understanding large software, impact analysis, program migration and transformation, refactoring, tools for software evolution and maintenance, experimental studies and quantitative measurements of software evolution. Written reports and oral presentation.

CPR E 418. High Speed System Engineering Measurement and Testing.

(Cross-listed with E E). (3-2) Cr. 4. F. *Prereq: E E 230 and E E 311*

Measurement of high speed systems and mixed signal systems. Measurement accuracy and error. Network analysis and spectrum analysis used in high speed measurement and testing. Test specification process and parametric measurement. Sampling and digital signal processing concepts. Design for testability. Testing equipment. Applications.

CPR E 419. Software Tools for Large Scale Data Analysis.

(Cross-listed with S E). (3-3) Cr. 4. *Prereq: CPR E 308 or COM S 352, COM S 309*

Software tools for managing and manipulating large volumes of data, external memory processing, large scale parallelism, and stream processing, data interchange formats. Weekly programming labs that involve the use of a parallel computing cluster.

CPR E 425. High Performance Computing for Scientific and Engineering Applications.

(Cross-listed with COM S). (3-1) Cr. 3. S. *Prereq: COM S 311, COM S 330, ENGL 250, SP CM 212*

Introduction to high performance computing platforms including parallel computers and workstation clusters. Discussion of parallel architectures, performance, programming models, and software development issues. Sample applications from science and engineering. Practical issues in high performance computing will be emphasized via a number of programming projects using a variety of programming models and case studies. Oral and written reports.

CPR E 426. Introduction to Parallel Algorithms and Programming.

(Dual-listed with CPR E 526). (Cross-listed with COM S). (3-2) Cr. 4. F. *Prereq: CPR E 308 or COM S 321, CPR E 315 or COM S 311*

Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms.

CPR E 431. Basics of Information System Security.

(3-0) Cr. 3. S. *Prereq: credit or enrollment in CPR E 489 or COM S 454*

Introduction to and application of basic mechanisms for protecting information systems from accidental and intentional threats. Basic cryptography use and practice. Computer security issues including authentication, access control, and malicious code. Network security mechanisms such as intrusion detection, firewalls, IPSEC, and related protocols. Ethics and legal issues in information security. Wireless security. Programming and system configuration assignments.

CPR E 435. Analog VLSI Circuit Design.

(Cross-listed with E E). (3-3) Cr. 4. S. *Prereq: E E 324, E E 330, E E 332, and either E E 322 or STAT 330*

Basic analog integrated circuit and system design including design space exploration, performance enhancement strategies, operational amplifiers, references, integrated filters, and data converters.

CPR E 444. Introduction to Bioinformatics.

(Cross-listed with BCB, BCBO, BIOL, COM S, GEN). (4-0) Cr. 4. F. *Prereq: MATH 165 or STAT 401 or equivalent*

Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics, systems biology.

CPR E 450. Distributed Systems and Middleware.

(Dual-listed with CPR E 550). (3-0) Cr. 3. *Prereq: CPR E 308 or COM S 352*

Fundamentals of distributed computing, software agents, naming services, distributed transactions, security management, distributed object-based systems, web-based systems, middleware-based application design and development, case studies of middleware and internet applications.

CPR E 454. Distributed Systems.

(Dual-listed with CPR E 554). (Cross-listed with COM S). (3-1) Cr. 3. S. *Prereq: COM S 311, COM S 352*

(3-1) Cr. 3. Theoretical and practical issues of design and implementation of distributed systems. The client server paradigm, inter-process communications, synchronization and concurrency control, naming, consistency and replication, fault tolerance, and distributed file systems. Graduate credit requires additional in-depth study of concepts. Programming projects and written reports.

CPR E 458. Real Time Systems.

(Dual-listed with CPR E 558). (3-0) Cr. 3. *Prereq: CPR E 308 or COM S 352*

Fundamental concepts in real-time systems. Real time task scheduling paradigms. Resource management in uniprocessor, multiprocessor, and distributed real-time systems. Fault-tolerance, resource reclaiming, and overload handling. Real-time channel, packet scheduling, and real-time LAN protocols. Case study of real-time operating systems. Laboratory experiments.

CPR E 465. Digital VLSI Design.

(Cross-listed with E E). (3-3) Cr. 4. S. *Prereq: E E 330*

Digital design of integrated circuits employing very large scale integration (VLSI) methodologies. Technology considerations in design. High level hardware design languages, CMOS logic design styles, area-energy-delay design space characterization, datapath blocks: arithmetic and memory, architectures and systems on a chip (SOC) considerations. VLSI chip hardware design project.

CPR E 466. Multidisciplinary Engineering Design.

(Cross-listed with A B E, AER E, E E, ENGR, I E, M E, MAT E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and permission of instructor.*

Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

CPR E 467. Multidisciplinary Engineering Design II.

(Cross-listed with AER E, E E, ENGR, I E, M E, MAT E). (1-4) Cr. 3. Repeatable, maximum of 2 times. F.S. *Prereq: Student must be within two semesters of graduation or receive permission of instructor.*

Build and test of a conceptual design. Detail design, manufacturability, test criteria and procedures. Application of design tools such as CAD and CAM and manufacturing techniques such as rapid prototyping. Development and testing of a full-scale prototype with appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

CPR E 480. Graphics Processing and Architecture.

(3-3) Cr. 4. S. *Prereq: CPR E 381 or COM S 321*

Introduction to hardware architectures for computer graphics and their programming models. System-level view, including framebuffer, video output devices, displays, 2D and 3D graphics acceleration, and device interfacing. Architectural design of GPUs, from 2D and 3D sprite engines to 3D rendering pipelines to unified shader architectures. Computing models for graphics processors. GPGPU and GPU computing.

CPR E 483. Hardware Software Integration.

(3-3) Cr. 4. S. *Prereq: CPR E 381*

Embedded system design using hardware description language (HDL) and field programmable gate array (FPGA). HDL modeling concepts and styles are introduced; focus on synthesizability, optimality, reusability and portability in hardware design description. Introduction to complex hardware cores for data buffering, data input/output interfacing, data processing. System design with HDL cores and implementation in FPGA. Laboratory-oriented design projects.

CPR E 488. Embedded Systems Design.

(3-3) Cr. 4. Prereq: CPR E 381 or COM S 321

Embedded microprocessors, embedded memory and I/O devices, component interfaces, embedded software, program development, basic compiler techniques, platform-based FPGA technology, hardware synthesis, design methodology, real-time operating system concepts, performance analysis and optimizations.

CPR E 489. Computer Networking and Data Communications.

(3-2) Cr. 4. F.S. Prereq: CPR E 381 or E E 324

Modern computer networking and data communications concepts. TCP/IP, OSI protocols, client server programming, data link protocols, local area networks, and routing protocols.

CPR E 490. Independent Study.

Cr. arr. Repeatable. Prereq: Senior classification in computer engineering
Investigation of an approved topic.

CPR E 490H. Independent Study: Honors.

Cr. arr. Repeatable. Prereq: Senior classification in computer engineering
Investigation of an approved topic.

CPR E 491. Senior Design Project I and Professionalism.

(Cross-listed with E E). (2-3) Cr. 3. F.S. Prereq: E E 322 or CPR E 308, completion of 24 credits in the E E core professional program or 29 credits in the Cpr E core professional program, ENGL 314

Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; design review presentation. First of two-semester team-oriented, project design and implementation experience.

CPR E 492. Senior Design Project II.

(Cross-listed with E E). (1-3) Cr. 2. F.S. Prereq: CPR E 491 or E E 491

Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in E E 491 or Cpr E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements; project poster.

CPR E 494. Portfolio Assessment.

(Cross-listed with E E). Cr. R. Prereq: CPR E 394 or E E 394, credit or enrollment in CPR E 491 or E E 491

Portfolio update and evaluation. Portfolios as a tool to enhance career opportunities.

CPR E 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. Prereq: CPR E 398, permission of department and Engineering Career Services

Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduates:**CPR E 501. Analog and Mixed-Signal VLSI Circuit Design Techniques.**

(Cross-listed with E E). (3-3) Cr. 4. F. Prereq: E E 435

Design techniques for analog and mixed-signal VLSI circuits. Amplifiers; operational amplifiers, transconductance amplifiers, finite gain amplifiers and current amplifiers. Linear building blocks; differential amplifiers, current mirrors, references, cascading and buffering. Performance characterization of linear integrated circuits; offset, noise, sensitivity and stability. Layout considerations, simulation, yield and modeling for high-performance linear integrated circuits.

CPR E 504. Power Management for VLSI Systems.

(Cross-listed with E E). (3-3) Cr. 4. Prereq: E E 435, Credit or Registration for E E 501

Theory, design and applications of power management and regulation circuits (Linear and switching regulators, battery chargers, and reference circuits) including: Architectures, Performance metrics and characterization, Noise and stability analysis, Practical implementation and on-chip integration issues, design considerations for portable, wireless, and RF SoCs.

CPR E 505. CMOS and BiCMOS Data Conversion Circuits.

(Cross-listed with E E). (3-3) Cr. 4. Alt. S., offered even-numbered years. Prereq: E E 501

Theory, design and applications of data conversion circuits (A/D and D/A converters) including: architectures, characterization, quantization effects, conversion algorithms, spectral performance, element matching, design for yield, and practical comparators, implementation issues.

CPR E 506. Design of CMOS Phase-Locked Loops.

(Cross-listed with E E). (3-3) Cr. 4. Prereq: E E 435 or E E 501 or instructor approval

Analysis and design of phase-locked loops implemented in modern CMOS processes including: architectures, performance metrics, and characterization; noise and stability analysis; and design issues of phase-frequency detectors, charge pumps, loop filters (passive and active), voltage controlled oscillators, and frequency dividers.

CPR E 507. VLSI Communication Circuits.

(Cross-listed with E E). (3-3) Cr. 4. Alt. S., offered odd-numbered years. Prereq: E E 435 or E E 501

Phase-locked loops, frequency synthesizers, clock and data recovery circuits, theory and implementation of adaptive filters, low-noise amplifiers, mixers, power amplifiers, transmitter and receiver architectures.

CPR E 511. Design and Analysis of Algorithms.

(Cross-listed with COM S). (3-0) Cr. 3. F. Prereq: COM S 311

A study of basic algorithm design and analysis techniques. Advanced data structures, amortized analysis and randomized algorithms. Applications to sorting, graphs, and geometry. NP-completeness and approximation algorithms.

CPR E 525. Numerical Analysis of High Performance Computing.

(Cross-listed with COM S, MATH). (3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: CPR E 308 or MATH 481; experience in scientific programming; knowledge of FORTRAN or C

Introduction to parallelization techniques and numerical methods for state-of-the-art high performance computers. A major component will be a final project in an area related to each student's research interests.

CPR E 526. Introduction to Parallel Algorithms and Programming.

(Dual-listed with CPR E 426). (Cross-listed with COM S). (3-2) Cr. 4. F. Prereq: CPR E 308 or COM S 321, CPR E 315 or COM S 311

Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms.

CPR E 528. Probabilistic Methods in Computer Engineering.

(3-0) Cr. 3. Prereq: CPR E 315 or COM S 311

The application of randomization and probabilistic methods in the design of computer algorithms, and their efficient implementation. Discrete random variables in modeling algorithm behavior, with applications to sorting, selection, graph algorithms, hashing, pattern matching, cryptography, distributed systems, and massive data set algorithmics.

CPR E 530. Network Protocols and Security.

(Cross-listed with INFAS). (3-0) Cr. 3. Prereq: CPR E 381 or equivalent

Detailed examination of networking standards, protocols, and their implementation. TCP/IP protocol suite, network application protocols. Network security issues, attack and mitigation techniques. Emphasis on laboratory experiments.

CPR E 531. Information System Security.

(Cross-listed with INFAS). (3-0) Cr. 3. Prereq: CPR E 489 or CPR E 530 or COM S 586 or MIS 535

Computer, software, and data security: basic cryptography, security policies, multilevel security models, attack and protection mechanisms, legal and ethical issues.

CPR E 532. Information Warfare.

(Cross-listed with INFAS). (3-0) Cr. 3. S. Prereq: CPR E 531

Computer system and network security: implementation, configuration, testing of security software and hardware, network monitoring. Authentication, firewalls, vulnerabilities, exploits, countermeasures. Study and use of attack tools. Ethics in information assurance. Emphasis on laboratory experiments.

CPR E 533. Cryptography.

(Cross-listed with INFAS, MATH). (3-0) Cr. 3. S. Prereq: MATH 301 or CPR E 310 or COM S 330

Basic concepts of secure communication, DES and AES, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, applications. Relevant material on number theory and finite fields.

CPR E 534. Legal and Ethical Issues in Information Assurance.

(Cross-listed with INFAS, POL S). (3-0) Cr. 3. S. Prereq: Graduate classification; CPR E 531 or INFAS 531

Legal and ethical issues in computer security. State and local codes and regulations. Privacy issues.

CPR E 535. Steganography and Digital Image Forensics.

(Cross-listed with INFAS, MATH). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: E E 524 or MATH 317 or MATH 407 or COM S 330*

Basic principles of covert communication, steganalysis, and forensic analysis for digital images. Steganographic security and capacity, matrix embedding, blind attacks, image forensic detection and device identification techniques. Related material on coding theory, statistics, image processing, pattern recognition.

CPR E 536. Computer and Network Forensics.

(Cross-listed with INFAS). (3-0) Cr. 3. *Prereq: CPR E 489 or CPR E 530*

Fundamentals of computer and network forensics, forensic duplication and analysis, network surveillance, intrusion detection and response, incident response, anonymity and pseudonymity, privacy-protection techniques, cyber law, computer security policies and guidelines, court testimony and report writing, and case studies. Emphasis on hands-on experiments.

CPR E 537. Wireless Network Security.

(3-0) Cr. 3. S. *Prereq: Credit or enrollment in CPR E 489 or CPR E 530*

Introduction to the physical layer and special issues associated with the security of wireless networks. The basics of wireless communication systems (antennas and propagation, modulation, multiple access, channel modeling, specific security issues of the wireless link), jamming and countermeasures (spread spectrum technologies, channel coding, interleaving), authentication and confidentiality (basics of classic cryptography, common authentication and encryption algorithms). Detailed case studies on authentication, encryption and privacy flaws, and good practices based on the most common wireless technologies, including WiFi, GSM/3G, Bluetooth, and RFID. Individual or team-based class projects.

CPR E 538. Reverse Engineering and Security Testing.

(Cross-listed with INFAS). (2-3) Cr. 3. S. *Prereq: COM S 321 or CPR E 381, COM S 352 or CPR E 308*

Techniques and tools for understanding the behavior of software/hardware systems based on reverse engineering. Flaw hypothesis, black, grey, and white box testing as well as other methods for testing the security of software systems. Discussion of counter-reverse engineering techniques.

CPR E 539. Cyber Physical System Security for the Smart Grid.

(3-0) Cr. 3. S.

Introduction to cyber security, cyber physical system (CPS), and smart grid automation technologies; supervisor control and data acquisition (SCADA) systems; cyber risk modeling, vulnerability analysis, impact analysis, defense and mitigation techniques; cyber security of wide-area monitoring, protection, and control; security and privacy in advanced metering infrastructure (AMI), cyber security compliance and best practices, CPS security test-beds and attack-defense hands-on laboratory experiments.

CPR E 541. High-Performance Communication Networks.

(3-0) Cr. 3. *Prereq: CPR E 489 or CPR E 530*

Selected topics from recent advances in high performance networks; next generation internet; asynchronous transfer mode; traffic management, quality of service; high speed switching.

CPR E 542. Optical Communication Networks.

(3-0) Cr. 3. S. *Prereq: CPR E 489*

Optical components and interfaces; optical transmission and reception techniques; wavelength division multiplexing; network architectures and protocol for first generation, single and multihop optical network; routing and wavelength assignment in second generation wavelength routing networks; traffic grooming, optical network control; survivability; access networks; metro networks.

CPR E 543. Wireless Network Architecture.

(3-0) Cr. 3. *Prereq: Credit or enrollment in CPR E 489 or CPR E 530*

Introduction to the protocol architecture of the data link layer, network layer and transport layer for wireless networking. Operation and management of Medium Access Control in Wireless Local Area Networks (WLAN) and Wireless Metropolitan Area Networks (WMAN); recent developments in IEEE 802.11 & 802.16 and Bluetooth; Mobile IP; Mobile TCP.

CPR E 544. Introduction to Bioinformatics.

(Cross-listed with BCB, COM S, GDCB). (4-0) Cr. 4. F. *Prereq: MATH 165 or STAT 401 or equivalent*

Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative, functional genomics, and systems biology.

CPR E 545. Fault-Tolerant Systems.

(3-0) Cr. 3. *Prereq: CPR E 381*

Faults and their manifestations, errors, and failures; fault detection, location and reconfiguration techniques; time, space, and information (coding) redundancy management; design for testability; self-checking and fail-safe circuits; system-level fault diagnosis; Byzantine agreement; stable storage and RAID; clock synchronization; fault-tolerant networks; fault tolerance in real-time systems; reliable software design; checkpointing and rollback recovery; atomic actions; replica management protocols; and reliability evaluation techniques and tools.

CPR E 546. Wireless and Sensor Networks.

(3-0) Cr. 3. *Prereq: CPR E 489 or CPR E 530*

Fundamental and well-known protocols for wireless ad hoc and sensor networks at various layers, including physical layer issues, MAC (medium access control) layer protocols, routing protocols for wireless ad hoc and sensor networks, data management in sensor networks, coverage and connectivity, localization and tracking, security and privacy issues. Introduction to TinyOS and the nesC language. Hands-on experiments with Crossbow Mote sensor devices.

CPR E 547. Resource Allocation in Communication Networks.

(3-0) Cr. 3.

Analytical approach to resource allocation on communication networks (e.g. the Internet, multihop wireless networks, etc.). Network utility maximization and the internet congestion control algorithm. Layering as optimization decomposition: a cross-layer design approach in multihop wireless networks. Capacity of ad hoc wireless networks.

CPR E 549. Advanced Algorithms in Computational Biology.

(Cross-listed with COM S). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: COM S 311 and either COM S 228 or COM S 208

Design and analysis of algorithms for applications in computational biology, pairwise and multiple sequence alignments, approximation algorithms, string algorithms including in-depth coverage of suffix trees, semi-numerical string algorithms, algorithms for selected problems in fragment assembly, phylogenetic trees and protein folding. No background in biology is assumed. Also useful as an advanced algorithms course in string processing.

CPR E 550. Distributed Systems and Middleware.

(Dual-listed with CPR E 450). (3-0) Cr. 3. *Prereq: CPR E 308 or COM S 352*

Fundamentals of distributed computing, software agents, naming services, distributed transactions, security management, distributed object-based systems, web-based systems, middleware-based application design and development, case studies of middleware and internet applications.

CPR E 554. Distributed Systems.

(Dual-listed with CPR E 454). (Cross-listed with COM S). (3-1) Cr. 3. S. *Prereq: COM S 311, COM S 352*

(3-1) Cr. 3. Theoretical and practical issues of design and implementation of distributed systems. The client server paradigm, inter-process communications, synchronization and concurrency control, naming, consistency and replication, fault tolerance, and distributed file systems. Graduate credit requires additional in-depth study of concepts. Programming projects and written reports.

CPR E 556. Scalable Software Engineering.

(3-0) Cr. 3. *Prereq: COM S 309*

Design and analysis techniques scalable to large software, project-based learning of problem solving techniques, automation tools for high productivity and reliability of software, analysis-based measurement and estimation techniques for predictable software engineering.

CPR E 557. Computer Graphics and Geometric Modeling.

(Cross-listed with COM S, M E). (3-0) Cr. 3. F.S. *Prereq: M E 421, programming experience in C*

Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing.

CPR E 558. Real Time Systems.

(Dual-listed with CPR E 458). (3-0) Cr. 3. *Prereq: CPR E 308 or COM S 352*

Fundamental concepts in real-time systems. Real time task scheduling paradigms. Resource management in uniprocessor, multiprocessor, and distributed real-time systems. Fault-tolerance, resource reclaiming, and overload handling. Real-time channel, packet scheduling, and real-time LAN protocols. Case study of real-time operating systems. Laboratory experiments.

CPR E 566. Physical Design of VLSI Systems.

(3-0) Cr. 3. *Prereq: CPR E 465*

Physical design of VLSI systems. Partitioning algorithms. Placement and floorplanning algorithms. Routing-global and detailed. Layout compaction. Physical design of FPGA's and MCM's. Performance-driven layout synthesis.

CPR E 567. Bioinformatics I (Fundamentals of Genome Informatics).

(Cross-listed with BCB, COM S). (3-0) Cr. 3. F. *Prereq:* COM S 228; COM S 330; STAT 341; *credit or enrollment in* BIOL 315, STAT 430

Biology as an information science. Review of algorithms and information processing. Generative models for sequences. String algorithms. Pairwise sequence alignment. Multiple sequence alignment. Searching sequence databases. Genome sequence assembly.

CPR E 569. Bioinformatics III (Structural Genome Informatics).

(Cross-listed with BBMB, BCB, COM S). (3-0) Cr. 3. F. *Prereq:* BCB 567, GEN 411, STAT 430

Algorithmic and statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

CPR E 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology).

(Cross-listed with BCB, COM S, GDCB, STAT). (3-0) Cr. 3. S. *Prereq:* BCB 567, BIOL 315, COM S 311 and either 208 or 228, GEN 411, STAT 430

Algorithmic and statistical approaches in computational functional genomics and systems biology. Elements of experiment design. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Multi-scale, multi-granularity models. Ontology-driven, network based, and probabilistic approaches to information integration.

CPR E 575. Computational Perception.

(Cross-listed with COM S, HCI). (3-0) Cr. 3. S. *Prereq:* Graduate standing or permission of instructor

This class covers statistical and algorithmic methods for sensing, recognizing, and interpreting the activities of people by a computer. This semester we will focus on machine perception techniques that facilitate and augment human-computer interaction. The main goal of the class is to introduce computational perception on both theoretical and practical levels. Participation in small groups to design, implement, and evaluate a prototype of a human-computer interaction system that uses one or more of the techniques covered in the lectures.

CPR E 581. Computer Systems Architecture.

(Cross-listed with COM S). (3-0) Cr. 3. F. *Prereq:* CPR E 381

Quantitative principles of computer architecture design, instruction set design, processor architecture: pipelining and superscalar design, instruction level parallelism, memory organization: cache and virtual memory systems, multiprocessor architecture, cache coherency, interconnection networks and message routing, I/O devices and peripherals.

CPR E 582. Computer Systems Performance.

(3-0) Cr. 3. *Prereq:* CPR E 381, CPR E 310 and STAT 330

Review of probability and stochastic processes concepts; Markovian processes; Markovian queues; renewal theory; semi-Markovian queues; queueing networks, applications to multiprocessor architectures, computer networks, and switching systems.

CPR E 583. Reconfigurable Computing Systems.

(Cross-listed with COM S). (3-0) Cr. 3. *Prereq:* Background in computer architecture, design, and organization

Introduction to reconfigurable computing, FPGA technology and architectures, spatial computing architectures such as systolic and bit serial adaptive network architectures, static and dynamic rearrangeable interconnection architectures, processor architectures incorporating reconfigurability.

CPR E 584. Models and Techniques in Embedded Systems.

(3-0) Cr. 3.

Industry-standard tools and optimization strategies; practical embedded platforms and technology (reconfigurable platforms, multi-core platforms, low-power platforms); instruction augmentation, memory-mapped accelerator design, embedded software optimization. Students will be encouraged to compete as teams in an embedded system design competition.

CPR E 585. Developmental Robotics.

(Cross-listed with HCI). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* knowledge of C/C++ programming language.

An introduction to the emerging interdisciplinary field of Developmental Robotics, which crosses the boundaries between robotics, artificial intelligence, developmental psychology, and philosophy. The main goal of this field is to create autonomous robots that are more intelligent, more adaptable, and more useful than the robots of today, which can only function in very limited domains and situations.

CPR E 586. Pervasive Computing.

(3-0) Cr. 3. *Prereq:* CPR E 489 or CPR E 530

Fundamentals of pervasive computing, including location and context awareness, mobile and location services, ubiquitous data access, low power computing and energy management, middleware, security and privacy issues.

CPR E 588. Embedded Computer Systems.

(3-0) Cr. 3. *Prereq:* CPR E 308

Hardware/software systems and codesign. Models of computation for embedded systems. System-level design. Modeling, specification, synthesis, and verification. Hardware/software implementation. Design space exploration. Performance analysis and optimization. Multiprocessor system on chip. Platform-based design. Design methodologies and tools. Case studies and design projects.

CPR E 590. Special Topics.

Cr. 1-6. Repeatable.

Formulation and solution of theoretical or practical problems in computer engineering.

CPR E 592. Seminar in Computer Engineering.

Cr. 1-4. Repeatable. *Prereq:* Permission of instructor

Projects or seminar in Computer Engineering.

CPR E 594. Selected Topics in Computer Engineering.

(3-0) Cr. 3. Repeatable.

CPR E 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:**CPR E 626. Parallel Algorithms for Scientific Applications.**

(Cross-listed with COM S). (3-0) Cr. 3. *Prereq:* CPR E 526

Algorithm design for high-performance computing. Parallel algorithms for multidimensional tree data structures, space-filling curves, random number generation, graph partitioning and load balancing. Applications to grid and particle-based methods and computational biology.

CPR E 632. Information Assurance Capstone Design.

(Cross-listed with INFAS). (3-0) Cr. 3. *Prereq:* INFAS 531, INFAS 532, INFAS 534

Capstone design course which integrates the security design process. Design of a security policy. Creation of a security plan. Implementation of the security plan. The students will attack each other's secure environments in an effort to defeat the security systems. Students evaluate the security plans and the performance of the plans. Social, political and ethics issues. Student self-evaluation, journaling, final written report.

CPR E 681. Advanced Topics in Computer Architecture.

(Cross-listed with COM S). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: CPR E 581. Repeatable with Instructor permission

Current topics in computer architecture design and implementation. Advanced pipelining, cache and memory design techniques. Interaction of algorithms with architecture models and implementations. Tradeoffs in architecture models and implementations.

CPR E 697. Engineering Internship.

(Cross-listed with E E). Cr. R. Repeatable.

One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

CPR E 699. Research.

Cr. arr. Repeatable.

Computer Science (COM S)

Courses primarily for undergraduates:

COM S 101. Orientation.

Cr. R. F.S.

Introduction to the procedures and policies of Iowa State University and the Department of Computer Science, test-outs, honorary societies, etc. Issues relevant to student adjustment to college life will also be discussed. Offered on a satisfactory-fail basis only.

COM S 103. Computer Applications.

Cr. 4. F.S.SS.

Introduction to computer literacy and applications. Applications: Windows, Internet browser/HTML, word processing, spreadsheets, database management and presentation software. Literacy: history of computing, structure of computers, telecommunications, computer ethics, computer crime, and history of programming languages. No prior computer experience necessary. Course is offered online only. Students must attend an orientation session the first week of class.

COM S 104. Introduction to Programming.

(1.5-1) Cr. 2. F.S.

Offered first 8 weeks and last 8 weeks. Use of personal computer and workstation operating systems and beginning programming. Project-oriented approach to computer operation and programming, including use of tools to aid in programming. Topics from computer history, using basic Windows and Unix tools, program structure, expression, variables, decision and logic, and iteration. No prior computer experience necessary.

COM S 107. Applied Computer Programming.

(3-0) Cr. 3. F.S.

Introduction to computer programming for non-majors using a language such as the Visual Basic language. Basics of good programming and algorithm development. Graphical user interfaces.

COM S 108. Applied Computer Programming II.

(3-0) Cr. 3. F.S. Prereq: *Com S 107 or equivalent*

Advanced programming applications in Visual Basic for non-majors. Emphasis on programming projects including sorting, file processing, database processing, web programming, and graphics and animation. Students will learn problem solving techniques and advanced programming skills to build real-world applications.

COM S 113. Introduction to Spreadsheets and Databases.

(2-2) Cr. 3. F.S.SS.

Using Microsoft Excel spreadsheets and Microsoft Access databases to input, store, process, manipulate, query, and analyze data for business and industrial applications. Credit in Com S 113 may not be applied toward graduation in the COM S, S E, and CPR E majors. Only one of COM S 102, COM S 103, and COM S 113 may count toward graduation.

COM S 201. Computer Programming in COBOL.

(3-0) Cr. 3. SS.

Computer programming in COBOL. Emphasis on the design, writing, debugging, and testing of business applications programs in a transaction-oriented environment.

COM S 203. Careers in Computer Science.

Cr. R. F.S.

Computer science as a profession. Introduction to career fields open to computer science majors. Relationship of coursework to careers. Presentations by computer science professionals. Offered on a satisfactory-fail basis only.

COM S 207. Fundamentals of Computer Programming.

(Cross-listed with MIS). (3-1) Cr. 3. F.S. Prereq: *MATH 150 or placement into MATH 140/MATH 141/MATH 142 or higher*

An introduction to computer programming using an object-oriented programming language. Emphasis on the basics of good programming techniques and style. Extensive practice in designing, implementing, and debugging small programs. Use of abstract data types. Interactive and file I/O. Exceptions/error-handling. This course is not designed for computer science, software engineering, and computer engineering majors. Credit may not be applied toward graduation for both Com S 207/MIS 207 and Com S 227.

COM S 208. Intermediate Computer Programming.

(3-1) Cr. 3. S. Prereq: *MIS/COM S 207, credit or enrollment in MATH 151, MATH 160, or MATH 165*

Intermediate-level programming techniques. Emphasis on designing, writing, testing, debugging, and documenting medium-sized programs. Data structures and their uses. Dynamic memory usage. Inheritance and polymorphism. Algorithm design and efficiency: recursion, searching, and sorting. Event-driven and GUI programming. The software development process. This course is not designed for computer science, software engineering and computer engineering majors. Credit may not be applied toward the major in computer science, software engineering, or computer engineering.

COM S 227. Introduction to Object-oriented Programming.

(3-2) Cr. 4. F.S. Prereq: *Placement into MATH 143, 165, or higher; recommended: a previous high school or college course in programming or equivalent experience.*

Introduction to object-oriented design and programming techniques. Symbolic and numerical computation, recursion and iteration, modularity procedural and data abstraction, and specifications and subtyping. Object-oriented techniques including encapsulation, inheritance and polymorphism. Imperative programming. Emphasis on principles of programming and object-oriented design through extensive practice in design, writing, running, debugging, and reasoning. Course intended for Com S majors. Credit may not be applied toward graduation for both Com S 207 and 227.

COM S 228. Introduction to Data Structures.

(3-1) Cr. 3. F.S. Prereq: *Minimum of C- in 227, credit or enrollment in MATH 165*

An object-oriented approach to data structures and algorithms. Object-oriented analysis, design, and programming, with emphasis on data abstraction, inheritance and subtype polymorphism. Abstract data type specification and correctness. Collections and associated algorithms, such as stacks, queues, lists, trees. Searching and sorting algorithms. Graphs. Data on secondary storage. Analysis of algorithms. Emphasis on object-oriented design, writing and documenting medium-sized programs. This course is designed for majors.

COM S 252. Linux Operating System Essentials.

(3-0) Cr. 3. F. Prereq: *COM S 107 or COM S 207 or COM S 227*

Introduction to installation, utilization, and administration of Linux systems. Topics include open-source software, package installation and management, shell programming and command-line utilities, process and service management, account management, network configuration, file sharing, interoperation with other computers and operating systems, automation, and system security.

COM S 290. Independent Study.

Cr. arr. F.S. Prereq: *Permission of instructor*

Offered on a satisfactory-fail basis only.

COM S 290H. Independent Study: Honors.

Cr. arr. F.S. Prereq: *Permission of instructor*

Offered on a satisfactory-fail basis only.

COM S 309. Software Development Practices.

(3-1) Cr. 3. F.S. Prereq: *Minimum of C- in COM S 228*

A practical introduction to methods for managing software development. Process models, requirements analysis, structured and object-oriented design, coding, testing, maintenance, cost and schedule estimation, metrics. Programming projects.

COM S 311. Design and Analysis of Algorithms.

(3-1) Cr. 3. F.S. Prereq: *Minimum of C- in COM S 228; MATH 166, ENGL 250, and COM S 330 or CPR E 310*

Basic techniques for design and analysis of efficient algorithms. Sorting, searching, graph algorithms, computational geometry, string processing and NP-completeness. Design techniques such as dynamic programming and the greedy method. Asymptotic, worst-case, average-case and amortized analyses. Data structures including heaps, hash tables, binary search trees and red-black trees. Programming projects.

COM S 319. Software Construction and User Interfaces.

(Cross-listed with S E). (3-0) Cr. 3. F. Prereq: *COM S 228*

Basic theory of grammars, parsing. Language paradigms. State transition and table-based software design. Review of principles of object orientation, object oriented analysis using UML. Frameworks and APIs. User interface architecture, evaluation of user interface. Design of windows, menus, and commands. Introduction to formal specification and model-based software design. Introduction to domain-specific software engineering.

COM S 321. Introduction to Computer Architecture and Machine-Level Programming.

(3-1) Cr. 3. F.S. *Prereq: Minimum of C- in COM S 228, CPR E 281 and ENGL 250*
Introduction to computer architecture and organization. Emphasis on evaluation of performance, instruction set architecture, datapath and control, memory-hierarchy design, and pipelining. Assembly language on a simulator.

COM S 327. Advanced Programming Techniques.

(3-0) Cr. 3. F.S. *Prereq: COM S 228, credit or enrollment in MATH 166, CPR E 281.*

Object-oriented programming experience using a language suitable for exploring advanced topics in programming. Topics include memory management, parameter passing, inheritance, compiling, debugging, and maintaining programs. Significant programming projects.

COM S 330. Discrete Computational Structures.

(3-1) Cr. 3. F.S. *Prereq: Minimum of C- in COM S 228 and MATH 166; ENGL 250*
Concepts in discrete mathematics as applied to computer science. Logic, proof techniques, set theory, relations, graphs, combinatorics, discrete probability and number theory.

COM S 331. Theory of Computing.

(Cross-listed with LING). (3-1) Cr. 3. F.S. *Prereq: Minimum of C- in COM S 228, MATH 166, and in COM S 330 or CPR E 310; ENGL 250*

Models of computation: finite state automata, pushdown automata and Turing machines. Study of grammars and their relation to automata. Limits of digital computation, unsolvability and Church-Turing thesis. Chomsky hierarchy and relations between classes of languages.

COM S 336. Introduction to Computer Graphics.

(3-0) Cr. 3. F. *Prereq: COM S 327, CoReq MATH 207 or MATH 317*

Basic algorithms, design, and programming of interactive computer graphics systems and hardware. Topics include 2D and 3D transformations, 3D viewing, visible surface algorithms, collision detection, illumination models, shading, ray tracing, shadows, transparency and texture mapping.

COM S 342. Principles of Programming Languages.

(Cross-listed with S E). (3-1) Cr. 3. F.S. *Prereq: Minimum of C- in COM S 228, COM S 330 or CPR E 310*

Study of concepts in programming languages and major programming paradigms, especially functional programming. Special emphasis on design tradeoffs that enable students to make sound choices of programming languages for a given software development task. Programming projects.

COM S 350. Number Theory.

(Cross-listed with MATH). (3-0) Cr. 3. S. *Prereq: MATH 201 or COM S 330*

Divisibility, integer representations, primes and divisors, linear diophantine equations, congruences, and multiplicative functions. Applications to cryptography.

COM S 352. Introduction to Operating Systems.

(3-1) Cr. 3. F.S. *Prereq: COM S 321, and COM S 327; ENGL 250*

Survey of operating system issues. Introduction to hardware and software components including: processors, peripherals, interrupts, management of processes, threads and memory, deadlocks, file systems, protection, virtual machines and system organization, and introduction to distributed operating systems. Programming projects.

COM S 362. Object-Oriented Analysis and Design.

(3-0) Cr. 3. F.S. *Prereq: Minimum of C- in COM S 228; ENGL 250*

Object-oriented requirements analysis and systems design. Design notations such as the Unified Modeling Language. Design Patterns. Group design and programming with large programming projects.

COM S 363. Introduction to Database Management Systems.

(3-0) Cr. 3. F.S. *Prereq: Minimum of C- in COM S 228; ENGL 250*

Relational, object-oriented, and semistructured data models and query languages. SQL, ODMG, and XML standards. Database design using entity-relationship model, data dependencies and object definition language. Application development in SQL-like languages and general purpose host languages with application program interfaces. Information integration using data warehouses, mediators and wrappers. Programming Projects.

COM S 398. Cooperative Education.

Cr. R. *Prereq: Permission of department chair*

Required of all cooperative students. Students must register for this course prior to commencing each work period.

COM S 401. Projects in Computing Applications.

(2-2) Cr. 3. F. *Prereq: ENGL 250, SP CM 212, COM S 309, and either COM S 362 or COM S 363*

Applications of software development methods (requirements collection and analysis, software design, project management, documentation and testing), programming techniques, database designs and administration, network application programming to solve computing needs in business settings. A study of practical applications of emerging technologies in computing. Emphasis on semester-long team programming projects. Lab assignments. Oral and written reports.

COM S 402. Computer Science Senior Project.

Cr. 2-3. Repeatable. F.S.

Students work as individuals and teams to complete the planning, design, and implementation of a significant project in the topic area. Oral and written reports.

COM S 402A. Computer Science Senior Project: Multimedia and Computer Gaming I.

Cr. 2-3. Repeatable. F.S. *Prereq: COM S 437 or permission of the instructor*

Students conceive, plan, architect and design a computer game. Student registered in this course will work with students in ARTIS 409. Oral and written reports.

COM S 402B. Computer Science Senior Project: Project Multimedia and Computer Gaming II.

(0-4) Cr. 2. Repeatable. F.S. *Prereq: COM S 402A*

Students implement, test, and present a completed production computer game. Students in this class will work with students in ARTIS 409. Oral and written reports.

COM S 402C. Computer Science Senior Project: Project in Computer Science.

(0-6) Cr. 3. Repeatable. F.

Students work as individuals and teams to complete the planning, design, and implementation of a significant project in the topic area. Oral and written reports.

COM S 409. Software Requirements Engineering.

(Dual-listed with COM S 509). (Cross-listed with S E). (3-0) Cr. 3. F. *Prereq: COM S 309*

The requirements engineering process including identification of stakeholders requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required.

COM S 410. Distributed Software Development.

(Dual-listed with COM S 510). (3-0) Cr. 3. F. *Prereq: COMS 228, COMS 309, COMS 327*

Team with students at foreign universities to develop a software application. Importance of distributed development. Design for distributed development, effective processes for distributed development, and cultural issues in distributed development, organizing for distributed development, communication techniques and skills for distributed development, including oral presentations. Graduate credit requires in-depth study of concepts.

COM S 412. Formal Methods in Software Engineering.

(Dual-listed with COM S 512). (Cross-listed with CPR E, S E). (3-0) Cr. 3. S. *Prereq: COM S 330 or CPR E 310; COM S 311, STAT 330*

A study of formal techniques for model-based specification and verification of software systems. Topics include logics, formalisms, graph theory, numerical computations, algorithms, and tools for automatic analysis of systems. Graduate credit requires in-depth study of concepts.

COM S 414. Gerontechnology in Smart Home Environments.

(Dual-listed with COM S 514). (3-0) Cr. 3. F. *Prereq: Com S 227 or (Com S 207 or Geron 377 or ArtGr 271) or equivalent.*

An interdisciplinary course designed for students who are interested in assistive technology, pervasive computing, mobile computing and principles of universal and inclusive design for end users, in particular, the elderly population. Students will work in semester-long projects as interdisciplinary teams to apply knowledge obtained from lectures and mutual presentations. For graduate credit students are required to submit a research report and give an oral presentation.

COM S 417. Software Testing.

(Cross-listed with S E). (3-0) Cr. 3. S. *Prereq:* COM S 309; COM S 330 or CPR E 310; ENGL 250, SP CM 212

Comprehensive study of software testing, principles, methodologies, management strategies and techniques. Test models, test design techniques (black box and white box testing techniques), test adequacy criteria, integration, regression, system testing methods, and software testing tools.

COM S 418. Introduction to Computational Geometry.

(Dual-listed with COM S 518). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: COM S 311 or permission of instructor

Introduction to data structures, algorithms, and analysis techniques for computational problems that involve geometry. Line segment intersection, polygon triangulation, 2D linear programming, range queries, point location, arrangements and duality, Voronoi diagrams and Delaunay triangulation, convex hulls, robot motion planning, visibility graphs. Other selected topics. Programming assignments.

COM S 421. Logic for Mathematics and Computer Science.

(Cross-listed with MATH). (3-0) Cr. 3. S. *Prereq:* MATH 301 or MATH 307 or MATH 317 or COM S 330

Propositional and predicate logic. Topics selected from Horn logic, equational logic, resolution and unification, foundations of logic programming, reasoning about programs, program specification and verification, model checking and binary decision diagrams, temporal logic and modal logic.

COM S 425. High Performance Computing for Scientific and Engineering Applications.

(Cross-listed with CPR E). (3-1) Cr. 3. S. *Prereq:* COM S 311, COM S 330, ENGL 250, SP CM 212

Introduction to high performance computing platforms including parallel computers and workstation clusters. Discussion of parallel architectures, performance, programming models, and software development issues. Sample applications from science and engineering. Practical issues in high performance computing will be emphasized via a number of programming projects using a variety of programming models and case studies. Oral and written reports.

COM S 426. Introduction to Parallel Algorithms and Programming.

(Dual-listed with COM S 526). (Cross-listed with CPR E). (3-2) Cr. 4. F. *Prereq:* CPR E 308 or COM S 321, CPR E 315 or COM S 311

Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms.

COM S 430. Advanced Programming Tools.

(3-1) Cr. 3. S. *Prereq:* COM S 311, COM S 362 or COM S 363, ENGL 250, SP CM 212

Topics in advanced programming techniques and tools widely used by industry (e.g., event-driven programming and graphical user interfaces, standard libraries, client/server architectures and techniques for distributed applications). Emphasis on programming projects in a modern integrated development environment. Oral and written reports.

COM S 433. Computational Models of Nanoscale Self-Assembly.

(Dual-listed with COM S 533). (3-0) Cr. 3. S. *Prereq:* Minimum of C- in COM S 331 or consent of the instructor

Modeling and analysis of natural and engineered systems that spontaneously assemble themselves from small components. Topics include biomolecular self-assembly, tile assembly models, computation via self-assembly, distributed folding, origami models, and self-repair. Emphasis on mathematical methods of describing, simulating, programming, and verifying the behaviors of self-assembling systems. Graduate credit requires a written or oral report on current research.

COM S 437. Computer Game and Media Programming.

(3-0) Cr. 3. S. *Prereq:* COM S 336 or permission of instructor

Students will learn video game programming using current game engine interfaces with real hardware. Particular attention is paid to the console architecture, development environment, tool chains, 2D graphics, 3D graphics, controllers, memory management, and audio systems. Students will complete the course by writing a simple game that runs on console hardware.

COM S 440. Principles and Practice of Compiling.

(Dual-listed with COM S 540). (3-1) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: COM S 331, COM S 342, ENGL 250, SP CM 212

Theory of compiling and implementation issues of programming languages. Programming projects leading to the construction of a compiler. Projects with different difficulty levels will be given for 440 and 540. Topics: lexical, syntax and semantic analyses, syntax-directed translation, runtime environment and library support. Written reports.

COM S 441. Programming Languages.

(Dual-listed with COM S 541). (3-1) Cr. 3. F. *Prereq:* COM S 342 or COM S 440

Survey of the goals and problems of language design. Formal and informal studies of a wide variety of programming language features including type systems. Creative use of functional and declarative programming paradigms.

COM S 444. Introduction to Bioinformatics.

(Cross-listed with BCB, BCBO, BIOL, CPR E, GEN). (4-0) Cr. 4. F. *Prereq:* MATH 165 or STAT 401 or equivalent

Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics, systems biology.

COM S 454. Distributed Systems.

(Dual-listed with COM S 554). (Cross-listed with CPR E). (3-1) Cr. 3. S. *Prereq:* COM S 311, COM S 352

(3-1) Cr. 3. Theoretical and practical issues of design and implementation of distributed systems. The client server paradigm, inter-process communications, synchronization and concurrency control, naming, consistency and replication, fault tolerance, and distributed file systems. Graduate credit requires additional in-depth study of concepts. Programming projects and written reports.

COM S 455. Simulation: Algorithms and Implementation.

(Dual-listed with COM S 555). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: COM S 311 and COM S 330, STAT 330, ENGL 150, SP CM 212

Introduction to discrete-event simulation with a focus on computer science applications, including performance evaluation of networks and distributed systems. Overview of algorithms and data structures necessary to implement simulation software. Discrete and continuous stochastic models, random number generation, elementary statistics, simulation of queuing and inventory systems, Monte Carlo simulation, point and interval parameter estimation. Graduate credit requires additional in-depth study of concepts. Oral and written reports.

COM S 461. Principles and Internals of Database Systems.

(Dual-listed with COM S 561). (3-1) Cr. 3. F. *Prereq:* COM S 311, ENGL 250, SP CM 212.

Models for structured and semistructured data. Algebraic, first order, and user-oriented query languages. Database schema design. Physical storage, access methods, and query processing. Transaction management, concurrency control, and crash recovery. Database security. Information integration using data warehouses, mediators, wrappers, and data mining. Parallel and distributed databases, and special purpose databases. Students enrolling in Com S 561 will require additional study of advanced concepts in database systems.

COM S 472. Principles of Artificial Intelligence.

(Dual-listed with COM S 572). (3-1) Cr. 3. F. *Prereq:* COM S 311, COM S 330 or CPR E 310, STAT 330, ENGL 250, SP CM 212, COM S 342 or comparable programming experience

Specification, design, implementation, and selected applications of intelligent software agents and multi-agent systems. Computational models of intelligent behavior, including problem solving, knowledge representation, reasoning, planning, decision making, learning, perception, action, communication and interaction. Reactive, deliberative, rational, adaptive, learning and communicative agents and multiagent systems. Artificial intelligence programming. A research project and a written report is required for students enrolled in Com S 572.

COM S 474. Introduction to Machine Learning.

(3-1) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* COM S 311, COM S 330 or CPR E 310, STAT 330, MATH 165, ENGL 250, SP CM 212, COM S 342 or comparable programming experience

Basic principles, techniques, and applications of Machine Learning. Design, analysis, implementation, and applications of learning algorithms. Topics include: statistical learning, pattern classification, function approximation, Bayesian learning, linear models, artificial neural networks, support vector machines, decision trees, instance based learning, probabilistic graphical models, unsupervised learning, selected applications in automated knowledge acquisition, pattern recognition, and data mining.

COM S 477. Problem Solving Techniques for Applied Computer Science. (Dual-listed with COM S 577). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* COM S 228; COM S 330 or CPR E 310, MATH 166, MATH 207 or MATH 317, or consent of the instructor
Selected topics in applied mathematics and modern heuristics that have found applications in areas such as geometric modeling, graphics, robotics, vision, human machine interface, speech recognition, computer animation, etc. Homogeneous coordinates and transformations, perspective projection, quaternions and rotations, polynomial interpolation, roots of polynomials, resultants, solution of linear and nonlinear equations, approximation, data fitting, Fourier series and fast Fourier transform, linear programming, nonlinear optimization, Lagrange multipliers, parametric and algebraic curves, curvature, Frenet formulas, Bezier curves. Programming components. A scholarly report is required for graduate credit.

COM S 481. Numerical Methods for Differential Equations. (Cross-listed with MATH). (3-0) Cr. 3. S. *Prereq:* MATH 265 and either MATH 266 or MATH 267; *knowledge of a programming language*
First order Euler method, high order Runge-Kutta method, and multistep method for solving ordinary differential equations. Finite difference and finite element methods for solving partial differential equations. Local truncation error, stability, and convergence for finite difference method. Numerical solution space, polynomial approximation, and error estimate for finite element method.

COM S 486. Fundamental Concepts in Computer Networking. (3-0) Cr. 3. S. *Prereq:* COM S 352
An introduction to fundamental concepts in the design and implementation of computer communication in both the wired and wireless networks, their protocols, and applications. Layered network architecture in the Internet, applications, transport, Socket APIs, network, and data link layers and their protocols, multimedia networking, and network security.

COM S 487. Network Programming, Applications, and Research Issues. (Dual-listed with COM S 587). (3-0) Cr. 3. S. *Prereq:* Com S 352 or CPR E 489 or equivalent.
Programming paradigms for building distributed and networking applications, including multithreaded client-server programming, socket programming, distributed object frameworks and programming suites, and web computing and security. Introduction to some on-going research issues in distributed and networking applications, including peer-to-peer computing, multimedia communications, and mobile computing and networking. A written report and an oral presentation is required for students enrolling in Com S 587.

COM S 490. Independent Study.
Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq:* 6 credits in computer science, permission of instructor
Offered on a satisfactory-fail basis only. No more than 9 credits of Com S 490 may be counted toward graduation.

COM S 490H. Independent Study: Honors.
Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq:* 6 credits in computer science, permission of instructor
Offered on a satisfactory-fail basis only. No more than 9 credits of Com S 490 may be counted toward graduation.

Courses primarily for graduate students, open to qualified undergraduates:

COM S 502. Complex Adaptive Systems Seminar. (Cross-listed with CAS). (1-0) Cr. 1. F.S. *Prereq:* Admission to CAS minor
Understanding core techniques in artificial life is based on basic readings in complex adaptive systems. Techniques of complex system analysis methods including: evolutionary computation, neural nets, agent based simulations (agent based computational economics). Large-scale simulations are to be emphasized, e.g. power grids, whole ecosystems.

COM S 503. Complex Adaptive Systems Concepts and Techniques. (Cross-listed with CAS). (3-0) Cr. 3. S. *Prereq:* Admission to CAS minor or related field
Survey of complex systems and their analysis. Examples are drawn from engineering, computer science, biology, economics and physics.

COM S 509. Software Requirements Engineering. (Dual-listed with COM S 409). (3-0) Cr. 3. F. *Prereq:* COM S 309
The requirements engineering process including identification of stakeholders requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required.

COM S 510. Distributed Software Development. (Dual-listed with COM S 410). (3-0) Cr. 3. F. *Prereq:* COMS 228, COMS 309, COMS 327
Team with students at foreign universities to develop a software application. Importance of distributed development. Design for distributed development, effective processes for distributed development, and cultural issues in distributed development, organizing for distributed development, communication techniques and skills for distributed development, including oral presentations. Graduate credit requires in-depth study of concepts.

COM S 511. Design and Analysis of Algorithms. (Cross-listed with CPR E). (3-0) Cr. 3. F. *Prereq:* COM S 311
A study of basic algorithm design and analysis techniques. Advanced data structures, amortized analysis and randomized algorithms. Applications to sorting, graphs, and geometry. NP-completeness and approximation algorithms.

COM S 512. Formal Methods in Software Engineering. (Dual-listed with COM S 412). (3-0) Cr. 3. S. *Prereq:* COM S 311, COM S 330
A study of formal techniques for model-based specification and verification of software systems. Topics include logics, formalisms, graph theory, numerical computations, algorithms and tools for automatic analysis of systems. Graduate credit requires in-depth study of concepts.

COM S 514. Gerontechnology in Smart Home Environments. (Dual-listed with COM S 414). (3-0) Cr. 3. F. *Prereq:* COM S 227 or (COM S 207 or GERON 377 or ARTGR 271) or equivalent.
An interdisciplinary course designed for students who are interested in assistive technology, pervasive computing, mobile computing and principles of universal and inclusive design for end users, in particular, the elderly population. Students will work in semester-long projects as interdisciplinary teams to apply knowledge obtained from lectures and mutual presentations. For graduate credit students are required to submit a research report and give an oral presentation.

COM S 515. Software System Safety. (3-0) Cr. 3. F. *Prereq:* COM S 309 or COM S 311, COM S 342
An introduction to the analysis, design, and testing of software for safety-critical and high-integrity systems. Analysis techniques, formal verification, fault identification and recovery, model checking, and certification issues. Emphasizes a case-based and systematic approach to software's role in safe systems.

COM S 518. Introduction to Computational Geometry. (Dual-listed with COM S 418). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* COM S 311 or permission of instructor
Introduction to data structures, algorithms, and analysis techniques for computational problems that involve geometry. Line segment intersection, polygon triangulation, 2D linear programming, range queries, point location, arrangements and duality, Voronoi diagrams and Delaunay triangulation, convex hulls, robot motion planning, visibility graphs. Other selected topics. Programming assignments.

COM S 525. Numerical Analysis of High Performance Computing. (Cross-listed with CPR E, MATH). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* CPR E 308 or MATH 481; *experience in scientific programming; knowledge of FORTRAN or C*
Introduction to parallelization techniques and numerical methods for state-of-the-art high performance computers. A major component will be a final project in an area related to each student's research interests.

COM S 526. Introduction to Parallel Algorithms and Programming. (Dual-listed with COM S 426). (Cross-listed with CPR E). (3-2) Cr. 4. F. *Prereq:* CPR E 308 or COM S 321, CPR E 315 or COM S 311
Models of parallel computation, performance measures, basic parallel constructs and communication primitives, parallel programming using MPI, parallel algorithms for selected problems including sorting, matrix, tree and graph problems, fast Fourier transforms.

COM S 531. Theory of Computation. (3-0) Cr. 3. S. *Prereq:* COM S 331
A systematic study of the fundamental models and analytical methods of theoretical computer science. Computability, the Church-Turing thesis, decidable and undecidable problems, and the elements of recursive function theory. Time complexity, logic, Boolean circuits, and NP-completeness. Role of randomness in computation.

COM S 533. Computational Models of Nanoscale Self-Assembly.

(Dual-listed with COM S 433). (3-0) Cr. 3. S. Prereq: *Minimum of C- in COM S 331 or consent of the instructor*

Modeling and analysis of natural and engineered systems that spontaneously assemble themselves from small components. Topics include biomolecular self-assembly, tile assembly models, computation via self-assembly, distributed folding, origami models, and self-repair. Emphasis on mathematical methods of describing, simulating, programming, and verifying the behaviors of self-assembling systems. Graduate credit requires a written or oral report on current research.

COM S 540. Principles and Practice of Compiling.

(Dual-listed with COM S 440). (3-1) Cr. 3. Alt. S., offered odd-numbered years. Prereq: *COM S 331, COM S 342, ENGL 250, SP CM 212*

Theory of compiling and implementation issues of programming languages. Programming projects leading to the construction of a compiler. Projects with different difficulty levels will be given for 440 and 540. Topics: lexical, syntax and semantic analyses, syntax-directed translation, runtime environment and library support. Written reports.

COM S 541. Programming Languages.

(Dual-listed with COM S 441). (3-1) Cr. 3. F. Prereq: *COM S 342 or COM S 440*

Survey of the goals and problems of language design. Formal and informal studies of a wide variety of programming language features including type systems. Creative use of functional and declarative programming paradigms.

COM S 544. Introduction to Bioinformatics.

(Cross-listed with BCB, CPR E, GDCB). (4-0) Cr. 4. F. Prereq: *MATH 165 or STAT 401 or equivalent*

Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative, functional genomics, and systems biology.

COM S 549. Advanced Algorithms in Computational Biology.

(Cross-listed with CPR E). (3-0) Cr. 3. Alt. S., offered even-numbered years. Prereq: *COM S 311 and either COM S 228 or COM S 208*

Design and analysis of algorithms for applications in computational biology, pairwise and multiple sequence alignments, approximation algorithms, string algorithms including in-depth coverage of suffix trees, semi-numerical string algorithms, algorithms for selected problems in fragment assembly, phylogenetic trees and protein folding. No background in biology is assumed. Also useful as an advanced algorithms course in string processing.

COM S 550. Evolutionary Problems for Computational Biologists.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. Prereq: *COM S 311 and some knowledge of programming*

Discussion and analysis of basic evolutionary principles and the necessary knowledge in computational biology to solve real world problems. Topics include character and distance based methods, phylogenetic tree distances, and consensus methods, and approaches to extract the necessary information from sequence-databases to build phylogenetic trees.

COM S 551. Computational Techniques for Genome Assembly and Analysis.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. Prereq: *COM S 311 and some knowledge of programming*

Introduction to practical sequence assembly and comparison techniques. Topics include global alignment, local alignment, overlapping alignment, banded alignment, linear-space alignment, word hashing, DNA-protein alignment, DNA-cDNA alignment, comparison of two sets of sequences, construction of contigs, and generation of consensus sequences. Focus on development of sequence assembly and comparison programs.

COM S 552. Principles of Operating Systems.

(3-0) Cr. 3. F. Prereq: *COM S 352*

A comparative study of high-level language facilities for process synchronization and communication. Formal analysis of deadlock, concurrency control and recovery. Protection issues including capability-based systems, access and flow control, encryption, and authentication. Additional topics chosen from distributed operating systems, soft real-time operating systems, and advanced security issues.

COM S 554. Distributed Systems.

(Dual-listed with COM S 454). (Cross-listed with CPR E). (3-1) Cr. 3. S. Prereq: *COM S 311, COM S 352*

(3-1) Cr. 3. Theoretical and practical issues of design and implementation of distributed systems. The client server paradigm, inter-process communications, synchronization and concurrency control, naming, consistency and replication, fault tolerance, and distributed file systems. Graduate credit requires additional in-depth study of concepts. Programming projects and written reports.

COM S 555. Simulation: Algorithms and Implementation.

(Dual-listed with COM S 455). (3-0) Cr. 3. Alt. F., offered even-numbered years. Prereq: *COM S 311 and COM S 330, STAT 330, ENGL 150, SP CM 212*

Introduction to discrete-event simulation with a focus on computer science applications, including performance evaluation of networks and distributed systems. Overview of algorithms and data structures necessary to implement simulation software. Discrete and continuous stochastic models, random number generation, elementary statistics, simulation of queuing and inventory systems, Monte Carlo simulation, point and interval parameter estimation. Graduate credit requires additional in-depth study of concepts. Oral and written reports.

COM S 556. Analysis Algorithms for Stochastic Models.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: *COM S 331, MATH 307, and STAT 330*

Introduction to the use of stochastic models to study complex systems, including network communication and distributed systems. Data structures and algorithms for analyzing discrete-state models expressed in high-level formalisms. State space and reachability graph construction, model checking, Markov chain construction and numerical solution, computation of performance measures, product-form models, approximations, and advanced techniques.

COM S 557. Computer Graphics and Geometric Modeling.

(Cross-listed with CPR E, M E). (3-0) Cr. 3. F.S. Prereq: *M E 421, programming experience in C*

Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing.

COM S 558. Introduction to the 3D Visualization of Scientific Data.

(Cross-listed with GEOL, HCI). (2-2) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: *Graduate-student standing in the mathematical or natural sciences*
Introduction to visualizing scientific information with 3D computer graphics and their foundation in human perception. Overview of different visualization techniques and examples of 3D visualization projects from different disciplines (natural sciences, medicine, and engineering). Class project in interactive 3D visualization using the OpenDX, VTK or a similar system.

COM S 561. Principles and Internals of Database Systems.

(Dual-listed with COM S 461). (3-1) Cr. 3. F. Prereq: *COM S 311, ENGL 250, SP CM 212.*

Models for structured and semistructured data. Algebraic, first order, and user-oriented query languages. Database schema design. Physical storage, access methods, and query processing. Transaction management, concurrency control, and crash recovery. Database security. Information integration using data warehouses, mediators, wrappers, and data mining. Parallel and distributed databases, and special purpose databases. Students enrolling in Com S 561 will require additional study of advanced concepts in database systems.

COM S 562. Implementation of Database Systems.

(3-0) Cr. 3. F. Prereq: *COM S 461 or COM S 561*

Implementation topics and projects are chosen from the following: Storage architecture, buffer management and caching, access methods, design, parsing and compilation of query languages and update operations, application programming interfaces (APIs), user interfaces, query optimization and processing, and transaction management for relational, object-oriented, semistructured (XML), and special purpose database models; client-server architectures, metadata and middleware for database integration, web databases.

COM S 567. Bioinformatics I (Fundamentals of Genome Informatics).

(Cross-listed with BCB, CPR E). (3-0) Cr. 3. F. Prereq: *COM S 228; COM S 330; STAT 341; credit or enrollment in BIOL 315, STAT 430*

Biology as an information science. Review of algorithms and information processing. Generative models for sequences. String algorithms. Pairwise sequence alignment. Multiple sequence alignment. Searching sequence databases. Genome sequence assembly.

COM S 568. Bioinformatics II (Advanced Genome Informatics).

(Cross-listed with BCB, GDCB, STAT). (3-0) Cr. 3. S. Prereq: *BCB 567, BBMB 301, BIOL 315, STAT 430, credit or enrollment in GEN 411*

Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

COM S 569. Bioinformatics III (Structural Genome Informatics).

(Cross-listed with BBMB, BCB, CPR E). (3-0) Cr. 3. F. Prereq: *BCB 567, GEN 411, STAT 430*

Algorithmic and statistical approaches in structural genomics including protein, DNA and RNA structure. Structure determination, refinement, representation, comparison, visualization, and modeling. Analysis and prediction of protein secondary and tertiary structure, disorder, protein cores and surfaces, protein-protein and protein-nucleic acid interactions, protein localization and function.

COM S 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology).

(Cross-listed with BCB, CPR E, GDCB, STAT). (3-0) Cr. 3. S. *Prereq:* BCB 567, BIOL 315, COM S 311 and either 208 or 228, GEN 411, STAT 430
Algorithmic and statistical approaches in computational functional genomics and systems biology. Elements of experiment design. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Multi-scale, multi-granularity models. Ontology-driven, network based, and probabilistic approaches to information integration.

COM S 572. Principles of Artificial Intelligence.

(Dual-listed with COM S 472). (3-1) Cr. 3. F. *Prereq:* COM S 311, COM S 330 or CPR E 310, STAT 330, ENGL 250, SP CM 212, COM S 342 or comparable programming experience

Specification, design, implementation, and selected applications of intelligent software agents and multi-agent systems. Computational models of intelligent behavior, including problem solving, knowledge representation, reasoning, planning, decision making, learning, perception, action, communication and interaction. Reactive, deliberative, rational, adaptive, learning and communicative agents and multiagent systems. Artificial intelligence programming. A research project and a written report is required for students enrolled in Com S 572.

COM S 573. Machine Learning.

(3-1) Cr. 3. S. *Prereq:* COM S 311, COM S 362, STAT 330

Algorithmic models of learning. Design, analysis, implementation and applications of learning algorithms. Learning of concepts, classification rules, functions, relations, grammars, probability distributions, value functions, models, skills, behaviors and programs. Agents that learn from observation, examples, instruction, induction, deduction, reinforcement and interaction. Computational learning theory. Data mining and knowledge discovery using artificial neural networks, support vector machines, decision trees, Bayesian networks, association rules, dimensionality reduction, feature selection and visualization. Learning from heterogeneous, distributed, dynamic data and knowledge sources. Learning in multi-agent systems. Selected applications in automated knowledge acquisition, pattern recognition, program synthesis, bioinformatics and Internet-based information systems. Oral and written reports.

COM S 574. Intelligent Multiagent Systems.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* STAT 330; COM S 331; COM S 572, COM S 573, COM S 472, or COM S 474

Specification, design, implementation, and applications of multi-agent systems. Intelligent agent architectures; infrastructures, languages and tools for design and implementation of distributed multi-agent systems; Multi-agent organizations, communication, interaction, cooperation, team formation, negotiation, competition, and learning. Selected topics in decision theory, game theory, contract theory, bargaining theory, auction theory, and organizational theory. Selected topics in knowledge representation and ontologies. Agent-based systems and the Semantic Web. Applications in distributed intelligent information networks for information retrieval, information integration, inference, and discovery from heterogeneous, autonomous, distributed, dynamic information sources.

COM S 575. Computational Perception.

(Cross-listed with CPR E, HCI). (3-0) Cr. 3. S. *Prereq:* Graduate standing or permission of instructor

This class covers statistical and algorithmic methods for sensing, recognizing, and interpreting the activities of people by a computer. This semester we will focus on machine perception techniques that facilitate and augment human-computer interaction. The main goal of the class is to introduce computational perception on both theoretical and practical levels. Participation in small groups to design, implement, and evaluate a prototype of a human-computer interaction system that uses one or more of the techniques covered in the lectures.

COM S 577. Problem Solving Techniques for Applied Computer Science.

(Dual-listed with COM S 477). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* COM S 228; COM S 330 or CPR E 310, MATH 166, MATH 207 or MATH 317, or consent of the instructor

Selected topics in applied mathematics and modern heuristics that have found applications in areas such as geometric modeling, graphics, robotics, vision, human machine interface, speech recognition, computer animation, etc. Homogeneous coordinates and transformations, perspective projection, quaternions and rotations, polynomial interpolation, roots of polynomials, resultants, solution of linear and nonlinear equations, approximation, data fitting, Fourier series and fast Fourier transform, linear programming, nonlinear optimization, Lagrange multipliers, parametric and algebraic curves, curvature, Frenet formulas, Bezier curves. Programming components. A scholarly report is required for graduate credit.

COM S 581. Computer Systems Architecture.

(Cross-listed with CPR E). (3-0) Cr. 3. F. *Prereq:* CPR E 381
Quantitative principles of computer architecture design, instruction set design, processor architecture: pipelining and superscalar design, instruction level parallelism, memory organization: cache and virtual memory systems, multiprocessor architecture, cache coherency, interconnection networks and message routing, I/O devices and peripherals.

COM S 583. Reconfigurable Computing Systems.

(Cross-listed with CPR E). (3-0) Cr. 3. *Prereq:* Background in computer architecture, design, and organization
Introduction to reconfigurable computing, FPGA technology and architectures, spatial computing architectures such as systolic and bit serial adaptive network architectures, static and dynamic rearrangeable interconnection architectures, processor architectures incorporating reconfigurability.

COM S 586. Computer Network Architectures.

(3-0) Cr. 3. F. *Prereq:* COM S 511, COM S 552 or CPR E 489
Design and implementation of computer communication networks: layered network architectures, local area networks, data link protocols, distributed routing, transport services, network programming interfaces, network applications, error control, flow/congestion control, interconnection of heterogeneous networks, TCP/IP, ATM networks, multimedia communications, IP and application multicast, overlay networks, network security and web computing.

COM S 587. Network Programming, Applications, and Research Issues.

(Dual-listed with COM S 487). (3-0) Cr. 3. S. *Prereq:* Com S 352 or CPR E 489 or equivalent.

Programming paradigms for building distributed and networking applications, including multithreaded client-server programming, socket programming, distributed object frameworks and programming suites, and web computing and security. Introduction to some on-going research issues in distributed and networking applications, including peer-to-peer computing, multimedia communications, and mobile computing and networking. A written report and an oral presentation is required for students enrolling in Com S 587.

COM S 590. Special Topics.

Cr. arr. Repeatable. *Prereq:* Permission of instructor
Offered on a satisfactory-fail basis only.

COM S 592. Research Colloquia.

Cr. 1. F.S. *Prereq:* Graduate classification
Attend Computer Science Research Colloquia. Written summary is required. Offered on a satisfactory-fail basis only.

COM S 598. Graduate Internship.

Cr. R. Repeatable. F.S.SS. *Prereq:* Graduate Classification
Supervised internship working in professional settings appropriate to the student's degree program. Academic work under faculty supervision.

COM S 599. Creative Component.

Cr. 1-3.
Creative component for nonthesis option of Master of Science degree. Offered on a satisfactory-fail basis only.

Courses for graduate students:**COM S 610. Seminar.**

Cr. arr.
Offered on a satisfactory-fail basis only.

COM S 611. Advanced Topics in Analysis of Algorithms.

(3-0) Cr. 3. Repeatable. Alt. S., offered odd-numbered years. *Prereq:* COM S 511, COM S 531
Advanced algorithm analysis and design techniques. Topics include graph algorithms, algebraic algorithms, number-theoretic algorithms, randomized and parallel algorithms. Intractable problems and NP-completeness. Advanced data structures.

COM S 612. Distributed Algorithms.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* COM S 511 or COM S 531
The theory of distributed computation. Algorithms, lower bounds and impossibility results. Leader Elections, mutual exclusion, consensus and clock synchronization algorithms. Synchronous, asynchronous and partially synchronous distributed systems models. Shared memory and message passing systems. Fault-tolerance and randomization. Broadcast and multicast. Wait-free object simulations. Distributed shared memory.

COM S 625. Issues in Parallel Programming and Performance.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* COM S 511
Parallel solutions of numerical and non-numerical problems, implementation of parallel programs on parallel machines, performance and other computational issues in parallel programming.

COM S 626. Parallel Algorithms for Scientific Applications.

(Cross-listed with CPR E). (3-0) Cr. 3. *Prereq:* CPR E 526
Algorithm design for high-performance computing. Parallel algorithms for multidimensional tree data structures, space-filling curves, random number generation, graph partitioning and load balancing. Applications to grid and particle-based methods and computational biology.

COM S 631. Advanced Topics in Computational Complexity.

(3-0) Cr. 3. Repeatable. Alt. F., offered even-numbered years. *Prereq:* COM S 531
Advanced study in the quantitative theory of computation. Time and space complexity of algorithmic problems. The structure of P, NP, PH, PSPACE, and other complexity classes, especially with respect to resource-bounded reducibilities and complete problems. Complexity relative to auxiliary information, including oracle computation and relativized classes, randomized algorithms, advice machines, Boolean circuits. Kolmogorov complexity and randomness.

COM S 633. Advanced Topics in Computational Randomness.

(3-0) Cr. 3. Repeatable. Alt. F., offered odd-numbered years. *Prereq:* COM S 531
Advanced study of the role of randomness in computation. Randomized algorithms, derandomization, and probabilistic complexity classes. Kolmogorov complexity, algorithmic information theory, and algorithmic randomness. Applications chosen from cryptography, interactive proof systems, computational learning, lower bound arguments, mathematical logic, and the organization of complex systems.

COM S 634. Theory of Games, Knowledge and Uncertainty.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* COM S 330
Fundamentals of Game Theory: individual decision making, strategic and extensive games, mixed strategies, backward induction, Nash and other equilibrium concepts. Discussion of Auctions and Bargaining. Repeated, Bayesian and evolutionary games. Interactive Epistemology: reasoning about knowledge in multiagent environment, properties of knowledge, agreements, and common knowledge. Reasoning about and representing uncertainty, probabilities, and beliefs. Uncertainty in multiagent environments. Aspects and applications of game theory, knowledge, and uncertainty in other areas, especially Artificial Intelligence and Economics, will be discussed.

COM S 641. Advanced Topics in Programming Language Semantics.

(3-0) Cr. 3. Repeatable. Alt. S., offered even-numbered years. *Prereq:* COM S 531, COM S 541
Operational and other mathematical models of programming language semantics. Type systems and their soundness. Applications of semantics on areas such as program correctness, language design or translation.

COM S 652. Advanced Topics in Distributed Operating Systems.

(3-0) Cr. 3. Repeatable. Alt. F., offered odd-numbered years. *Prereq:* COM S 552
Concepts and techniques for network and distributed operating systems: Communications protocols, processes and threads, name and object management, synchronization, consistency and replications for consistent distributed data, fault tolerance, protection and security, distributed file systems, design of reliable software, performance analysis.

COM S 657. Advanced Topics in Computer Graphics.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* COM S 228, I E 557/M E 557/CPR E 557/COM S 557
Modern lighting models: Rendering Equation, Spherical Harmonics, Lafortune, Cook-Torrance. Non-polygonal primitives: volumes, points, particles. Textures: filtering, reflections creation. Graphics hardware: pipeline, performance issues, programmability in vertex and fragment path. Per-pixel lighting. Nonphotorealistic rendering. Radiosity; Ray tracing.

COM S 661. Advanced Topics in Database Systems.

(3-0) Cr. 3. Repeatable. Alt. F., offered even-numbered years. *Prereq:* COM S 461 or COM S 561
Advanced topics chosen from the following: database design, data models, query systems, query optimization, incomplete information, logic and databases, multimedia databases; temporal, spatial and belief databases, semistructured data, concurrency control, parallel and distributed databases, information retrieval, data warehouses, wrappers, mediators, and data mining.

COM S 672. Advanced Topics in Computational Models of Learning.

(3-0) Cr. 3. Repeatable. Alt. S., offered even-numbered years. *Prereq:* COM S 572 or COM S 573 or COM S 472 or COM S 474
Selected topics in Computational Learning Theory (PAC learning, Sample complexity, VC Dimension, Occam Learning, Boosting, active learning, Kolmogorov Complexity, Learning under helpful distributions, Mistake Bound Analysis). Selected topics in Bayesian and Information Theoretic Models (ML, MAP, MDL, MML). Advanced statistical methods for machine learning. Selected topics in reinforcement learning.

COM S 673. Advanced Topics in Computational Intelligence.

(3-0) Cr. 3. Repeatable. Alt. S., offered odd-numbered years. *Prereq:* COM S 572 or COM S 573 or COM S 472 or COM S 474
Advanced applications of artificial intelligence in bioinformatics, distributed intelligent information networks and the Semantic Web. Selected topics in distributed learning, incremental learning, multi-task learning, multi-strategy learning; Graphical models, multi-relational learning, and causal inference; statistical natural language processing; modeling the internet and the web; automated scientific discovery; neural and cognitive modeling.

COM S 681. Advanced Topics in Computer Architecture.

(Cross-listed with CPR E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* CPR E 581. *Repeatable with Instructor permission*
Current topics in computer architecture design and implementation. Advanced pipelining, cache and memory design techniques. Interaction of algorithms with architecture models and implementations. Tradeoffs in architecture models and implementations.

COM S 686. Advanced Topics in High-Speed Networks.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* COM S 586
Advanced topics in IP networks and optical networks. QoS routing and scheduling, multicast, multiprotocol label switching (MPLS), traffic engineering. Optical network architectures, routing and wavelength assignment algorithms, optical multicast, traffic grooming, optical burst switching, lightpath protection/restoration schemes, and IP over WDM.

COM S 699. Research.

Cr. arr. Repeatable. *Prereq:* Approval of instructor
Offered on a satisfactory-fail basis only.

Construction Engineering (CON E)

Courses primarily for undergraduates:

CON E 112. Orientation to Learning and Productive Team Membership.

(Cross-listed with AER E, FS HN, HORT, NREM). (2-0) Cr. 2. F.
Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

CON E 114. Developing Responsible Learners and Effective Leaders.

(Cross-listed with FS HN, HORT, NREM). (2-0) Cr. 2. S. Prereq: Hort 112 or NREM 112
Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

CON E 121. Cornerstone Learning Community: Orientation to Academic Life.

(0-2) Cr. 1. F.
Integration of first-year and transfer students into the engineering profession and the Construction Engineering program. Assignments and activities completed both individually and in learning teams involving teamwork, academic preparation, and study skills. Introduction to construction industry professionals. Teamwork topics include interdisciplinary teamwork, skills for academic success, diversity issues and leadership. Introduction to organization of program, department, college, and university. Overview of faculty, staff, policies, procedures and resources.

CON E 122. Cornerstone Learning Community: Orientation to Professional Life.

(0-2) Cr. 1. S.
Continuation of Con E 121. Integration of first-year and transfer students into the engineering profession. Career preparation, professional ethics, construction research, leadership. Introduction to construction industry professionals including how they interact with engineers in other disciplines. Continued introduction to program, department, college, and university organization. Overview of faculty, staff, policies, procedures and resources.

CON E 222. Contractor Organization and Management of Construction.

(3-0) Cr. 3. F.S. Prereq: Completion of basic program
Entry level course for construction engineering: integration of significant engineering and management issues related to construction company operations. Company organization and operations; construction and project administration; construction contracts; delivery systems; insurance and bonding; construction safety; construction labor relations; contract documents.

CON E 241. Construction Materials and Methods.

(2-3) Cr. 3. F.S. Prereq: CON E 222
Introduction to materials and methods of building construction and to construction drawings. Foundation, structural framing, floor, roof, and wall systems. Blueprint reading and quantity takeoff techniques.

CON E 251. Mechanical/Electrical Materials and Methods.

(0-3) Cr. 1. F.S. Prereq: Credit or enrollment in CON E 241
Introduction to the materials and methods for mechanical and electrical construction systems and drawings. HVAC, water and waste water, power distribution, lighting, and fire protection. Blueprint reading and quantity takeoff.

CON E 298. Cooperative Education.

Cr. R. F.S.SS. Prereq: Permission of department and Engineering Career Services
First professional work period in the cooperative education program. Students must register for this course before commencing work.

CON E 322. Construction Equipment and Heavy Construction Methods.

(2-2) Cr. 3. F.S. Prereq: CON E 241 or C E 306
Selection and acquisition of construction equipment. Application of engineering fundamentals and economics to performance characteristics and production of equipment. Heavy construction methods and economic applications.

CON E 340. Concrete and Steel Construction.

(2-2) Cr. 3. F.S. Prereq: EM 324, credit or enrollment in CON E 322
Planning and field engineering for concrete and steel construction. Design and applications of concrete formwork to construction. Erection of structural steel. Emerging industry themes.

CON E 352. Mechanical Systems in Buildings.

(2-2) Cr. 3. F.S. Prereq: CON E 251, PHYS 222
Comprehensive coverage of mechanical systems, plumbing, fire protection. Analysis techniques and design principles for each system. Required comprehensive design project for a major building project.

CON E 353. Electrical Systems in Buildings.

(3-0) Cr. 3. F.S. Prereq: PHYS 222 and credit or enrollment in CON E 352
Comprehensive coverage of building electrical systems including power, lighting, fire alarm, security and communications. Analysis techniques and design principles for each system. Required comprehensive design project for a major building project.

CON E 354. Building Energy Performance.

(3-0) Cr. arr. F. Prereq: Junior Classification
Energy performance of buildings, building shells, HVAC, electrical and other building systems. Analysis and evaluation of building performance, energy efficiency, environmental quality, first costs, and operating costs. Strategies to exceed energy code requirements through the ASHRAE Standard 90.1.

CON E 380. Engineering Law.

(3-0) Cr. 3. F.S. Prereq: Junior classification
Introduction to law and judicial procedure as they relate to the practicing engineer. Contracts, professional liability, professional ethics, licensing, bidding procedures, intellectual property, products liability, risk analysis. Emphasis on development of critical thinking process, abstract problem analysis and evaluation.

CON E 381. Bidding Construction Projects I.

(0-3) Cr. 1. F. Prereq: Permission from the instructor
Team development of construction process designs and cost estimates for transportation construction projects under closely simulated conditions. Examine project sites, consult with construction industry mentors, obtain subcontractor and supplier quotations, and submit bids. Offered in the following specialties:.

CON E 381A. Bidding Construction Projects I: Heavy and Highway.

(0-3) Cr. 1. F. Prereq: Permission from the instructor
Team development of construction process designs and cost estimates for transportation construction projects under closely simulated conditions. Examine project sites, consult with construction industry mentors, obtain subcontractor and supplier quotations, and submit bids. Offered in the following specialties:.

CON E 381B. Bidding Construction Projects I: Building.

(0-3) Cr. 1. F. Prereq: Permission from the instructor
Team development of construction process designs and cost estimates for transportation construction projects under closely simulated conditions. Examine project sites, consult with construction industry mentors, obtain subcontractor and supplier quotations, and submit bids. Offered in the following specialties:.

CON E 381C. Bidding Construction Projects I: Mechanical.

(0-3) Cr. 1. F. Prereq: Permission from the instructor
Team development of construction process designs and cost estimates for transportation construction projects under closely simulated conditions. Examine project sites, consult with construction industry mentors, obtain subcontractor and supplier quotations, and submit bids. Offered in the following specialties:.

CON E 381D. Bidding Construction Projects I: Electrical.

(0-3) Cr. 1. F. Prereq: Permission from the instructor
Team development of construction process designs and cost estimates for transportation construction projects under closely simulated conditions. Examine project sites, consult with construction industry mentors, obtain subcontractor and supplier quotations, and submit bids. Offered in the following specialties:.

CON E 381E. Bidding Construction Projects I: Mechanical and Electrical.

(0-3) Cr. 1. F. Prereq: Permission from the instructor
Team development of construction process designs and cost estimates for transportation construction projects under closely simulated conditions. Examine project sites, consult with construction industry mentors, obtain subcontractor and supplier quotations, and submit bids. Offered in the following specialties:.

CON E 381F. Bidding Construction Projects I: Miscellaneous.

(0-3) Cr. 1. F. Prereq: Permission from the instructor
Team development of construction process designs and cost estimates for transportation construction projects under closely simulated conditions. Examine project sites, consult with construction industry mentors, obtain subcontractor and supplier quotations, and submit bids. Offered in the following specialties:.

CON E 396. Summer Internship.

Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services*

Summer professional work period. Students must register for this course before commencing work.

CON E 397. Engineering Internship.

Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services*

Professional work period, one semester maximum per academic year. Students must register for this course before commencing work.

CON E 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq: CON E 298, permission of department and Engineering Career Services*

Second professional work period in the cooperative education program. Students must register for this course before commencing work.

CON E 422. Construction Cost Estimating and Cost Engineering.

(2-2) Cr. 3. F.S. *Prereq: CON E 241 and 251*

Conceptual and detailed cost estimating. Theory and practice of estimating construction costs of materials, labor, equipment, contingency, overhead and markup. Estimating competencies and bid ethics. Electronic quantity take off and pricing methods. Assemblies costs, unit costs, production rates. Analysis of project profitability, cost analysis and cost control methods. Value engineering. Life cycle cost analysis.

CON E 441. Construction Planning, Scheduling, and Control.

(2-2) Cr. 3. F.S. *Prereq: Credit or enrollment in CON E 421*

Integration of previous construction coursework into the planning, scheduling, and management of time, costs, and other resources. Emphasis on preparation and analysis of network schedules. Comprehensive planning and scheduling project. Computer project management applications.

CON E 481. Bidding Construction Projects II.

(0-3) Cr. 1. F. *Prereq: Permission from the instructor*

Similar to Con E 381, except students with previous experience attempt projects with larger scope or lead students with less experience.

CON E 481A. Bidding Construction Projects II: Heavy and Highway.

(0-3) Cr. 1. F. *Prereq: Permission from the instructor*

Similar to Con E 381, except students with previous experience attempt projects with larger scope or lead students with less experience.

CON E 481B. Bidding Construction Projects II: Building.

(0-3) Cr. 1. F. *Prereq: Permission from the instructor*

Similar to Con E 381, except students with previous experience attempt projects with larger scope or lead students with less experience.

CON E 481C. Bidding Construction Projects II: Mechanical.

(0-3) Cr. 1. F. *Prereq: Permission from the instructor*

Similar to Con E 381, except students with previous experience attempt projects with larger scope or lead students with less experience.

CON E 481D. Bidding Construction Projects II: Electrical.

(0-3) Cr. 1. F. *Prereq: Permission from the instructor*

Similar to Con E 381, except students with previous experience attempt projects with larger scope or lead students with less experience.

CON E 481E. Bidding Construction Projects II: Mechanical and Electrical.

(0-3) Cr. 1. F. *Prereq: Permission from the instructor*

Similar to Con E 381, except students with previous experience attempt projects with larger scope or lead students with less experience.

CON E 481F. Bidding Construction Projects II: Miscellaneous.

(0-3) Cr. 1. F. *Prereq: Permission from the instructor*

Similar to Con E 381, except students with previous experience attempt projects with larger scope or lead students with less experience.

CON E 487. Construction Engineering Design I.

(2-2) Cr. 3. F.S. *Prereq: CON E 380 or ACCT 215, CON E 340 (B, H), CON E 352 (B, E, M), CON E 353 (B, E, M), CON E 421, CON E 441. Student must be within two semesters of graduation*

The integrated delivery of project services as a team, including preliminary engineering design process, constructability review, interaction with the client, identification of engineering problems, developments of a proposal, identification of design criteria, cost estimating, planning and scheduling, application of codes and standards, development of feasible alternatives, selection of best alternative, and delivery of oral presentations.

CON E 488. Construction Engineering Design II.

(1-5) Cr. 3. F.S. *Prereq: CON E 380 or ACCT 215. Coreq: CON E 487*

Application of team design concepts to a construction engineering project. Project planning. Advanced construction and project management.

CON E 490. Independent Study.

Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Individual study in any phase of construction engineering. Pre-enrollment contract required.

CON E 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. *Prereq: CON E 398, permission of department and Engineering Career Services*

Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Criminal Justice Studies (CJ ST)

Courses primarily for undergraduates:

CJ ST 240. Introduction to the U.S. Criminal Justice System.

(3-0) Cr. 3. F.

Provides systematic overview of law, police organization and behavior, prosecution and defense, sentencing, the judiciary, community corrections, penology, and capital punishment. The course demonstrates the role of discretion in all of these agencies as well as the sociological influences of age, race, gender, and social class on criminal justice system processes.

CJ ST 241. Youth and Crime.

(Cross-listed with SOC). (3-0) Cr. 3. F. *Prereq:* SOC 134

An examination of delinquency that focuses on the relationship between youth as victims and as offenders, social and etiological features of delinquency, the role of the criminal justice system, delinquents' rights, and traditional and alternative ways of dealing with juvenile crime.

CJ ST 320. American Judicial Process.

(Cross-listed with POL S). (3-0) Cr. 3. S. *Prereq:* POL S 215

An overview of the American judicial process. Emphasis on specific topics such as application of constitutional rights to the states (particularly the Fourth, Fifth, Sixth, and Fourteenth Amendments), mechanics of judicial opinions, constitutional philosophies of Supreme Court Justices, decisions of first impression, and the value and scope of precedent.

CJ ST 332. Philosophy of Law.

(Cross-listed with PHIL). (3-0) Cr. 3. F.S. *Prereq:* PHIL 201 or PHIL 230

Extent of our obligation to obey the law; what constitutes just punishment; how much of the immoral should be made illegal? Relation of these questions to major theories of law and the state. Discussion of such concepts as coercion, equality, and responsibility.

CJ ST 340. Deviant and Criminal Behavior.

(Cross-listed with SOC). (3-0) Cr. 3. S.SS. *Prereq:* SOC 134

Theory and research on the etiology of types of social deviance; issues relating to crime, antisocial behavior and social policies designed to control deviant behavior.

CJ ST 341. Criminology.

(Cross-listed with SOC). (3-0) Cr. 3. F. *Prereq:* SOC 134

The nature of crime and criminology; the concept of crime; statistics and theories of criminality; major forms of crime; official responses to crime and control of crime.

CJ ST 351. Police and Society.

(Cross-listed with SOC). (3-0) Cr. 3. F.S. *Prereq:* SOC 241 or CJ ST 240

Introduction and overview of law enforcement in the United States. Theory and research on police history, function, and organization; constitutional issues of policing; and critical topics, such as community policing, officer discretion and decision-making, corruption, use of force, and racial profiling. The course illustrates the interconnections between communities, police organizations, citizens, and criminal offenders.

CJ ST 352. Punishment, Corrections, and Society.

(Cross-listed with SOC). (3-0) Cr. 3. F.S. *Prereq:* SOC 241 or CJ ST 240

Introduction and overview of corrections in the United States. Theory and research on probation, parole, intermediate sanctions, prison, inmate society, inmate behavior and misconduct, capital punishment, recidivism, correctional treatment, rehabilitation, and offender reintegration into society.

CJ ST 402. White-Collar Crime.

(Cross-listed with SOC). (3-0) Cr. 3. S. *Prereq:* SOC 241 or CJ ST 240

Introduction and overview of white-collar crime as a form of deviance. Theory and research on occupational, corporate, and organizational offending; prevalence, costs, and consequences of white-collar crime; predictors and correlates of white-collar crime; and political, business, and public policy responses to white-collar crime.

CJ ST 403. Criminal Offenders.

(3-0) Cr. 3. F.S. *Prereq:* CJ ST 240 or CJ ST 241

Introduction and overview of criminal offenders. Theory and research on epidemiology, offender typologies, etiology of violence, recidivism, societal costs, correctional supervision, treatment, and prevention of serious antisocial behavior.

CJ ST 460. Criminal and Juvenile Justice Practicum.

(Cross-listed with SOC). Cr. 3-12. Repeatable, maximum of 12 credits. F.S.SS.

Prereq: Junior or senior classification; permission of criminal justice studies coordinator; major or minor in sociology, or criminal justice studies minor

Study of the criminal and juvenile justice systems and social control processes. Supervised placement in a police department, prosecutor's office, court, probation and parole department, penitentiary, juvenile correctional institution, community-based rehabilitation program, or related agency. Offered on a satisfactory-fail basis only. Not more than a total of 12 credits of field experience (Soc 454 and 460) may be counted toward graduation. No credits in Soc 460 may be used to satisfy minimum sociology requirements for sociology majors.

CJ ST 484. Topical Studies in Criminal and Juvenile Justice.

(Cross-listed with SOC). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq:* 6 credits in sociology and permission from instructor

Thematic or topical issues and studies dealing with the sociology of police, judiciary, institutional and community-based corrections, gender/ethnicity and crime/delinquency, criminal and delinquent gangs, and crime and delinquency prevention.

Curriculum and Instruction (C I)

Courses primarily for undergraduates:

C I 201. Learning Technologies in the PK-6 Classroom.

(2-2) Cr. 3. F.S.Alt. SS., offered odd-numbered years.

Overview of ways to use educational technologies to support instruction in PK-6 settings. Focus on pedagogical approaches that integrate technologies to support learning in the content areas. Laboratory experiences include development of activities to use tool software, multimedia, web page development, digital video and other technologies to facilitate learning and teaching.

C I 202. Learning Technologies in the 7-12 Classroom.

(2-2) Cr. 3. F.S.Alt. SS., offered even-numbered years.

Overview of ways to use educational technologies to support instruction in 7-12 settings. Focus on pedagogical approaches that integrate technologies to support learning in the content areas. Laboratory experiences include development of activities to use tool software, multimedia, web page development, digital video and other technologies to facilitate learning and teaching.

C I 204. Social Foundations of Education in the United States.

(3-0) Cr. 3. F.S.SS.

Introduction to the historical and contemporary landscape of schooling in the United States. Emphasis is placed on topics and tensions in the relationship between school and society (e.g. equity of access to education and competing purposes of education) and the implications of these topics and tensions for teaching and learning in public schools. Designed for prospective teachers.

C I 208. Early Childhood Education Orientation.

(Cross-listed with HD FS). Cr. 1. F.S. *Prereq: classification as ECE major*

Overview of early childhood education (birth-grade 3) teacher licensure requirements. Program planning and university procedures. Required of all students majoring in early childhood education. Offered on a satisfactory-fail basis only.

C I 216. Learning Community Orientation to Teacher Education.

(1-0) Cr. 1. F. *Prereq: First semester freshman Elementary Education major or other majors interested in seeking pre-K to grade 12 teacher certification*

Learning community for transition to university community life. Overview of pre-K to grade 12 teacher certification requirements in Iowa and other states. Program and career planning. Offered on a satisfactory-fail basis only.

C I 219. Orientation to Teacher Education: Math, Science, FCS Education, and History/Social Science Majors.

Cr. 1. F.S. *Prereq: Students seeking teacher licensure in mathematics, science family and consumer sciences, or history/social sciences in grades 5-12*

Overview of mathematics, science, family and consumer sciences and history/social sciences secondary education (grades 5-12), teacher licensure requirements in Iowa and other states. Program and career planning. Offered on a satisfactory-fail basis only.

C I 245. Strategies in Teaching.

(2-0) Cr. 2. F.S. *Prereq: C I 204; HD FS 220 or HD FS 224 or HD FS 226 (or concurrent enrollment in one of these courses); concurrent enrollment in C I 268; sophomore standing*

Introduction to elementary education teaching strategies, classroom management, and curriculum organization. Open to students in the elementary education curriculum or the early childhood education curriculum.

C I 268. Strategies Practicum.

(0-2) Cr. 1. F.S. *Prereq: C I 204*

Clinical experience, to be taken concurrently with C I 245. Offered on a satisfactory-fail basis only.

C I 280. Pre-Student Teaching Experience I.

(1-8) Cr. 0.5-2. Repeatable. F.S.

Pre-Student teaching experience in area educational settings. Offered on a satisfactory-fail basis only. C I 280 may be taken more than once for credit toward graduation.

C I 280A. Pre-Student Teaching Experience I: Core Experience.

(1-8) Cr. 1-2. Repeatable. F.S. *Prereq: Restricted to students with admission to teacher education.*

Pre-Student teaching experience in school settings. 1/2 day of time needed. Clinical Experience Level 2. Offered on a satisfactory-fail basis only. C I 280 may be taken more than once for credit toward graduation.

C I 280B. Pre-Student Teaching Experience I: Learning Technologies.

(1-8) Cr. 1-2. Repeatable. F.S. *Prereq: C I 201 or C I 202. Permission of instructor for 2 credits.*

Pre-Student teaching experience in learning technologies in school settings. 2 1/2-hour blocks of time needed. Clinical Experience Level 1. Offered on a satisfactory-fail basis only. C I 280 may be taken more than once for credit toward graduation.

C I 280C. Pre-Student Teaching Experience I: Native American Tutoring.

(1-8) Cr. 1. Repeatable. F.S.

Pre-Student teaching experience in Native American tutoring in school settings. 2 1/2 hour blocks of time needed. Clinical Experience Level 1. Offered on a satisfactory-fail basis only. C I 280 may be taken more than once for credit toward graduation.

C I 280D. Pre-Student Teaching Experience I: Museum Education.

(1-8) Cr. 1. Repeatable. F.S. *Prereq: Completion of or concurrent enrollment in C I 280A.*

Pre-Student teaching experience in museum settings. 2 1/2-hour blocks of time needed. Supervision level 1. Offered on a satisfactory-fail basis only. C I 280 may be taken more than once for credit toward graduation.

C I 280E. Pre-Student Teaching Experience I: Multicultural Youth.

(1-8) Cr. 1-2. Repeatable. F.S. *Prereq: C I 280A must be either a prerequisite or taken currently; permission of instructor for 2 credits.*

Pre-Student teaching experience for multicultural youth in school settings. 2 1/2-hour blocks of time needed. Clinical Experience Level 1. Offered on a satisfactory-fail basis only. C I 280 may be taken more than once for credit toward graduation.

C I 280I. Pre-Student Teaching Experience I: Mild/Moderate Disabilities.

(1-8) Cr. 1-2. Repeatable. F. *Prereq: Admission to teacher education; concurrent enrollment in SP ED 330.*

Pre-Student teaching experience in mild/moderate disabilities in school settings. 2 1/2-hour blocks of time needed. Clinical Experience Level 1. Offered on a satisfactory-fail basis only.

C I 280K. Pre-Student Teaching Experience I: Music.

(Cross-listed with MUSIC). Cr. 0.5. Repeatable. S.

Pre-student teaching experience in music in school settings. Permission of Music coordinator required prior to enrollment. Clinical Experience Level 1. Offered on a satisfactory-fail basis only.

C I 280L. Pre-Student Teaching Experience I: Secondary Education.

Cr. 0.5. Repeatable. F.S.

Pre-student teaching experience for secondary education students in school settings. 2 1/2 hour blocks of time needed. Clinical Experience Level 1. Offered on a satisfactory-fail basis only.

C I 280M. Pre-Student Teaching Experience I: Secondary Science.

(1-8) Cr. 1-2. Repeatable. S. *Prereq: Permission of instructor for 2 credits.*

Pre-student teaching experience in secondary science in school settings. 2 1/2-hour blocks of time needed. Clinical Experience Level 1. Offered on a satisfactory-fail basis only. C I 280 may be taken more than once for credit toward graduation.

C I 280N. Pre-Student Teaching Experience I: Learning Community.

(1-8) Cr. 1. Repeatable. F.S. *Prereq: Permission of department required.*

Pre-student teaching experience for Preparing Tomorrow's Teachers learning community students in school settings. 2 1/2-hour blocks of time needed. Clinical Experience Level 1. Offered on a satisfactory-fail basis only. C I 280 may be taken more than once for credit toward graduation.

C I 280O. Pre-Student Teaching Experience 1: Art Education.

(1-8) Cr. 1. Repeatable. F.S. *Prereq: Permission of the Art and Design Department required.*

Pre-student teaching experience in art education in school settings. 2 1/2-hour blocks of time needed. Clinical Experience Level 1. Offered on a satisfactory-fail basis only. C I 280 may be taken more than once for credit toward graduation.

C I 280S. Pre-Student Teaching Experience I: English as a Second Language (ESL).

(0-4) Cr. 1. Repeatable, maximum of 2 times. F.S. *Prereq: Admission to teacher education.*

Pre-student teaching experience in English as a Second Language. 1/2 day of time needed. Clinical Experience Level 1. Offered on a satisfactory-fail basis only.

C I 280T. Pre-Student Teaching Experience I: Tutoring.

Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor*

Pre-student teaching experience tutoring in a school setting focused on mathematics, literacy, and/or other content areas. Two, one-hour blocks of time per week needed. Clinical Experience Level 1. Offered on a satisfactory-fail basis only.

C I 290. Independent Study.

Cr. 1-3. *Prereq: 6 credits in education, permission of department chair*

Independent study, under faculty supervision, of a topic in the field of education.

C I 302. Principles and Practices of Learning with Technology.

(2-2) Cr. 3. F.S. Prereq: C I 201 or C I 202

Advanced integration of learning technologies into K-12 educational contexts. Students will examine current trends in the use of learning technologies with K-12 students; explore the use of Web 2.0 applications in the classroom; and delve into issues and trends in classroom technology use. Required for Learning Technologies minor.

C I 315. Transfer Orientation.

Cr. 1. F.S.

Overview of elementary education requirements, curricular opportunities, and university procedures. Program planning. Required of all transfer students majoring in elementary education. Offered on a satisfactory-fail basis only.

C I 332. Educational Psychology of Young Learners.

(3-0) Cr. 3. F.S. Prereq: PSYCH 230 or HD FS 102, open only to majors in Early Childhood Education or Elementary Education

Psychological theory relevant to classroom learning, cognition, motivation, classroom management and assessment for children from birth to grade 6. Implications of theory for teaching children and for assessing learning in educational settings with young and grade school aged children.

C I 333. Educational Psychology.

(Cross-listed with PSYCH). (3-0) Cr. 3. F.S. Prereq: PSYCH 230 or HD FS 102, application to the teacher education program or major in psychology

Classroom learning with emphasis on theories of learning and cognition, and instructional techniques. Major emphasis on measurement theory and the classroom assessment of learning outcomes.

C I 347. Nature of Science.

(Dual-listed with C I 547). (3-0) Cr. 3. F. Prereq: C I 280M; concurrent enrollment in C I 418 or instructor permission

The intersection of issues in the history, philosophy sociology, and psychology of science and their application to and impact on science teaching and learning, science teacher education, and science education research.

C I 377. The Teaching of Reading and Language Arts in the Primary Grades (K-3).

(4-0) Cr. 4. F.S.SS. Prereq: admission to teacher education program, C I 245, SP ED 250, HD FS 240, HD FS 226 (EI Ed majors) or HD FS 221 (ECE majors); concurrent enrollment in C I 448, C I 468A, C I 468C (EI Ed majors) or C I 438, C I 468F, C I 468G, SP ED 368, HD FS 343 (ECE majors)

Theories, teaching strategies, and instructional materials pertinent to teaching reading, writing, listening, and speaking to children in kindergarten through third grade.

C I 378. The Teaching of Reading and Language Arts in the Intermediate Grades (4-6).

(4-0) Cr. 4. F.S.SS. Prereq: C I 377; concurrent enrollment in C I 449, C I 468B, C I 468D

Theories and processes of literacy. Application through reading and writing across the curriculum, integration of language arts, literature-based instruction, and metacognitive strategies.

C I 395. Content Area Reading and Literacy.

(Dual-listed with C I 595). (3-0) Cr. 3. F.S. Prereq: C I 204 and junior standing

Analysis and application of strategies to enhance students' literacy development in middle and secondary school settings.

C I 406. Multicultural Foundations of School and Society: Introduction.

(3-0) Cr. 3. F.S.SS. Prereq: C I 201 or C I 202, C I 332 or C I 333, junior classification, admission to teacher education program

Awareness and nature of cultural pluralism; need for multicultural education; multicultural concepts and theories; cultural groups - their perceptions, needs, and contributions; problems and issues regarding ethnocentrism, prejudice, and discrimination based on race, ethnicity, socioeconomic class, sex/gender, sexual identity, and language in the school environment; curriculum infusion and transformation, multicultural interaction, design and execution of teaching strategies.

Meets U.S. Diversity Requirement

C I 407. Principles and Practices of Distance Learning.

(Dual-listed with C I 507). (2-2) Cr. 3. F.SS. Prereq: C I 201 or C I 202; convenient access to the Web

Review of flexible and distance learning (FDL) cases in a variety of contexts and pedagogic styles, identification of underlying principles and frameworks for best practice in this field.

C I 416. Supervised Student Teaching - Elementary.

Cr. arr. F.S. Prereq: GPA 2.5; full admission to teacher education; senior classification; C I 378, C I 443, C I 448, C I 449; reservation required

Supervised teaching experience in the elementary grades.

C I 416A. Supervised Student Teaching - Elementary: Primary grades (K-3).

Cr. arr. F.S. Prereq: GPA 2.5; full admission to teacher education; senior classification; C I 378, C I 443, C I 448, C I 449; reservation required

Supervised teaching experience in the elementary grades.

C I 416B. Supervised Student Teaching - Elementary: Intermediate grades (4-6).

Cr. arr. F.S. Prereq: GPA 2.5; full admission to teacher education; senior classification; C I 378, C I 443, C I 448, C I 449; reservation required

Supervised teaching experience in the elementary grades.

C I 416C. Supervised Student Teaching - Elementary: World Language.

Cr. arr. F.S. Prereq: GPA 2.5; full admission to teacher education; senior classification; C I 378, C I 443, C I 448, C I 449; reservation required

Supervised teaching experience in the elementary grades.

C I 416D. Supervised Student Teaching - Elementary: International Student Teaching - Primary Grades.

Cr. arr. F.S. Prereq: GPA 2.5; full admission to teacher education; senior classification; C I 378, C I 443, C I 448, C I 449; reservation required

Supervised teaching experience in the elementary grades.

C I 416E. Supervised Student Teaching - Elementary: International Student Teaching - Intermediate Grades.

Cr. arr. F.S. Prereq: GPA 2.5; full admission to teacher education; senior classification; C I 378, C I 443, C I 448, C I 449; reservation required

Supervised teaching experience in the elementary grades.

C I 417. Student Teaching.

Cr. arr. F.S. Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching

Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 417A. Student Teaching: Social Studies-Middle School.

(Dual-listed with C I 517A). Cr. arr. F.S. Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching

Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 417B. Student Teaching: Physical Sciences.

(Dual-listed with C I 517B). Cr. arr. F.S. Prereq: Full admission to teacher education, approval of coordinator during semester before student teaching

Evaluation of instruction, lesson planning, and teaching in physical sciences grades 5-12.

C I 417C. Student Teaching: Mathematics.

(Dual-listed with C I 517C). Cr. arr. F.S. Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching

Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 417D. Student Teaching: Biological Sciences.

(Dual-listed with C I 517D). Cr. arr. F.S. Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching

Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 417E. Student Teaching: English and Literature.

(Cross-listed with ENGL). Cr. arr. F.S. Prereq: ENGL 494, admission to teacher education, approval of coordinator the semester prior to student teaching

Full-time teaching in secondary English: long term and unit planning, lesson planning, classroom teaching practice in English language arts.

C I 417G. Student Teaching: World Language.

(Dual-listed with C I 517G). (Cross-listed with WLC). Cr. arr. F.S. Prereq: Admission to teacher education or licensed teacher, approval of coordinator during semester before student teaching.

Evaluation of instruction, lesson planning, and teaching in world languages grades K-8.

C I 417J. Student Teaching: Earth Sciences.

(Dual-listed with C I 517J). Cr. arr. F.S. Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching

Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 417M. Student Teaching: Science-Basic.

(Dual-listed with C I 517M). Cr. arr. F.S. Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching

Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 417N. Student Teaching: International.

(Dual-listed with C I 517N). Cr. arr. F.S. *Prereq:* GPA 2.5; *Admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 417P. Student Teaching: Social Studies-High School.

(Dual-listed with C I 517P). Cr. arr. F.S. *Prereq:* GPA 2.5; *Admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 417R. Student Teaching: Music-Elementary.

(Dual-listed with C I 517R). (Cross-listed with MUSIC). Cr. arr. F.S. *Prereq:* Minimum GPA of 2.5; *Admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 417S. Student Teaching: Music-Secondary.

(Dual-listed with C I 517S). (Cross-listed with MUSIC). Cr. arr. F.S. *Prereq:* Minimum GPA of 2.5; *Admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 418. Secondary Science Methods I: A Research-Based Framework for Teaching Science.

(Dual-listed with C I 518). (3-0) Cr. 3. F. *Prereq:* C I 280M or C I 514; *undergraduate students must register concurrently for C I 347 and C I 468J*
Development of a research-based framework for teaching science that includes student goals, congruent student actions, the character and role of science inquiry, teaching behaviors and strategies, contemporary learning theories, and self evaluation.

C I 419. Secondary Science Methods II: Advancing A Research-Based Framework for Teaching Science.

(Dual-listed with C I 519). (3-0) Cr. 3. S. *Prereq:* C I 418 or C I 518, *undergraduate students must register concurrently for C I 468K*
Advancing a research-based framework for teaching science in a variety of school settings, emphasizing the teacher's role, the development and revision of science curriculum, exceptional learners, content area reading strategies, management strategies, technology and student assessment.

C I 420. Bilingualism, Bilingual Education, and U.S. Mexican Youth.

(Dual-listed with C I 520). (3-0) Cr. 3. F. *Prereq:* C I 406
Introduction to research on bilingualism and examination of the social, historical, and political contexts of bilingual education in U.S. schools. Attention to policy environment, school program structure, mode of classroom instruction, family and community context, and attainment of bilingualism and biculturalism for U.S. Mexican youth.

C I 426. Principles of Secondary Education.

(Dual-listed with C I 526). (3-0) Cr. 3. F.S.SS. *Prereq:* C I 202, *senior classification, admission to teacher education program*
The curriculum, human relations, student evaluation, support services, classroom management, organization of schools, legal aspects of schools, professionalism, and career planning.

C I 433. Teaching Social Studies in the Primary Grades.

(2-0) Cr. 2. F.S. *Prereq:* C I 377, HD FS 224; *concurrent enrollment in C I 439, SP ED 355, SP ED 455*
Emphasis is placed on providing appropriate social studies learning experiences (e.g. curriculum content, instructional strategies, and assessment) for primary grade children.

C I 438. Teaching Mathematics in the Primary Grades.

(2-0) Cr. 2. F.S. *Prereq:* HD FS 224; MATH 195, MATH 196 (*minimum grade of C- in both Math 195 and MATH 196*), *concurrent enrollment in C I 377, C I 468F, C I 468G, SP ED 368*
Study, development, and application of current methods for providing appropriate mathematics learning experiences for primary grade children. Formal and informal assessment strategies and instructional methods for diverse learners.

C I 439. Teaching Science in the Primary Grades.

(2-0) Cr. 2. F.S. *Prereq:* C I 377, HD FS 224; *concurrent enrollment in C I 433, C I 468I, SP ED 355, SP ED 455*
Study, development, and application of current methods for providing appropriate science learning experiences and processes for primary grade children. Formal and informal assessment strategies and instructional methods for diverse learners.

C I 443. The Teaching of Social Studies.

(3-0) Cr. 3. F.S.SS. *Prereq:* C I 377
Emphasis is placed on providing appropriate social studies learning experiences (e.g. curriculum content, instructional strategies, and assessment) for primary and intermediate grade children.

C I 448. Teaching Children Mathematics.

(3-0) Cr. 3. F.S.SS. *Prereq:* MATH 195 (*minimum grade of C-*), MATH 196 (*minimum grade of C-*); *concurrent enrollment in C I 377, C I 468A, C I 468C*
Study, development, and application of current methods for providing appropriate mathematical learning experiences for primary and intermediate children. Includes critical examination of factors related to the teaching and learning of mathematics.

C I 449. The Teaching of Science.

(3-0) Cr. 3. F.S.SS. *Prereq:* C I 377, *concurrent enrollment in C I 378, C I 468B, C I 468D, junior classification*
Procedures for teaching science to children. Emphasis on developmental implications, teaching processes and methods, current programs, and assessment of learning in science.

C I 450. Ethnicity and Learning.

(Dual-listed with C I 550). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* C I 332 or C I 333, C I 406
Examination of cultural relevance in education. Development and application of strategies and techniques for implementing multicultural goals and multiethnic perspectives in PreK-12 school classroom settings. Meets U.S. Diversity Requirement

C I 452. Assessment for Literacy and Learning.

(Dual-listed with C I 552). (3-0) Cr. 3. F.S.SS. *Prereq:* C I 378 or equivalent; *special education majors must register concurrently for Sp Ed 365 and Sp Ed 436*
Identification, analysis and correction of reading problems in five areas: print knowledge, integration of print knowledge, oral reading fluency, vocabulary, and comprehension.

C I 454. Emerging Topics in Learning Technologies.

(2-2) Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq:* C I 201 or C I 202
Development and application of emerging technology topics related to digital learning. Series of 1-3 credit on-line learning modules on topics such as grant writing, interactive on-line tools, social networking, gaming technologies, technology leadership in schools, and web/graphic design. Required for the Learning Technologies minor.

C I 456. Integrating Technology into the Reading and Language Arts Curriculum.

(Dual-listed with C I 556). (3-0) Cr. 3. F.SS. *Prereq:* C I 201 or C I 202, C I 377
Methods and strategies used to integrate technology into the reading and language arts curriculum. Use and evaluation of reading and language arts software for elementary classrooms.

C I 468. Pre-Student Teaching Experience II.

Cr. 1-2. F.S.SS. *Prereq:* *Admission to teacher education program*
Application of current methods, and instructional experiences with children in a supervised elementary, middle, or high school classroom while engaged in other methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 468A. Pre-Student Teaching Experience II: Primary Grades, Reading and Language Arts.

Cr. 1. F.S.SS. *Prereq:* *Admission to teacher education program*
Application of current methods and instructional experiences with children in a supervised K-3 elementary classroom while engaged in other elementary methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 468B. Pre-Student Teaching Experience II: Intermediate Grades, Reading and Language Arts.

Cr. 1. F.S.SS. *Prereq:* *Admission to teacher education program*
Application of current methods and instructional experiences with children in a supervised 3-6 elementary classroom while engaged in other elementary methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 468C. Pre-Student Teaching Experience II: Primary Grades, Mathematics.

Cr. 1. F.S.SS. *Prereq:* *Admission to teacher education program*
Application of current methods, and instructional experiences with children in a supervised K-3 elementary classroom while engaged in other elementary methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 468D. Pre-Student Teaching Experience II: Intermediate Grades, Science.

Cr. 1. F.S.SS. *Prereq:* *Admission to teacher education program*
Application of current methods and instructional experiences with children in a supervised 3-6 elementary classroom while engaged in other elementary methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 468E. Pre-Student Teaching Experience II: World Languages.

Cr. 1. F. *Prereq: Admission to teacher education program*

Application of current methods, and instructional experiences with children in a supervised K-6 elementary classroom while engaged in other elementary methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 468F. Pre-Student Teaching Experience II: Primary Grades Inclusive, Literacy.

Cr. 1. F.S. *Prereq: Admission to teacher education program*

Application of current methods and instructional experiences with children in a supervised K-3 inclusive elementary classroom while engaged in other elementary methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 468G. Pre-Student Teaching Experience II: Primary Grades Inclusive, Mathematics.

Cr. 1. F.S. *Prereq: Admission to teacher education program*

Application of current methods and instructional experiences with children in a supervised K-3 inclusive elementary classroom while engaged in other elementary methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 468I. Pre-Student Teaching Experience II: Primary Grades Inclusive, Science.

Cr. 1. F.S. *Prereq: Admission to teacher education program*

Application of current methods and instructional experiences with children in a supervised K-3 inclusive elementary classroom while engaged in other elementary methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 468J. Pre-Student Teaching Experience II: Secondary Science I.

Cr. 2. F. *Prereq: Admission to teacher education program*

Application of current methods and instructional experiences with children in a supervised grade 5-12 science classroom while engaged in other elementary methods courses. Clinical Supervision Level 3. Offered on a satisfactory-fail basis only.

C I 468K. Pre-Student Teaching Experience II: Secondary Science II.

Cr. 2. S. *Prereq: Admission to teacher education program*

Application of current methods and instructional experiences with children in a supervised 5-12 science classroom while engaged in other elementary methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 468R. Pre-Student Teaching Experience II: Intermediate Grades, Reading Endorsement.

Cr. 1. F.S.SS. *Prereq: Admission to teacher education program. Permission of School of Education required; concurrent enrollment in C I 378*

Application of current methods and instructional experiences with children in a supervised 3-6 elementary classroom while engaged in other elementary methods courses. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

C I 469. Pre-student Teaching Seminar.

Cr. 1. Repeatable. F.S. *Prereq: Admission to teacher education program.*

Future teachers learn about teaching as they connect theory, practice and classroom experiences. Learning is supported with video-based seminars focused on effective classroom practices. Offered on a satisfactory-fail basis only.

C I 480. Pre-Student Teaching Experience III.

Cr. 0.5-2. Repeatable, maximum of 2 times. F.S. *Prereq: Admission to Teacher Education*

Observation and participation in a variety of school settings after admission to the teacher education program. Permission of area coordinator required prior to enrollment. (S/F grading may be used in some offerings of some sections.)

C I 480A. Pre-Student Teaching Experience III: History/Social Sciences.

(Cross-listed with HIST). Cr. 2. Repeatable, maximum of 2 times. F. *Prereq: Admission to Teacher Education*

Supervised participation in a 5-12 school setting. Permission of History/Social Sciences coordinator required prior to enrollment. 1/2 day of time needed. Clinical Supervision Level 3.

C I 480B. Field Experience for Secondary Teaching Preparation: Physical Sciences.

Cr. 0.5. Repeatable, maximum of 2 times. F.S. *Prereq: Permission of area coordinator required prior to enrollment*

Observation and participation in a variety of school settings after admission to the teacher preparation program. Physical Sciences.

C I 480C. Pre-Student Teaching Experience III: Mathematics.

Cr. 0.5-2. Repeatable, maximum of 2 times. F.S. *Prereq: Admission to teacher education*

Supervised participation mathematics in a 5-12 school setting. Permission of mathematics coordinator required prior to enrollment. 1/2 day of time needed. Clinical Experience Level 3.

C I 480D. Field Experience for Secondary Teaching Preparation: Biological Sciences.

Cr. 0.5. Repeatable, maximum of 2 times. F.S. *Prereq: Permission of area coordinator required prior to enrollment*

D. Biological Sciences.

C I 480E. Pre-Student Teaching Experience III: English.

Cr. 1-2. Repeatable, maximum of 2 times. F.S. *Prereq: Admission to teacher education*

Supervised participation in a 5-12 school setting. Cross listed with English 480K. Permission of English coordinator required prior to enrollment. 1/2 day of time needed. Clinical Experience Level 3.

C I 480G. Pre-Student Teaching Experience III: World Languages and Cultures.

Cr. 1-2. Repeatable, maximum of 2 times. F. *Prereq: Admission to teacher education*

Supervised participation in a 5-12 school setting. Permission of World Languages and Cultures coordinator required prior to enrollment. 1/2 day of time needed. Clinical Experience Level 3.

C I 480J. Field Experience for Secondary Teaching Preparation: Earth Science.

Cr. 0.5. Repeatable, maximum of 2 times. F.S.

J. Earth Science.

C I 480K. Pre-Student Teaching Experience III: Music.

(Cross-listed with MUSIC). Cr. 1. Repeatable, maximum of 2 times. F.S. *Prereq: Admission to teacher education*

Participation in a K-12 school setting. Cross-listed with Music 480K. Permission of Music coordinator required prior to enrollment. Clinical Experience Level 2. Offered on a satisfactory-fail basis only.

C I 480S. Pre-Student Teaching Experience III: English as a Second Language (ESL).

(0-4) Cr. 2. Repeatable, maximum of 2 times. *Prereq: C I 280S, ENGL/LING 219; ENGL/LING 220; ENGL/LING 511; admission to teaching education.*

Supervised participation in a school setting. Permission of ESL area coordinator required prior to enrollment. 1/2 day of time needed. Clinical experience level 3. Offered on a satisfactory-fail basis only.

C I 481. Philosophy of Education.

(Dual-listed with H P C 581). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Introduction to Western philosophy of education. Emphasis is placed on enduring debates about the purposes(s) of education in a just society. Readings include classic and contemporary texts.

C I 486. Methods in Elementary School World Language Instruction.

(Cross-listed with LING, WLC). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language*

Planning, implementation, and assessment of standards-based, student-centered, and thematic instruction in the elementary (K-8) classroom. Special emphasis on K-8 students' communicative skills, cultural knowledge, and content learning.

C I 487. Methods in Secondary School World Language Instruction.

(Cross-listed with LING, WLC). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language, admission to the teacher education program, OPI*

Theories and principles of contemporary world language learning and teaching. Special emphasis on designing instruction and assessments for active learning.

C I 488. Supervised Tutoring in Reading.

(Dual-listed with C I 588). (2-2) Cr. 3. F.S.SS. *Prereq: concurrent enrollment in or completion of one course in corrective reading; diagnosis and correction of reading problems; graduate status required for C I 588*

Using formal and informal diagnostic procedures to plan and implement individualized reading instruction. Field experience in tutoring and a related research project.

C I 490. Independent Study.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

C I 490A. Independent Study: Education.

(Cross-listed with MUSIC). Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor; 12 credits in music, approval of department head*

C I 490C. Independent Study: Curriculum Construction.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490D. Independent Study: Principles of Education.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490E. Independent Study: Methods of Teaching.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490F. Independent Study: Educational Psychology.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490G. Independent Study: Digital Learning.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490H. Independent Study: Honors.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490J. Independent Study: Multicultural Education.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490K. Independent Study: History/Social Sciences.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490L. Independent Study: Literacy Education.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490M. Independent Study: Mathematics Education.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490N. Independent Study: World Language.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490O. Independent Study: Foundations of Education.

Cr. 1-3. F.S.SS. *Prereq: GPA of 2.5 or more for preceding semester*

CI 490P. Independent Study: Science Education.

Cr. 1-3. F.S. *Prereq: GPA of 2.5 or more for preceding semester*

Independent Study in science education.

CI 494. Practice and Theory of Teaching Literature in the Secondary Schools.

(Cross-listed with ENGL). (3-0) Cr. 3. F.S. *Prereq: ENGL 310, ENGL 397, 9 other credits in English beyond ENGL 250, PSYCH 333, admission to teacher education program*

Portfolio review. Current theories and practices in the teaching of literature to secondary school students. Integrating literary study and writing. Preparation and selection of materials. Classroom presentation. Unit planning. (Taken concurrently with CI 280, Cr. 2, and Sp Ed 450).

CI 495B. Independent Study: Teaching Speech.

(Cross-listed with SP CM). (3-0) Cr. 3. F. *Prereq: CI 301; 9 credits in speech communication; minimum GPA of 2.5 in speech communication courses*

Problems, methods, and materials related to teaching speech, theatre, and media in secondary schools.

CI 497. Teaching Secondary School Mathematics.

(Cross-listed with MATH). (3-0) Cr. 3. F. *Prereq: 15 credits in college mathematics and admission to a teacher licensure program, concurrent enrollment in CI 426 or CI 526; CI 480C*

Theory and methods for teaching mathematics in grades 5-12. Includes critical examination of instructional strategies, curriculum materials, learning tools, assessment methods, Common Core State Standards-Mathematics, and equity issues.

CI 498. Methods of Teaching History/Social Sciences.

(Cross-listed with HIST). (3-0) Cr. 3. F.S. *Prereq: Concurrent enrollment in HIST 480A; Admission to teacher education and 30 credits in subject-matter field*

Concurrent enrollment in 480A; Admission to teacher education and 30 credits in subject-matter field. Theories and processes of teaching and learning secondary history/social sciences. Emphasis on development and enactment of current methods, assessments, and curriculum materials for providing appropriate learning experiences.

Courses primarily for graduate students, open to qualified undergraduates:**CI 501. Foundations of Digital Learning.**

(3-0) Cr. 3. F.SS. *Prereq: Graduate classification*

Educational philosophies and theories of instructional technology. Application of research to the production and use of instructional technology for learning and teaching. Equipment operation.

CI 503. Designing Effective Learning Environments.

(3-0) Cr. 3. F. *Prereq: 501*

Introduction to theories and models of instructional design. Design decision-making based on the analysis of performance problems and instructional inputs. Practical experience with the design and development of instruction and evaluation principles.

CI 504. Evaluating Digital Learning Environments.

(Cross-listed with HCI). (3-0) Cr. 3. S. *Prereq: CI 501*

Principles and procedures to plan, design, and conduct effective evaluation studies (formative, summative, usability) in different settings are studied. Opportunities to engage in real or simulated evaluation projects of substantial scope are provided. Create evaluation instruments, develop methods with which to evaluate a product or program, conduct try-outs or usability sessions, analyze the data, report the findings, and recommendations are some of the course activities.

CI 505. Using Technology in Learning and Teaching.

(3-0) Cr. 3. F.S.SS. *Prereq: Graduate classification*

Teaching and learning using computers. Selection and evaluation of software and hardware for teaching and learning. Research on computers. Tool software. Telecommunications. Trends in computer-based instruction.

CI 506. Multicultural Foundations of School and Society: Advanced.

(3-0) Cr. 3. F. *Prereq: 6 graduate credits in education*

Theories, legal bases, and principles of multicultural education. Pluralism and contributing cultures in the United States; presence and contributions of cultural group diversity with implications for educational programs, curriculum development, classroom instruction, materials utilization and development; problems and issues regarding ethnocentrism, prejudice, and discrimination based on race, ethnicity, socioeconomic class, sex/gender, sexual identity, and language in the school environment; curriculum infusion and transformation, multicultural interaction, design and execution of teaching strategies and techniques; inquiry and research on multicultural education issues.

CI 507. Principles and Practices of Distance Learning.

(Dual-listed with CI 407). (2-2) Cr. 3. F.SS. *Prereq: CI 201 or CI 202; convenient access to the Web*

Review of flexible and distance learning (FDL) cases in a variety of contexts and pedagogic styles, identification of underlying principles and frameworks for best practice in this field.

CI 508. Algebra in the K-12 Classrooms.

(3-0) Cr. 3. F. *Prereq: CI 448 or CI 497*

Focus on Algebraic concept explorations and associated procedures. Use of research-based strategies and appropriate technologies to apply fundamental ideas of patterning, coordinate graphing, and relationships among variables into K-12 classrooms. Additional topics facilitate critical examination of K-12 curriculum, pedagogy, and assessment.

CI 509. Geometry in the K-12 Classrooms.

(3-0) Cr. 3. S. *Prereq: CI 448 or CI 497*

Euclidean and non-Euclidean geometry explorations with a focus on pedagogical issues in the K-12 classroom. Use of research-based strategies and appropriate technologies to teach geometry in K-12 classrooms. Additional topics from discrete mathematics, history and philosophy of geometry and fractal geometries.

CI 511. Technology Diffusion, Leadership and Change.

(3-0) Cr. 3. S. *Prereq: Admission to graduate study, CI 501 or equivalent and CI 505 or equivalent*

Principles and practices of technology diffusion, leadership and school change. Readings and coursework focus on technology diffusion in a broad sense, and examine more closely how this has played out in educational contexts. Leadership is addressed relative to frameworks and strategies for professional development and organizational change.

CI 512. Research Trends in Digital Learning.

(3-0) Cr. 3. F. *Prereq: Admission to graduate study and at least two courses in research and foundations of instructional technology*

Critical review of current research trends in educational technology. Designed to consolidate graduate students' knowledge of current trends, issues in research, and methods of conducting research in practice.

CI 513. Mathematical Problem Solving in K-12 Classrooms.

(3-0) Cr. 3. F. *Prereq: 6 credits of mathematics, CI 448 or CI 497 or CI 597 or permission of instructor*

Strategies for improving problem solving skills across all strands of mathematics (e.g., geometry, algebra, number theory) will be emphasized. Issues surrounding the appropriate role of problem solving in K-12 mathematics classrooms will also be discussed, including distinctions among teaching "about," "for," and "through" problem solving. Note: This course is open to undergraduate students, but it is a graduate level course.

CI 514. Introduction to the Purposes and Complexities of Science Teaching.

(1-2) Cr. 2. SS. *Prereq: Admission to M.A.T. program*

Introduction to critical issues facing science education, science education goals reflecting contemporary purposes of schooling, and how people learn science.

C I 515. Action Research in Education.

(3-0) Cr. 3. S. *Prereq: Admission to graduate study, one course in research methods, educational inquiry, statistics, educational psychology, or instructional design*

Philosophy and methods of conducting and communicating action research focused on improving educational practices. Designed specifically for practicing teachers.

C I 516. Antiracist Curriculum Development and Implementation.

(2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: 9 credits in education*
Introduction to historical, sociological, philosophical and pedagogical foundations of antiracist/multicultural education. Examination of causes of racism, other forms of discrimination, and intergroup conflict from different theoretical perspectives and experiential exercises.

C I 517. Student Teaching.

(Dual-listed with C I 417). Cr. arr. F.S. *Prereq: Full admission to teacher education or licensed teacher; approval of coordinator during semester before student teaching*

Evaluation of instruction, lesson planning, and teaching.

C I 517A. Student Teaching: Social Studies-Middle School.

(Dual-listed with C I 417A). Cr. arr. F.S. *Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 517B. Student Teaching: Physical Sciences.

(Dual-listed with C I 417B). Cr. arr. F.S. *Prereq: Full admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in physical sciences grades 5-12.

C I 517C. Student Teaching: Mathematics.

(Dual-listed with C I 417C). Cr. arr. F.S. *Prereq: Full admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in mathematics grades 5-12.

C I 517D. Student Teaching: Biological Sciences.

(Dual-listed with C I 417D). Cr. arr. F.S. *Prereq: Full admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in biological sciences grades 5-12.

C I 517G. Student Teaching: World Language.

(Dual-listed with C I 417G). (Cross-listed with WLC). Cr. arr. F.S. *Prereq: Admission to teacher education or licensed teacher, approval of coordinator during semester before student teaching.*
Evaluation of instruction, lesson planning, and teaching in world languages grades K-8.

C I 517J. Student Teaching: Earth Sciences.

(Dual-listed with C I 417J). Cr. arr. F.S. *Prereq: Full admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in earth sciences grades 5-12.

C I 517M. Student Teaching: Science - Basic.

(Dual-listed with C I 417M). Cr. arr. F.S. *Prereq: Full admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in basic sciences grades 5-12.

C I 517N. Student Teaching: International.

(Dual-listed with C I 417N). Cr. arr. F.S. *Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 517P. Student Teaching: Social Studies-High School.

(Dual-listed with C I 417P). Cr. arr. F.S. *Prereq: GPA 2.5; Admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 517R. Student Teaching: Music-Elementary.

(Dual-listed with C I 417R). (Cross-listed with MUSIC). Cr. arr. F.S. *Prereq: Minimum GPA of 2.5; Admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 517S. Student Teaching: Music-Secondary.

(Dual-listed with C I 417S). (Cross-listed with MUSIC). Cr. arr. F.S. *Prereq: Minimum GPA of 2.5; Admission to teacher education, approval of coordinator during semester before student teaching*
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

C I 518. Science Methods I: A Research-Based Framework for Teaching Science.

(Dual-listed with C I 418). (3-0) Cr. 3. F. *Prereq: C I 514; concurrent enrollment in C I 547 and C I 591D*
Development of a research-based framework for teaching science that includes student goals, congruent student actions, the character and role of science inquiry, teaching behaviors and strategies, contemporary learning theories, and self-evaluation.

C I 519. Secondary Science Methods II: A Research-Based Framework for Teaching Science.

(Dual-listed with C I 419). (3-0) Cr. 3. S. *Prereq: C I 418 or C I 518, concurrent enrollment in C I 591D*
Advancing a research-based framework for teaching science in a variety of school settings; emphasizing the teacher's role, the development and revision of science curriculum, exceptional learners, content area reading strategies, management strategies, technology, and student assessment.

C I 520. Bilingualism, Bilingual Education, and U.S. Mexican Youth.

(Dual-listed with C I 420). (3-0) Cr. 3. F. *Prereq: C I 406*
Introduction to research on bilingualism and examination of the social, historical, and political contexts of bilingual education in U.S. schools. Attention to policy environment, school program structure, mode of classroom instruction, family and community context, and attainment of bilingualism and biculturalism for U.S. Mexican youth.

C I 523. Teaching Mathematics to Struggling Elementary Learners.

(3-0) Cr. 3. SS. *Prereq: C I 438 or C I 448*
Instructional methods and assessment techniques for elementary students struggling to learn mathematics. Emphasis on current research and practices for at-risk students and students with disabilities.

C I 526. Principles of Secondary Education.

(Dual-listed with C I 426). (3-0) Cr. 3. F.S.SS. *Prereq: C I 202, senior classification, admission to teacher education program*
The curriculum, human relations, student evaluation, support services, classroom management, organization of schools, legal aspects of schools, professionalism, and career planning.

C I 529. Educational Psychology and the Secondary Classroom.

(3-0) Cr. 3. SS. *Prereq: Bachelor's degree; admission into a graduate level teacher licensure program*
Analysis of psychological research theory related to learning, cognition, motivation, individual differences, and teaching techniques. Student and classroom assessment to facilitate positive learning outcomes. Adaption and differentiation of instruction to meet individual learners' needs. This course can only be used for teacher licensure programs. It is not acceptable for use in meeting the non-licensure M.Ed., M.S. or Ph.D. requirements.

C I 533. Educational Psychology of Learning, Cognition, and Memory.

(Cross-listed with PSYCH). (3-0) Cr. 3. F.
Learning, cognition, and memory in educational/training settings.

C I 541. How People Learn: Implications for Teaching Science.

(3-0) Cr. 3. *Prereq: Bachelor's degree*
Current learning theories within science education and their application to science classrooms. Examination of models which assist the implementation of these theories of learning.

C I 546. Advanced Pedagogy in Science Education.

(3-0) Cr. 3. S.SS. *Prereq: Bachelor's degree*
Critical examination of pedagogy, emphasizing teacher behaviors and strategies, methods of self-assessment, action research, and current issues and trends in science education.

C I 547. Nature of Science.

(Dual-listed with C I 347). (3-0) Cr. 3. F. *Prereq: C I 280M; concurrent enrollment in C I 418 or instructor permission*
The intersection of issues in the history, philosophy sociology, and psychology of science and their application to and impact on science teaching and learning, science teacher education, and science education research.

C I 548. Restructuring Science Activities.

(3-0) Cr. 3. SS. *Prereq: Admission to teacher education or teaching license*
Modification of laboratory activities and other everyday science activities so they are more congruent with how students learn, the nature of science, and the National Science Education Standards.

C I 550. Ethnicity and Learning.

(Dual-listed with C I 450). (3-0) Cr. 3. Alt. S., offered even-numbered years.
Prereq: C I 332 or C I 333, C I 406

Examination of cultural relevance in education. Development and application of strategies and techniques for implementing multicultural goals and multiethnic perspectives in PreK-12 school classroom settings.
Meets U.S. Diversity Requirement

C I 551. Foundations of Reading and Language Arts.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: Teaching license*
Analyzing, discussing, and researching the theory and practice of current literacy issues.

C I 552. Assessment for Literacy and Learning.

(Dual-listed with C I 452). (3-0) Cr. 3. F.S.SS. *Prereq: C I 378 or equivalent; special education majors must register concurrently for Sp Ed 365 and Sp Ed 436.*
Identification, analysis and correction of reading problems in five areas: print knowledge, integration of print knowledge, oral reading fluency, vocabulary, and comprehension.

C I 553. Teaching Struggling Adolescent Readers.

(Cross-listed with SP ED). (3-0) Cr. 3. SS. *Prereq: Teaching license*
Instructional strategies for enhancing the fluency, vocabulary and comprehension of struggling adolescent readers. Attention to content-area reading materials and strategies.

C I 554. Reading and Responding to Children's Literature.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: Senior status or teaching license*
Research and discussion of issues surrounding the classroom use of literature for children and young adults including censorship, diversity, selection, and the influences of technology.

C I 555. Literacy, Leadership, and Advocacy.

(3-0) Cr. 3. S. *Prereq: Graduate Standing*
Examination of the roles of literacy specialists/coaches in diverse pre-K-12 schools and communities. Particular focus placed on current theories, research, standards, and policies relative to literacy processes and instruction, including culturally responsive literacy; processes of successful literacy coaching; and methods of supporting teachers and other school personnel in planning, implementing, and evaluating literacy instruction for all students.

C I 556. Integrating Technology into the Reading and Language Arts Curriculum.

(Dual-listed with C I 456). (3-0) Cr. 3. F.SS. *Prereq: C I 201 or C I 202, C I 377*
Methods and strategies used to integrate technology into the reading and language arts curriculum. Use and evaluation of reading and language arts software for elementary classrooms.

C I 558. Perspectives on Reading Comprehension.

(3-0) Cr. 3. F. *Prereq: Graduate standing*
Critical examination of the topics central to the study of reading comprehension, including processes, development, contexts, motivation, teaching and learning, and assessment. Reading and discussion of research literature in reading comprehension and comprehension instruction.

C I 565. Literacy: Connecting Research, Policy and Practice.

(3-0) Cr. 3. Alt. F., offered irregularly. Alt. S., offered irregularly. *Prereq: Graduate standing*
Critical examination of current policy initiatives and reform efforts that affect how literacy is viewed, assessed, and practiced, as well as how literacy professionals are prepared for their roles in public schools and colleges.

C I 567. Teaching Mathematics to Struggling Secondary Learners.

(Cross-listed with SP ED). (3-0) Cr. 3. *Prereq: Secondary teaching experience*
Instructional methods and assessment techniques for secondary students struggling to learn mathematics. Particular emphasis on current research, practices, and trends in mathematics interventions for at-risk students and students with disabilities.

C I 568. New Media Literacies: Understanding Research and Practice.

(3-0) Cr. 3. F. *Prereq: Graduate Standing*
Designed to increase awareness and understanding of critical issues surrounding the evolving concept of literacy and examine the effect that technology has on the literacy we use every day, teach in our schools, and need in order to function as 21st century citizens.

C I 570. Toying With Technology for Practicing Teachers.

(Cross-listed with M S E). (2-0) Cr. 2. SS. *Prereq: C I 201 or 202 or 505 or equivalent*

A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Other technological advances with K-12 applications will be explored. K-12 teachers will leave the course with complete lesson plans for use in their classrooms.

C I 577. Historical Perspectives on Technology Equity: Implications for Policy and Practice.

(3-0) Cr. 3. S. *Prereq: Graduate Status*
Exploration of the historical, political, sociological, and economic factors that engender global inequities. Examination of the definition and origin of the "digital divide" and its relationship to the histories of racism, sexism, classism, and imperialism/globalization. Exploration and analysis of research-based alternative approaches to alleviating technology inequities in educational settings.

C I 578. Pedagogy, Equality of Opportunity, and the Education of Blacks in the United States.

(3-0) Cr. 3. *Prereq: Graduate or senior level status or permission of instructor*
This course takes a nonlinear, reflective view of the historical, social, economic, political, and legal contexts of the education of African Americans in the U.S. Educational theories and philosophies, Critical Race Theory and Black Feminist Thought form the framework for investigating broad-based, multiple issues of education for African Americans in the U.S. as they are situated in the prevailing dominant views.

C I 588. Supervised Tutoring in Reading.

(Dual-listed with C I 488). (2-2) Cr. 3. F.S.SS. *Prereq: concurrent enrollment in or completion of one course in corrective reading; diagnosis and correction of reading problems; graduate status required for C I 588*
Using formal and informal diagnostic procedures to plan and implement individualized reading instruction. Field experience in tutoring and a related research project.

C I 590. Special Topics.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590A. Special Topics: Curriculum.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590B. Special Topics: Digital Learning.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590C. Special Topics: Science Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590D. Special Topics: Secondary Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590F. Special Topics: Multicultural Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590G. Special Topics: Mathematics Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590I. Special Topics: Elementary Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590J. Special Topics: World Language Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590K. Special Topics: Educational Psychology.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590L. Special Topics: Social Studies Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 590M. Special Topics: Literacy Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 591. Graduate Level Pre-Student Teaching Experience.

(0-2) Cr. 1-4. Repeatable, maximum of 3 times. F.S. *Prereq: 15 graduate credits in special area; admission to teacher education.*
Supervised pre-student teaching experience in secondary schools. Supervision level 3.

C I 591C. Supervised Field Experience: Elementary Education.

(0-2) Cr. 1-6. F.S.SS. *Prereq: 15 graduate credits in special area*
Supervised on-the-job field experience in special area.

C I 591D. Graduate Level Pre-Student Teaching Experience: Secondary Science.

(0-2) Cr. 1-4. Repeatable. F.S. *Prereq: 15 graduate credits in specialty area; admission to teacher education*
Supervised pre-student teaching experience in secondary science education. Supervision level 3.

C I 591G. Graduate Level Pre-Student Teaching Experience: Secondary Mathematics Education.

(0-2) Cr. 1-4. Repeatable. F.S. *Prereq: 15 graduate credits in specialty area; admission to teacher education*
Supervised pre-student teaching experience in mathematics education. Supervision level 3.

C I 591M. Supervised Field Experience: Literacy.

(0-2) Cr. 1-6. F.S.SS. *Prereq: 15 graduate credits in special area*
Supervised on-the-job field experience in special area.

C I 593. Workshops.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593A. Workshops: Curriculum.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593B. Workshops: Digital Learning.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593C. Workshops: Science Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593D. Workshops: Secondary Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593F. Workshops: Multicultural Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593G. Workshops: Mathematics Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593I. Workshops: Elementary Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593J. Workshops: World Language Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593K. Workshops: Educational Psychology.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593L. Workshops: Social Studies Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 593M. Workshops: Literacy Education.

Cr. 1-3. F.S. *Prereq: 9 graduate credits in education*

C I 594. Contemporary Curriculum Theory and Principles.

(3-0) Cr. 3. F. *Prereq: Graduate standing*
Theoretical and historical perspectives of contemporary curriculum; social, cultural, and epistemological aspects of curriculum theory; diverse philosophical positions and approaches to understanding curriculum as it relates to educational settings.

C I 595. Content Area Reading and Literacy.

(Dual-listed with C I 395). (3-0) Cr. 3. F.S. *Prereq: Graduate status and teaching license*
Analysis and application of strategies to enhance students' literacy development in middle and secondary school settings. Research paper related to a course topic.

C I 597. Teaching Secondary School Mathematics.

(3-0) Cr. 3. F. *Prereq: 15 credits in college mathematics; and either in a teacher licensure program or in the process of applying, concurrent enrollment in C I 426 or C I 526*

Theory and methods for teaching mathematics in grades 7-12. Includes critical examination of instructional strategies, curriculum materials, learning tools, assessment methods, National Standards in Mathematics Education, and equity issues.

C I 599. Creative Component.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599A. Creative Component: Curriculum.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599B. Creative Component: Digital Learning.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599C. Creative Component: Science Education.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599D. Creative Component: Secondary Education.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599F. Creative Component: Multicultural Education.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599G. Creative Component: Mathematics Education.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599I. Creative Component: Elementary Education.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599J. Creative Component: World Language Education.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599K. Creative Component: Educational Psychology.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599L. Creative Component: Social Studies Education.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

C I 599M. Creative Component: Literacy Education.

Cr. 1-3. F.S.SS. *Prereq: 9 graduate credits in education*

Courses for graduate students:**C I 601. Foundations of Educational Inquiry.**

(3-0) Cr. 3. F. *Prereq: Admission to a doctoral program*

First of a two-course sequence designed to welcome new Curriculum and Instruction PhD students into the community of educational scholars. Inquiry into (1) the history of education as an academic field of study; (2) the philosophical underpinnings of social scientific and educational inquiry; and (3) the contemporary landscape of the field of education.

C I 602. Educational Inquiry in Action.

(3-0) Cr. 3. S. *Prereq: C I 601*

Second in a sequence welcoming new Curriculum and Instruction PhD students into the community of educational scholars. Opportunities to learn about a variety of faculty research in the department, engage faculty in conversation about their research, and continue reflecting on the theory and practice of educational inquiry.

C I 603. Advanced Learning Environments Design.

(Cross-listed with HCI). (3-0) Cr. 3. S. *Prereq: C I 503*

Exploration of advanced aspects of the instructional design process. Application of analysis, design, development and production, evaluation, implementation, and project management principles. Focus on the production and use of instructional technology with an emphasis on the instructional design consulting process. Theory and research in instructional technology provides the foundation for design decisions.

C I 610. Digital Learning in Teacher Education.

(2-0) Cr. 2. F. *Prereq: C I 505*

Research on using technology in teacher education programs. Application examples studied. Field component involving relating material from class to a teacher education situation.

C I 611. Philosophical Foundations of Digital Learning.

(3-0) Cr. 3. *Prereq: 12 graduate credits in curriculum and instruction*

Exploration of philosophies of science that serve as foundations for research and practice in instructional technology, including positivism, post-positivism, interpretivism/constructivism, and critical theory. The roles of language, nature of truth and reality, and acceptable ways of knowing are explored in terms of their implications for instructional technology design, delivery, research, and scholarship.

C I 612. Socio-psychological Foundations of Digital Learning.

(3-0) Cr. 3. *Prereq: 12 graduate credits in curriculum and instruction*

Exploration of theories of learning and associated instructional models that are the foundation for research and practice in education and educational technology, including behaviorism, information processing theory, and cognitive science. Emphasis on cognitive and social constructivist paradigms and the creation and use of constructivist learning environments supported by technology.

C I 615. Seminar.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615A. Seminar: Curriculum.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615B. Seminar: Digital Learning.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615C. Seminar: Science Education.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615D. Seminar: Secondary Education.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615F. Seminar: Multicultural Education.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615G. Seminar: Mathematics Education.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615I. Seminar: Elementary Education.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615J. Seminar: World Language Education.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615K. Seminar: Educational Psychology.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615L. Seminar: Social Studies Education.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 615M. Seminar: Literacy Education.

(0-2) Cr. 1. F.S.

Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

C I 690. Advanced Special Topics.Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690A. Advanced Special Topics: Curriculum.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690B. Advanced Special Topics: Digital Learning.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690C. Advanced Special Topics: Science Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690D. Advanced Special Topics: Secondary Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690F. Advanced Special Topics: Multicultural Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690G. Advanced Special Topics: Mathematics Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690I. Advanced Special Topics: Elementary Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690J. Advanced Special Topics: World Language Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690K. Advanced Special Topics: Educational Psychology.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690L. Advanced Special Topics: Social Studies Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 690M. Advanced Special Topics: Literacy Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699. Research.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699A. Research: Curriculum.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699B. Research: Digital Learning.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699C. Research: Science Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699D. Research: Secondary Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699F. Research: Multicultural Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699G. Research: Mathematics Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699I. Research: Elementary Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699J. Research: World Language Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699K. Research: Educational Psychology.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699L. Research: Social Studies Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education***C I 699M. Research: Literacy Education.**Cr. arr. Repeatable. *Prereq: 9 graduate credits in education*

Dance (DANCE)

Courses primarily for undergraduates:

DANCE 120. Modern Dance I.

(0-3) Cr. 1. F.S.

Introduction and practice of basic dance concepts, including preparatory techniques and guided creativity problems. No previous modern dance experience required. Offered on a satisfactory-fail basis only.

DANCE 130. Ballet I.

(0-3) Cr. 1. F.S.

Introduction to the basic skills, vocabulary, and tradition of ballet with concentration on control and proper alignment. No previous ballet experience required. Offered on a satisfactory-fail basis only.

DANCE 140. Jazz I.

(0-3) Cr. 1. F.S.

Introduction to the modern jazz style with concentration on isolation and syncopation. No previous jazz experience required. Offered on a satisfactory-fail basis only.

DANCE 150. Tap Dance I.

(0-3) Cr. 1. F.

Instruction and practice in basic tap technique and terminology. No previous tap experience required. Offered on a satisfactory-fail basis only.

DANCE 160. Ballroom Dance I.

(0-2) Cr. 1. F.S.

Instruction and practice in foxtrot, waltz, swing, cha cha, rumba, tango, and selected contemporary dances. Offered on a satisfactory-fail basis only.

DANCE 199. Dance Continuum.

Cr. 0.5-2. Repeatable, maximum of 6 credits. F.S. *Prereq: Permission of instructor* Advance registration required. Continued instruction and practice in either modern dance, recreational dance, ballet, jazz and/or compositional skills. Offered on a satisfactory-fail basis only.

DANCE 211. Fundamentals and Methods of Social and World Dance.

(1-3) Cr. 1. S.

Skill enhancement, teaching, progressions with emphasis on world and social dance. Designed for kinesiology and health majors, open to others.

DANCE 220. Modern Dance Composition.

(1-3) Cr. 2. F. *Prereq: DANCE 120 or previous modern dance experience*

Theory and practice of the creative skills involved in solo and small group composition.

DANCE 222. Modern Dance II.

(0-3) Cr. 1. F. *Prereq: DANCE 120 or previous modern dance experience*

Dance techniques emphasizing strength, balance, endurance, rhythmic activity and extended combinations.

DANCE 223. Modern Dance III.

(0-3) Cr. 1. S. *Prereq: DANCE 222*

Continued experience in dance techniques and extended combinations. Emphasis on maturation of skill and artistry. Exposure to a variety of modern dance technical styles.

DANCE 224. Concert and Theatre Dance.

(Cross-listed with THTRE). (0-3) Cr. 0.5-2. Repeatable, maximum of 6 credits.

F.S. *Prereq: By audition only*

Choreography, rehearsal, and performance in campus dance concerts and/or musical theatre productions. Offered on a satisfactory-fail basis only.

DANCE 232. Ballet II.

(0-3) Cr. 1. S. *Prereq: Previous ballet experience*

Technical skills in the classical movement vocabulary. Emphasis on alignment, techniques, sequence development, and performing quality.

DANCE 233. Ballet III.

(0-3) Cr. 1. F. *Prereq: DANCE 232*

Concentration on technical proficiency at the intermediate level. Pointe work and partnering opportunities available.

DANCE 242. Jazz II.

(0-3) Cr. 1. S. *Prereq: Previous jazz dance experience*

Dance concepts within the jazz idiom. Instruction in extended movement sequences and artistic interpretation.

DANCE 270. Dance Appreciation.

(3-0) Cr. 3. F.S.SS.

Introduction to the many forms and functions of dance in world cultures. Develop abilities to distinguish and analyze various dance styles. No dance experience required.

DANCE 320. Sound and Movement.

(2-2) Cr. 3. S. *Prereq: DANCE 220*

Intermediate composition based on the relationship of movement to improvised sounds, rhythmic scores, and the musical works of composers from various periods.

DANCE 360. History and Philosophy of Dance.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: DANCE 270*

Study of the history of dance from early to modern times with emphasis on the theories and philosophies of contemporary modern dance, dancers, and dance educators.

DANCE 370. Advanced Studies in Dance.

Cr. 1-3. Repeatable, maximum of 8 credits. F.S. *Prereq: 2 credits in dance*

Advance registration required. Designed to meet special interests and talents of students to include both group and independent study in various aspects of dance as a performing art including production, choreography, and performance.

DANCE 384. Teaching Children's Dance.

(1-3) Cr. 2. S.

Content, experiences, and methods of a comprehensive dance program at the elementary school level. Theories and practice in guiding elementary school children in expressive movement experiences.

DANCE 385. Methods of Teaching Dance.

(1-3) Cr. 2. F.

Methods and techniques of teaching social and world dance forms. Introduction to teaching educational modern dance.

DANCE 386. Teaching Dance Technique and Composition.

(1-3) Cr. 2. *Prereq: DANCE 320*

Teaching of dance as an expressive art form with emphasis on technique, rhythm, and the creative teaching process.

DANCE 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 6 credits. *Prereq: 6 credits in dance and permission of coordinator*

Independent study of problems or areas of interest in dance.

DANCE 490A. Independent Study: Dance.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S. *Prereq: 6 credits in dance and permission of coordinator*

Independent study of problems or areas of interest in dance.

DANCE 490H. Independent Study in Dance - Honors.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S. *Prereq: 6 credits in dance and permission of coordinator*

Independent study of problems or areas of interest in dance for those admitted to the honors program.

Design (DES)

Courses primarily for undergraduates:

DES 230. Design Thinking.

(3-0) Cr. 3. F.S.

Introduction to the phenomenon of design thinking as it appears in various design fields, including methodologies of reasoning and problem solving; patterns of creativity and individual style; and the interaction of art, science, and technology.

DES 240. Design Studio I.

(0-8) Cr. 2. Repeatable. F.S.SS. *Prereq: DSN S 102, DSN S 131 and DSN S 183*

Half-semester course. Studio projects develop students' ability to generate ideas and communicate those ideas visually, orally, and through writing. Field trips.

DES 250. Design Forum.

(2-0) Cr. 2. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: DSN S 102, DSN S 131, DSN S 183 and credit or concurrent enrollment in DES 230*

Introduction of themes and issues that are relevant to the design fields through theoretical readings, case studies, and visiting lecturers.

DES 340. Design Studio II.

(0-8) Cr. 2. Repeatable. F.S.SS. *Prereq: 4 credits of DES 240*

Half-semester course. Studio projects of increasing complexity requiring interdisciplinary approaches to contemporary challenges and opportunities. Continued development of students' abilities to generate ideas and communicate those ideas visually, orally, and through writing. Field trips.

DES 491. Portfolio and Professional Preparation.

(2-4) Cr. 4. F. *Prereq: 4 credits of DES 240 or permission of the instructor*

Preparation of printed and online portfolio of student work and materials for job search and/or graduate school applications. Guidance for interviewing, professional networking, business etiquette, and resume writing. Workshops and lectures.

DES 495. Capstone Experience.

(1-6) Cr. 4. S. *Prereq: classification as DES major; 2 credits of DES 340*

Individual projects designed by students in consultation with faculty instructor and mentor. Demonstration of student skill sets and knowledge of project planning and development.

Design Studies (DSN S)

Courses primarily for undergraduates:

DSN S 102. Design Studio I.

(1-6) Cr. 4.

A core design studio course exploring the interaction of two- and three-dimensional design. Emphasis on fundamental skills and ideas shared across design disciplines. Investigation of creative process, visual order and materials, and development of critical thinking through studio projects and lectures. Includes study of precedents, contemporary design practices and disciplines in their cultural contexts.

DSN S 110. Design Exchange Seminar I.

(0-2) Cr. 1. F. *Prereq:* Member of Design Exchange Learning Community Orientation to the College of Design. Introduction to the design disciplines and studio pedagogy. Offered on a satisfactory-fail basis only.

DSN S 111. Design Exchange Seminar II.

(0-2) Cr. 1. S. *Prereq:* Member of the Design Exchange Learning Community Development and clarification of career and academic plans. Offered on a satisfactory-fail basis only.

DSN S 115. Design Collaborative Seminar.

(1-0) Cr. 0.5. *Prereq:* Member of Design Collaborative Learning Community Orientation to the College of Design. Introduction to the design disciplines and studio pedagogy. Offered on a satisfactory-fail basis only.

DSN S 131. Design Representation.

(1-6) Cr. 4.

An introduction to drawing through lecture and studio experiences. Focus on creative problem solving and communication in order to give visual form to ideas. Emphasis on perceptual, conceptual, and evaluative abilities through experiences that build eye, brain, and hand coordination. Explorations include drawing from observation and memory, working at various scales and duration, and using a variety of media and processes.

DSN S 181. Origins and Evolution of Modern Design.

(3-0) Cr. 3. F.S.

History of designed artifacts, their creators, and their cultural environments in Western Europe and America from the beginning of the Industrial Revolution to the present.

DSN S 183. Design Cultures.

(3-0) Cr. 3.

A broad-based exploration of the dynamic relationship between design and culture, employing case study method to investigate particular examples of cultural production in contemporary society. Design processes and design works are presented as culturally, economically, environmentally, historically, ideologically, politically, and socially grounded events and artifacts.

DSN S 232. Digital Design Communications.

(3-0) Cr. 3.

Introductory investigations of various digital design media to develop multi-dimensional problem solving, digital communication skills and perceptual sensitivity. Open to all university majors.

DSN S 301. Study Abroad Preparation Seminar.

(1-0) Cr. 1. Repeatable.

Cultural introduction to host country, introduction to faculty sponsor and program of study, the particulars of traveling and living abroad, and financial and logistical preparations. Guest lectures. Required of all students planning to participate in a College of Design study abroad program for 9 or more credits. Offered on a satisfactory-fail basis only.

DSN S 302. Design Leadership Seminar.

(1-2) Cr. 2. Repeatable, maximum of 4 credits. *Prereq:* Selection as a peer mentor for the Core Design program.

For students serving as peer mentors for the Core Design Program, under faculty supervision. Development of teaching and leadership skills within the context of design education experiences. Offered on a satisfactory-fail basis only.

DSN S 303. Design Ambassadors.

(1-2) Cr. 1-2. Repeatable, maximum of 4 credits. *Prereq:* Admittance into one of the professional programs in the College of Design

Opportunity to strengthen leadership, communication and presentation skills. Introduction to student development theory. Students participate in collaborative projects focused on prospective design students. Offered on a satisfactory-fail basis only.

DSN S 310. Practical Experience.

Cr. R. *Prereq:* Permission of adviser or Coordinator of Design Studies Independent educational enrichment through practical experience. Students must register for this course prior to commencing each term. Available only to students taking course loads of eleven credits or less.

DSN S 332. Multi-Dimensional Digital Design Communication.

Cr. 3. *Prereq:* Arch 230, ARTGR 275, DSN S 232, or permission of the instructor Investigations of interoperable digital-design tools, techniques and methods directed at human scale interactive hybrid design from ideation to visualization, synthesis to analysis, and realization to fabrication.

DSN S 397. Internship Search Seminar.

(1-0) Cr. 1. F. *Prereq:* Sophomore classification or above in one of the College of Design degree programs

A structured environment to set realistic learning goals, research potential sites, develop a strategy, develop essential job search materials and skills for finding an internship. Successfully obtaining an internship either for credit or non credit is encouraged but not required. Offered on a satisfactory-fail basis only.

DSN S 445. Public Art/Public Space.

(3-0) Cr. 3. *Prereq:* Junior Standing, DSN S 102, DSN S 131, DSN S 183 Exploration of the history, precedents, and practice of public art and public space with a focus on developments since 1970 in the United States and abroad. Course includes development of a proposal for a site specific work of art. Meets U.S. Diversity Requirement

DSN S 446. Interdisciplinary Design Studio.

(0-12) Cr. 4-6. Repeatable, maximum of 18 credits. *Prereq:* Junior classification in a curriculum in the College of Design and permission of instructor Advanced interdisciplinary design projects.

DSN S 446H. Interdisciplinary Design Studio: Honors.

(0-12) Cr. 5-7. Repeatable, maximum of 18 credits. *Prereq:* Junior classification in a curriculum in the College of Design and permission of instructor Advanced interdisciplinary design projects.

DSN S 490. Independent Study.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq:* Written approval of instructor and department chair on required form prior to semester of enrollment Independent investigation of a topic of special interest to the student.

DSN S 490A. Independent Study: History.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq:* Written approval of instructor and department chair on required form prior to semester of enrollment Independent investigation of a topic of special interest to the student.

DSN S 490B. Independent Study: Technology.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq:* Written approval of instructor and department chair on required form prior to semester of enrollment Independent investigation of a topic of special interest to the student.

DSN S 490C. Independent Study: Communications.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq:* Written approval of instructor and department chair on required form prior to semester of enrollment Independent investigation of a topic of special interest to the student.

DSN S 490D. Independent Study: Design.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq:* Written approval of instructor and department chair on required form prior to semester of enrollment Independent investigation of a topic of special interest to the student.

DSN S 490E. Independent Study: Entrepreneurship.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq:* Written approval of instructor and department chair on required form prior to semester of enrollment Independent investigation of a topic of special interest to the student.

DSN S 490F. Independent Study: Social/Behavioral.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq:* Written approval of instructor and department chair on required form prior to semester of enrollment Independent investigation of a topic of special interest to the student.

DSN S 490G. Independent Study: Outreach.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq:* Written approval of instructor and department chair on required form prior to semester of enrollment. Independent investigation of a topic of special interest to the student.

DSN S 490H. Independent Study: Honors.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq:* Written approval of instructor and department chair on required form prior to semester of enrollment Independent investigation of a topic of special interest to the student.

DSN S 490I. Independent Study: Sustainability.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq: Written approval of instructor and department chair on required form prior to semester of enrollment.*

Independent investigation of a topic of special interest to the student. Offered on a satisfactory-fail basis only.

DSN S 492. Introduction to Italian Culture.

(1-0) Cr. 1. Repeatable, maximum of 3 credits. *Prereq: Enrollment in the College of Design Rome Study Abroad Program*

Introduction to Italian contemporary culture for design students, including food, religion, fashion, politics, media, and social mores.

Courses primarily for graduate students, open to qualified undergraduates:**DSN S 546. Interdisciplinary Design Studio.**

(0-12) Cr. 4-6. Repeatable, maximum of 18 credits. *Prereq: Graduate or senior standing in the College of Design and permission of instructor*

Advanced interdisciplinary design projects.

DSN S 590. Special Topics.

Cr. 1-4. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Written approval of instructor and department chair on required form prior to semester of enrollment*

Independent investigation of a topic of special interest to the student.

Dietetics (DIET)

Courses primarily for graduate students, open to qualified undergraduates:

DIET 511. Research Methods.

(3-0) Cr. 3. F.S. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

An overview of diverse research approaches focusing on methods for collecting and analyzing quantitative and qualitative data. www only. Only one of DIET 511 or FCEdS 511 may count toward graduation.

DIET 524. Financial Management and Cost Controls in Dietetics.

(3-0) Cr. 3. SS. *Prereq: Enrollment in GP-IDEA MFCS in Dietetics*

Overview of the fundamental knowledge of financial management, managerial accounting, and operational cost controls for dietetics professionals. Topics include a review of managerial accounting concepts for not-for-profit organizations and for-profit organizations based on the Uniform System of Accounts, value and risk analysis, budgeting, asset management, franchising and management contracts, cost-volume-profit analyses, and operational applications for financial performance.

DIET 527. Food Writing.

(3-0) Cr. 3. F. *Prereq: Enrollment in GP-IDEA MFCS in Dietetics*

Understanding and appreciating how to communicate effectively in writing about food and food-related topics. Hands-on experience in research and writing for various audiences and types of media.

DIET 530. Nutrition in Wellness.

(3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Addresses wellness promotion through nutrition. Nutritional risk and protective factors will be examined in relation to public health and individual nutrition. www only.

DIET 532. Maternal and Child Nutrition.

(3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Critical examination of behavioral, physiological, and public health issues impacting dietary and nutritional factors that support normal growth and development. Content focuses on early stages of the life cycle: gestation, lactation, infancy, preschool, school age, and adolescence. www only.

DIET 534. Nutrition Education in the Community.

(3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Principles and practices of teaching individuals and groups to translate nutrition knowledge into action. Emphasis on research in and evaluation of nutrition education. www only.

DIET 538. Nutrition: A Focus on Life Stages.

(3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Explores influence of normal physiological stresses on nutritional needs throughout the life span. Evaluates dietary intake and identification of appropriate community nutrition services in on-line discussions. Specific considerations, such as the influence of age and cultural heritage, are incorporated. www only.

DIET 540. Nutrition and Physical Activity in Aging.

(Cross-listed with GERON). (3-0) Cr. 3. Alt. F., offered even-numbered years.

WWW only. Basic physiologic changes during aging and their impacts in health and disease. The focus will be on successful aging with special emphasis on physical activity and nutrition. Practical application to community settings is addressed.

DIET 544. Pediatric Clinical Nutrition.

(3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in dietetics*

Examines the physiological, biochemical and nutritional aspects of disease processes relevant to infants and children up to 18 years of age. Discussion of medical nutrition therapy for a variety of medical conditions in this population including inborn errors of metabolism, food hypersensitivity, obesity, and diseases of the major organ systems. www only.

DIET 546. Phytochemicals.

(3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Overview of phytochemicals (non-nutritive biologically active compounds) from fruits, vegetables, cereals and oilseeds. Covers recent findings of chemistry, physiological functions, and potential health implications of phytochemicals. www only.

DIET 548. Professional Development Assessment.

(1-0) Cr. 1. F.S.SS. *Prereq: Enrollment in GPIDEA MFCS in Dietetics*

Web-based course providing information and practice for student to assess and evaluate own professional development and continuing professional education needs. Completion of professional 5-year plan. Offered on a satisfactory-fail basis only.

DIET 550. Finance and Cost Controls.

(3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Overview of the fundamental knowledge of hospitality managerial accounting, cost controls, and financial management. Important topics include financial statement analysis, cost concepts, cost-volume-profit analysis, calculating and controlling food and beverage costs, pricing, and capital budgeting. www only.

DIET 554. Statistics.

(3-0) Cr. 3. S.SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Tools used to make statistical decisions. Major emphasis on explanation and understanding of important concepts involved; basic theme is understanding of data and methods used to analyze such data. www only. Only one of DIET 554 or Stat 401, 495, 542 may count toward graduation by students in the GPIDEA Dietetics program.

DIET 556. Advanced Nutrition: Micronutrients.

(3-0) Cr. 3. S. *Prereq: BBMB 404 or BBMB 420 or equivalent; enrollment in GP-IDEA MFCS in Dietetics*

Integration of the molecular, cellular and physiological aspects of vitamins and minerals in mammalian systems. Interactions among nutrients, metabolic consequences of deficiencies or excesses, relevant polymorphisms, major research methodologies, and current topics related to micronutrients and non-nutrient components. www only. Only one of DIET 556 or NUTRS 502 may count toward graduation.

DIET 558. Advanced Nutrition: Macronutrients.

(3-0) Cr. 3. F. *Prereq: BBMB 404 or BBMB 420 or equivalent; enrollment in GP-IDEA MFCS in Dietetics*

Integration of the molecular, cellular and physiological aspects of macronutrients and energy metabolism in mammalian systems. Dietary energy, carbohydrates, fiber, lipids, proteins, their interactions, metabolic consequences, and major research methodologies. www only. Only one of DIET 558 or NUTRS 501 may count toward graduation.

DIET 560. Medical Nutrition and Disease.

(3-0) Cr. 3. F.S.SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Pathophysiology of selected acute and chronic disease states and their associated medical problems. Specific attention directed to medical nutrition needs of patients in the treatment of each disease state. www only. Only two of DIET 560 or NUTRS 561, 564 may count toward graduation.

DIET 565. Malnutrition in Low-Income Countries.

(3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Identification and assessment of malnutrition in low-income countries. Social, cultural, political, economic, and geographic determinants of malnutrition. Protein-energy malnutrition, vitamin and mineral deficiencies. Intervention approaches; international efforts and local sustainability. www only.

DIET 566. Nutrition Counseling and Education Methods.

(Cross-listed with FS HN). (2-2) Cr. 3. F.S. *Prereq: FS HN 361 and FS HN 362*

Application of counseling and learning theories with individuals and groups in community and clinical settings. Includes discussion and experience in building rapport, assessment, diagnosis, intervention, monitoring, evaluation, and documentation. Literature review of specific counseling and learning theories.

DIET 567. Nutrition for Dietitians.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: DIET 360; BBMB 301, undergraduate course in physiology; enrollment in GP-IDEA MFCS in Dietetics*

Study of the current scientific literature to evaluate current trends and issues in nutrition science and dietetic practice. Emerging areas of research investigating the role of nutrients in health and disease in humans will be explored. Emphasis on the impact of emerging research on nutrition recommendations and interventions designed to promote human health. www only.

DIET 568. Entrepreneurship in Dietetics.

(3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Definition and discussion of entrepreneurship and its importance to economic and business environment. www only.

DIET 569. Dietary and Herbal Supplements.

(3-0) Cr. 3. SS. *Prereq: Enrollment in GP-IDEA MFCS in Dietetics*

Develop skills to partner with patients in making dietary supplement decisions. Explore the safe, efficacious use of botanicals and supplements in nutritional support of aging, maternal health and wellness. Discussions on supplementation in the prevention and treatment of chronic disease include: arthritis, cancer, cardiovascular, diabetes, digestive, liver and renal disorders.

DIET 570. Nutrition and Human Performance.

(3-0) Cr. 3. S. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Develop an understanding of nutrition based on knowledge of the biochemical and physiological process and functions of specific nutrients in meeting nutritional requirements. Emphasis on the relationship of optimal nutrition and physical efficiency and performance. www only.

DIET 572. Environmental Scanning and Analysis of Current Issues in Dietetics.

(3-0) Cr. 3. F.S. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Overview of current topics, issues, and trends in dietetics practice. www only.

DIET 573. Administration of Health Care Organizations.

(3-0) Cr. 3. SS. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

A comprehensive review of today's health care institutions and their response to the economics, social, ethical, political, legal, technological, and ecological environments. www only.

DIET 595. Proposal and Grant Writing for the Working Professional.

(3-0) Cr. 3. F. *Prereq: enrollment in GP-IDEA MFCS in Dietetics*

Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Designed for the working professional. www only.

DIET 597. Nutritional Aspects of Oncology.

(Cross-listed with NUTRS). Cr. 3. Alt. S., offered even-numbered years. *Prereq: B.S. in nutrition, dietetics, biology, or related discipline.*

Understanding of basic cancer biology and methodology used to study nutrition and cancer relationships. Using current research as a basis, the role of nutrition in specific cancers will be explored. Students will learn about sources of information for cancer prevention programs, and how to apply this information to clinical patient management.

DIET 599. Creative Component.

Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in GPIDEA MS Dietetics*

For non-thesis option only.

Ecology and Evolutionary Biology (EEB)

Courses primarily for graduate students, open to qualified undergraduates:

EEB 511. Conceptual Foundations in Ecology and Evolutionary Biology.

(3-2) Cr. 4. F. *Prereq: Graduate classification*

Introduction to key figures and ideas that have shaped the development of ecology and evolutionary biology. Covers major developments in ecology and evolutionary biology at five levels of biological organization: Genome, Organism, Population, Community, and Ecosystem. Impacts of these developments on current approaches to investigation and argument formulation. Effects of technological advances on the direction of scientific investigations. Introduction to analytical skills important for critical thinking in ecology and evolutionary biology and the impact of accepted lines of scientific reasoning on the objectives and conduct of research, such as explanation and prediction, design of studies as experimentation, and structured or unstructured observation.

EEB 585. Extended Field Trip.

(0-6) Cr. 2. Repeatable. S. *Prereq: Graduate classification*

Annual field trip to a region of North America to study the major terrestrial and aquatic ecosystem types. Report required.

EEB 590. Special Topics.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and permission of instructor*

For students wishing to conduct in-depth study of a particular topic in ecology and evolutionary biology.

Courses for graduate students:

EEB 698. Seminar.

(1-0) Cr. 1. Repeatable. F.S.

Reports and discussion of recent research and literature.

EEB 699. Research.

Cr. arr. Repeatable. F.S.SS.

Thesis and dissertation research.

Ecology, Evolution, and Organismal Biology (EEOB)

Courses primarily for graduate students, open to qualified undergraduates:

EEOB 507. Advanced Animal Behavior.

(3-0) Cr. 3. S. *Prereq: Graduate standing, BIOL 354, or permission of instructor*
Analysis of current research in animal behavior. Topics covered may include behavioral ecology, mechanisms of behavior, evolution of behavior, applications of animal behavior to conservation biology, and applications of animal behavior to wild animals in captivity.

EEOB 514. Life History and Reproductive Strategies.

(Dual-listed with BIOL 414). (3-0) Cr. 3. F. *Prereq: BIOL 315 or equivalent recommended.*
Evolution of ecological adaptations at the individual, population, and species level. Emphasis is on evolutionary mechanisms and adaptive strategies related to life histories and reproduction; age and size at maturity; lifespan and senescence; offspring size/number trade-offs; sex and mating systems; sex determination and sex ratios.

EEOB 531. Conservation Biology.

(Cross-listed with A ECL). (3-0) Cr. 3. Alt. S., offered even-numbered years.
Prereq: BIOL 312; BIOL 313 or graduate standing
Examination of conservation issues from a population and a community perspective. Population-level analysis will focus on the role of genetics, demography, and environment in determining population viability. Community perspectives will focus on topics such as habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology.

EEOB 531I. Conservation Biology.

(Cross-listed with A ECL, IA LL). Cr. 4. Alt. SS., offered even-numbered years.
Prereq: IA LL 312I
Population- and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

EEOB 534. Endocrinology.

(Dual-listed with BIOL 434). (3-0) Cr. 3. S. *Prereq: BIOL 211, BIOL 212*
Chemical integration of vertebrate organisms. The structure, development, and evolution of the endocrine glands and the function and structure of their hormones.

EEOB 535. Restoration Ecology.

(Cross-listed with ENSCI, NREM). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: BIOL 366 or BIOL 474 or graduate standing*
Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies.

EEOB 535I. Restoration Ecology.

(Cross-listed with A ECL, ENSCI, IA LL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: A course in ecology*
Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

EEOB 539. Environmental Physiology.

(Dual-listed with BIOL 439). Cr. 3-4. Alt. S., offered even-numbered years. *Prereq: BIOL 335; physics recommended*
Physiological adaptations to the environment with an emphasis on vertebrates.

EEOB 542. Introduction to Molecular Biology Techniques.

(Cross-listed with B M S, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.
Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

EEOB 542A. Introduction to Molecular Biology Techniques: DNA Techniques.

(Cross-listed with B M S, BBMB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.
Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

EEOB 542B. Introduction to Molecular Biology Techniques: Protein.

(Cross-listed with B M S, BBMB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.SS. *Prereq: Graduate classification*
Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

EEOB 542C. Introduction to Molecular Biology Techniques: Cell Techniques.

(Cross-listed with B M S, BBMB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.
Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

EEOB 542D. Introduction to Molecular Biology Techniques: Plant Transformation.

(Cross-listed with B M S, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.
Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

EEOB 542E. Introduction to Molecular Biology Techniques: Proteomics.

(Cross-listed with B M S, BBMB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.
Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

EEOB 542F. Introduction to Molecular Biology Techniques: Metabolomics.

(Cross-listed with B M S, BBMB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.
Includes metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

EEOB 542G. Introduction to Molecular Biology Techniques: Genomic.

(Cross-listed with B M S, BBMB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.
Offered on a satisfactory-fail basis only.

EEOB 544. Introduction to Bioinformatics.

(Dual-listed with BIOL 444). (4-0) Cr. 4. F. *Prereq: MATH 165 or STAT 401 or equivalent*
Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics, systems biology.

EEOB 551. Plant Evolution and Phylogeny.

(Dual-listed with BIOL 451). (3-3) Cr. 4. F. *Prereq: BIOL 315 or equivalent.*
Survey of land plant evolution; phylogenetic comparison of anatomical, reproductive, and life history specializations. Relationships among bryophytes, lycophytes, pteridophytes, gymnosperms, and angiosperms emphasizing significant evolutionary changes documented by paleobotanical, morphological, and molecular studies.

EEOB 553. Agrostology.

(2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq: BIOL 366*
Structure, identification, classification, phylogeny, and economic aspects of grasses and related families.

EEOB 555. Bryophyte and Lichen Biodiversity.

(Dual-listed with BIOL 455). Cr. 3. *Prereq: BIOL 211, BIOL 211L*
Introduction to the biology and ecology of mosses, liverworts, and lichens. Emphasis on identification and diversity of local representatives of these three groups of organisms. Required field trips and service-learning.

EEOB 559. Mammalogy.

(2-3) Cr. 3. S. *Prereq: BIOL 351 or A ECL 365*
Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

EEOB 560. Resource Ecology.

(2-3) Cr. 3. Alt. S., offered even-numbered years. *Prereq: BIOL 212, BIOL 212L, BIOL 312; STAT 101 or STAT 104 or graduate standing*
Ecological and economical management of sustainable biological resources. Unifying current management concepts and models in wildlife, fisheries, water quality, forestry, recreation, and agriculture. Research problems.

EEOB 561. Evolutionary and Ecological Genomics.

(3-0) Cr. 3. S. *Prereq: Permission of instructor; BCBO 444 recommended.* Use of genomic and other "omic" data in evolution and ecology. Review of data-generation platforms, computational methods, and examples of how phylogenomics, metagenomics, epigenomics, and population genomics are transforming the disciplines of evolution and ecology.

EEOB 562. Evolutionary Genetics.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Permission of instructor* Seminar/discussion course covering the genetic basis of evolutionary processes in multicellular organisms.

EEOB 563. Molecular Phylogenetics.

(2-3) Cr. 3. F. *Prereq: BIOL 313 and BIOL 315*

An overview of the theory underlying phylogenetic analysis and the application of phylogenetic methods to molecular datasets. The course emphasizes a hands-on approach to molecular phylogenetics and combines lecture presentations with computer exercises and discussion of original scientific literature.

EEOB 564. Wetland Ecology.

(Dual-listed with BIOL 464). (Cross-listed with ENSCI). (3-0) Cr. 3. S. *Prereq: 15 credits in biological sciences.*

Ecology, classification, creation and restoration, and management of wetlands. Emphasis on North American temperate wetlands.

EEOB 564I. Wetland Ecology.

(Cross-listed with ENSCI, IA LL). Cr. 4. SS. *Prereq: IA LL 312I*

Ecology, classification, creation, restoration, and management of wetlands. Field studies will examine the composition, structure and functions of local natural wetlands and restored prairie pothole wetlands. Individual or group projects.

EEOB 565. Morphometric Analysis.

(Dual-listed with BIOL 465). (3-2) Cr. 4. Alt. S., offered even-numbered years. *Prereq: STAT 401*

A comprehensive overview of the theory and methods for the analysis of biological shape with emphasis on data acquisition, standardization, statistical analysis, and visualization of results. Methods for both landmark and outline data will be discussed.

EEOB 566. Molecular Evolution.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: Permission of instructor* Seminar/discussion course covering the fundamentals of molecular evolution. Emphasis is placed on original scientific literature and current topics, including rates and patterns of genetic divergence; nucleotide and allelic diversity; molecular clocks; gene duplications; genome structure; organellar genomes; polyploidy; transposable elements; and modes and mechanisms of gene and genome evolution.

EEOB 567. Empirical Population Genetics.

(3-0) Cr. 3. F. *Prereq: Permission of instructor*

An overview of fundamental population genetic theory and the ecological and evolutionary factors underlying the distribution of genetic variation within and among natural populations. Emphasis on the analysis of inbreeding, breeding systems, parentage, relatedness, spatial autocorrelation, effective population size, hierarchical population models, and phylogeography.

EEOB 568. Advanced Systematics.

(Cross-listed with ENT). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Permission of instructor*

Principles and practice of systematic biology; taxonomy, nomenclature and classification of plants and animals; sources and interpretation of systematic data; speciation; fundamentals of phylogenetic systematics.

EEOB 569. Biogeography.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: BIOL 315 or equivalent; permission of instructor*

Principles underlying the geographic distribution of organisms throughout the world; biological influences of geological history and tectonic movements; role of climate, migration, dispersal, habitat, and phylogeny on past and present organismal distribution patterns; biogeographic methods.

EEOB 570. Landscape Ecology.

(Cross-listed with A ECL). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: Permission of instructor; EEOB 588; a course in calculus

The study of ecological and evolutionary processes within a spatial context with emphasis on behavior, population, and community dynamics.

EEOB 573. Techniques for Biology Teaching.

(Cross-listed with A ECL, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573A. Techniques for Biology Teaching : Animal Biology.

(Cross-listed with A ECL, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573B. Techniques for Biology Teaching: Plant Biology.

(Cross-listed with IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573C. Techniques for Biology Teaching: Fungi and Lichens.

(Cross-listed with IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573D. Techniques for Biology Teaching: Aquatic Ecology.

(Cross-listed with IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573E. Techniques for Biology Teaching: Prairie Ecology.

(Cross-listed with IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573F. Techniques for Biology Teaching: Wetland Ecology.

(Cross-listed with IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573G. Techniques for Biology Teaching: Limnology.

(Cross-listed with A ECL, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573H. Techniques for Biology Teaching: Animal Behavior.

(Cross-listed with IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573I. Techniques for Biology Teaching: Insect Ecology.

(Cross-listed with A ECL, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573J. Techniques for Biology Teaching: Biology of Invertebrates.

(Cross-listed with IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573K. Techniques for Biology Teaching: Non-invasive Use of Living Organisms.

(Cross-listed with IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 573W. Techniques for Biology Teaching: Project WET.

(Cross-listed with A ECL, IA LL). Cr. 1-2. Repeatable. SS.
The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

EEOB 575I. Field Mycology.

(Cross-listed with IA LL). Cr. 4. Alt. SS., offered even-numbered years.
Identification and classification of the common fungi; techniques for identification, preservation, and culture practiced with members of the various fungi groups.

EEOB 576. Functional Ecology.

(Dual-listed with BIOL 476). (3-0) Cr. 3. Alt. S., offered odd-numbered years.
Prereq: BIOL 312
The nature of adaptations to physical and biotic environments. Biophysical, biomechanical, and physiological bases of the structure, form, growth, distribution, and abundance of organisms.

EEOB 577. Concepts in Theoretical Ecology and Evolution.

(2-0) Cr. 1. Alt. F., offered even-numbered years.
Readings and discussion of influential ideas in ecological and evolutionary theory, with an emphasis on how models are used as conceptual tools for building synthetic paradigms. Topics are chosen according to student interests; may include spatial ecology, behavioral theory, chaos, community assembly and biodiversity, and others.

EEOB 578. Foundations of Theoretical Ecology and Evolution.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: 1 semester of calculus or permission of instructor.*
Quantitative exploration of classic models and results in ecological and evolutionary theory. Introduction to conceptual, mathematical, and programming tools needed to build and analyze models.

EEOB 580I. Ecology and Systematics of Diatoms.

(Cross-listed with IA LL). Cr. 4. SS.
Field and laboratory study of freshwater diatoms; techniques in collection, preparation, and identification of diatom samples; study of environmental factors affecting growth, distribution, taxonomic characters; project design and execution including construction of reference and voucher collections and data organization and analysis.

EEOB 581. Environmental Systems I: Introduction to Environmental Systems.

(Dual-listed with BIOL 381). (Cross-listed with ENSCI). Cr. 3-4. F. *Prereq: 12 credits of natural science including biology and chemistry*
Introduction to the structure and function of natural environmental systems. Emphasis on the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

EEOB 582. Environmental Systems II: Analysis of Environmental Systems.

(Dual-listed with BIOL 382). (Cross-listed with ENSCI). (2-2) Cr. 3. S. *Prereq: ENSCI 381*
Continuation of EnSci 381. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

EEOB 584. Advanced Ecosystem Ecology.

(Cross-listed with ENSCI). (3-0) Cr. 3. Alt. S., offered even-numbered years.
Prereq: Combined 12 credits in biology, chemistry, and physics.
Advanced studies of ecosystems and the biological and physical factors that influence their properties and dynamics. Conceptual foundations and modern approaches to ecosystem studies. Interactions among organisms, biological diversity, and ecosystem attributes. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems. Global change issues.

EEOB 585. Advanced Community Ecology.

(2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq: BIOL 312*
Factors controlling species diversity, species abundance, and the structure and function of communities in space and time. Relationships between species diversity and ecosystem process rates and community stability.

EEOB 586. Aquatic Ecology.

(Dual-listed with BIOL 486). (Cross-listed with ENSCI). (3-0) Cr. 3. F. *Prereq: BIOL 312 or EnSci 381 or EnSci 402 or NREM 301*
Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology.

EEOB 586L. Aquatic Ecology Laboratory.

(Dual-listed with BIOL 486L). (Cross-listed with ENSCI). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in BIOL 486*
Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts.

EEOB 587. Microbial Ecology.

(Dual-listed with BIOL 487). (Cross-listed with ENSCI, MICRO). (3-0) Cr. 3. F. *Prereq: Six credits in biology and 6 credits in chemistry*
Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

EEOB 589. Population Ecology.

(Dual-listed with BIOL 489). (Cross-listed with A ECL). (2-2) Cr. 3. F. *Prereq: BIOL 312, STAT 101 or STAT 104, a course in calculus, or graduate standing*
Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

EEOB 590. Graduate Independent Study.

(Cross-listed with A ECL, ANTHR, IA LL). Cr. 1-4. Repeatable. SS. *Prereq: Graduate classification and permission of instructor*

EEOB 590A. Special Topics: Current Topics in Ecology.

Cr. 1-3. Repeatable. *Prereq: 10 credits in biology, permission of instructor*

EEOB 590B. Special Topics: Current Topics in Evolutionary Biology.

Cr. 1-3. Repeatable. *Prereq: 10 credits in biology, permission of instructor*

EEOB 590C. Special Topics: Current Topics in Organismal Biology.

Cr. 1-3. Repeatable. *Prereq: 10 credits in biology, permission of instructor*

EEOB 590I. Special Topics: Graduate Independent Study.

Cr. 1-4. Repeatable. SS. *Prereq: Graduate classification and permission of instructor*

EEOB 596. Ecology and Society.

(3-0) Cr. 3. *Prereq: Graduate classification in biological or environmental sciences/studies with at least one course in ecology*
Analysis of conceptual and methodological debates in ecology. Historical development of competing research traditions and philosophies. Topics include i) methodological issues in ecological science, ii) conceptual issues in theoretical ecology, iii) conceptual issues in applied ecology, iv) relation of ecology to environmental and social issues.

EEOB 599. Creative Component.

Cr. arr.
Research toward nonthesis master's degree.

Courses for graduate students:**EEOB 611. Analysis of Populations.**

(Cross-listed with A ECL). (2-2) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: BIOL 312; STAT 401; a course in calculus*
Quantitative techniques for analyzing vertebrate population data to estimate parameters such as density and survival. Emphasis on statistical inference and computing.

EEOB 698. Seminar.

Cr. 1. Repeatable.
Meetings of graduate students and faculty to discuss recent literature and problems under investigation.

EEOB 699. Research.

Cr. arr. Repeatable.
Research for thesis or dissertation. Offered on a satisfactory-fail basis only.

EEOB 699I. Research.

(Cross-listed with A ECL, ANTHR, GDCB, IA LL). Cr. 1-4. Repeatable.

Economics (ECON)

Courses primarily for undergraduates:

ECON 101. Principles of Microeconomics.

(3-0) Cr. 3. F.S.SS.

Resource allocation, opportunity cost, comparative and absolute advantage. Supply and demand. Marginal analysis. Theories of production and consumption, pricing, and the market system. Perfect and imperfect competition and strategic behavior. Factor markets. Present discounted value.

ECON 101H. Principles of Microeconomics: Honors.

(3-0) Cr. 3. *Prereq: Honors program students only*

Resource allocation, opportunity cost, comparative and absolute advantage. Supply and demand. Marginal analysis. Theories of production and consumption, pricing, and the market system. Perfect and imperfect competition and strategic behavior. Factor markets. Present discounted value.

ECON 101L. Laboratory in Principles of Microeconomics.

(0-2) Cr. 1. F. *Prereq: Concurrent enrollment in the appropriate section of ECON 101*

Discussion of material typically covered in Econ 101. Application of economic principles to real world problems. Economic principles and basic business management concepts applied to decision-making in agribusiness operations.

ECON 102. Principles of Macroeconomics.

(3-0) Cr. 3. F.S.SS. *Prereq: ECON 101 recommended*

Measurement of macro variables and general macro identities. Classical models of full employment. Production and growth. Savings and investment. Employment and unemployment. Money, inflation, and price levels. Operation of the U.S. banking system. Fiscal and monetary policy. Elements of international finance.

ECON 102H. Principles of Macroeconomics: Honors.

(3-0) Cr. 3. *Prereq: ECON 101 recommended; admission to the Honors program.*

Measurement of macro variables and general macro identities. Classical models of full employment. Production and growth. Savings and investment. Employment and unemployment. Money, inflation, and price levels. Operation of the U.S. banking system. Fiscal and monetary policy. Elements of international finance.

ECON 110. Orientation in Agricultural Business.

(1-0) Cr. 1. F.

Orientation course for freshman and new transfer students in agricultural business.

ECON 207. Applied Economic Optimization.

(2-2) Cr. 3. F.S. *Prereq: MATH 151, MATH 160, MATH 165 or equivalent*

Application of linear algebra, calculus and unconstrained and constrained optimization techniques to economic problems. Learning outcomes include the ability to (i) identify the objective, decision variables and constraints in economic decision problems, (ii) represent elements of an economic problem in simple mathematical models, (iii) identify and apply mathematical tools that can be used to solve the problems, (iv) identify the strengths and limitations of the solution method, and (v) interpret the economic meaning and implications of the solution.

ECON 230. Farm Business Management.

(2-2) Cr. 3. F.S. *Prereq: ECON 101; ACCT 284*

Business and economic principles applied to decision making and problem solving in the management of a farm business. Cash flow, partial, enterprise, and whole farm budgeting. Information systems for farm accounting, analysis, and control. Obtaining and managing land, capital, and labor resources. Alternatives for farm business organization and risk management.

ECON 234. Small Business Management.

(3-0) Cr. 3. *Prereq: ECON 101*

An introduction to small business management, entrepreneurship, and economics utilizing a series of case studies. Exploration of issues related to starting or acquiring a new business and development of knowledge and skills for successful management of a small business, with an emphasis on agricultural business.

ECON 235. Introduction to Agricultural Markets.

(3-0) Cr. 3. F.S. *Prereq: ECON 101*

Basic concepts and economics principles related to markets for agricultural inputs and products. Overview of current marketing problems faced by farms and agribusinesses, farm and retail price behavior, structure of markets, food marketing channels, food quality and food safety, and the role of agriculture in the general economy. The implications of consumer preferences at the farm level. Introduction to hedging, futures, and other risk management tools.

ECON 292. Career Seminar.

(1-0) Cr. 1. *Prereq: Classification in economics or agricultural business*

Career opportunities in the various industries and government institutions.

Required training and skills needed to perform successfully in different types of careers. Factors important in finding and obtaining employment either before or after graduation including personal resumes, interviewing, and letter writing. Only one of ECON 292, 292A, and 292B can be used toward graduation.

ECON 292A. Career Seminar: Agricultural Business.

(1-0) Cr. 1. *Prereq: Classification in economics or agricultural business*

Career opportunities in the various industries and government institutions.

Required training and skills needed to perform successfully in different types of careers. Factors important in finding and obtaining employment either before or after graduation including personal resumes, interviewing, and letter writing. Only one of ECON 292, 292A, and 292B can be used toward graduation.

ECON 292B. Career Seminar: Economics and Business Economics.

(1-0) Cr. 1. *Prereq: Classification in economics or agricultural business*

Career opportunities in the various industries and government institutions.

Required training and skills needed to perform successfully in different types of careers. Factors important in finding and obtaining employment either before or after graduation including personal resumes, interviewing, and letter writing. Only one of ECON 292, 292A, and 292B can be used toward graduation.

ECON 297. Internship.

Cr. 2. Repeatable, maximum of 4 credits. *Prereq: Permission of instructor and classification in agricultural business or economics*

Students complete a research report, based on their internship or approved work experience, that examines chosen topics in management, marketing or finance. Offered on a satisfactory-fail basis only.

ECON 298. Cooperative Education.

Cr. R. *Prereq: Permission of the department cooperative education coordinator; sophomore classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

ECON 301. Intermediate Microeconomics.

(3-0) Cr. 3-4. F.S.SS. *Prereq: ECON 101; ECON 207 or MATH 166*

Theory of consumer and business behavior; optimal consumption choices and demand; theory of firm behavior; costs, production, and supply; competitive and imperfectly competitive markets; theory of demand for and supply of factors of production; general equilibrium analysis. Recitation required for 4 credits.

ECON 301H. Intermediate Microeconomics: Honors.

(3-0) Cr. 3-4. *Prereq: ECON 101; ECON 207 or MATH 166*

Theory of consumer and business behavior; optimal consumption choices and demand; theory of firm behavior; costs, production, and supply; competitive and imperfectly competitive markets; theory of demand for and supply of factors of production; general equilibrium analysis. Recitation required for 4 credits.

ECON 302. Intermediate Macroeconomics.

(3-0) Cr. 3. F.S. *Prereq: ECON 101, ECON 102; MATH 160 or MATH 165*

Theory of income, employment, interest rates, and the price level; fiscal and monetary policy; budget and trade deficits; money and capital inflows, interest rates, and inflation.

ECON 302H. Intermediate Macroeconomics: Honors.

(3-0) Cr. 3. *Prereq: ECON 101, ECON 102; MATH 160 or MATH 165*

Theory of income, employment, interest rates, and the price level; fiscal and monetary policy; budget and trade deficits; money and capital inflows, interest rates, and inflation.

ECON 313. Economics of Sports.

(3-0) Cr. 3. *Prereq: ECON 101*

Application of economics to issues in sports, including franchising; rival leagues and barriers to entry; cooperative, competitive, and collusive behavior; player productivity and compensation; contracts, unions, and discrimination; antitrust, taxation, and subsidies. Economic concepts include supply and demand, labor economics, pricing, public finance, production, game theory, and industrial organization.

ECON 320. Labor Economics.

(3-0) Cr. 3. *Prereq: ECON 101*

Economic analysis of contemporary domestic and international labor market issues including labor supply and demand, unemployment, and employment in the U.S. and elsewhere; investments in and returns to education, training, health, immigration and migration; income inequality; labor productivity; out-sourcing and global competitiveness; work incentives; compensation including benefits; and labor policies such as minimum wages, over-time pay, discrimination, unions, and immigration. Examples drawn from the U.S. and other developed countries with reference to developing countries where relevant.

Meets International Perspectives Requirement.

ECON 321. Economics of Discrimination.(Cross-listed with W S). (3-0) Cr. 3. *Prereq: ECON 101*

Economic theories of discrimination. Analysis of the economic problems of women and minorities in such areas as earnings, occupations, and unemployment. Public policy concerning discrimination. Poverty measurement and antipoverty programs in the U.S.

Meets U.S. Diversity Requirement

ECON 330. Advanced Farm Business Management.(3-2) Cr. 4. *Prereq: ECON 230*

Effective use of strategic planning, decision methods, and computer assistance for solving farm problems. Applications of economic and management theory to analyze farm business decisions using efficiency measures to assess current resource use and direct the farm business analysis, planning, and tax process.

ECON 332. Cooperatives.(3-0) Cr. 3. *Prereq: ECON 101*

Survey of cooperative activities with emphasis on agricultural cooperatives, types of cooperatives, methods of organization and operation, principles, legal and tax aspects, cooperative finance, economic possibilities, and limitations of cooperation. Students will learn how to work together in teams to solve problems while role playing directors of cooperative boards.

ECON 334. Entrepreneurship in Agriculture.(3-0) Cr. 3. F.S. *Prereq: ECON 101*

Introduction to the process of entrepreneurship within the agricultural and food sectors. Emphasis on opportunity recognition and assessment, resource acquisition and feasibility analysis for both private and social enterprises. Students will develop a comprehensive feasibility study for a new business or non-profit organization.

ECON 336. Agricultural Selling.(3-0) Cr. 3. *Prereq: ECON 101*

Principles of selling with application to agricultural and food related businesses. Attitudes, value systems, and behavioral patterns that relate to agricultural sales. Electronic marketing, selling strategies, preparing for sales calls, making sales presentations, handling objections, and closing sales. Analysis of the buying or purchasing process. Evaluation of agri-selling as a possible career choice.

ECON 337. Agricultural Marketing.(2-2) Cr. 3. *Prereq: ECON 101 required, ECON 235 recommended*

Understanding of agricultural commodity markets for grain, livestock and dairy with emphasis on marketing decisions and risk management for farmers and processors. Lab will provide hands-on applications of marketing and management tools via market simulations.

ECON 344. Public Finance.(3-0) Cr. 3. *Prereq: ECON 101*

The economic role of governments in market economies. Public goods, externalities, income distribution, and income maintenance programs. The effect of taxes on economic behavior, descriptions of the structure of the principal U.S. taxes, and current reform proposals.

ECON 353. Money, Banking, and Financial Institutions.(3-0) Cr. 3. F.S. *Prereq: ECON 101, ECON 102*

Theoretical and applied analysis of money, banking, and financial markets; interest rates and portfolio choice; the banking industry in transition; the money supply process; the Federal Reserve System and the conduct of monetary policy; macro implications of monetary policy; international finance.

ECON 355. International Trade and Finance.(3-0) Cr. 3. *Prereq: ECON 101, ECON 102*

Explanations of causes of international trade and the impact of trade on welfare and employment patterns. Analysis of government policies towards trade, such as tariffs, quotas, and free trade areas. Theory of balance of payments and exchange rate determination, and the role of government policies. Examination of alternative international monetary arrangements.

Meets International Perspectives Requirement.

ECON 362. Applied Ethics in Agriculture.(Cross-listed with SOC). (3-0) Cr. 3. *Prereq: ECON 101 or SOC 134, junior or senior status in the College of Agriculture*

Identify major ethical issues and dilemmas in the conduct of agricultural and agribusiness management and decision making. Discuss and debate proper ethical behavior in these issues and situations and the relationship between business and personal ethical behavior.

ECON 364. Rural Property Appraisal.(3-0) Cr. 3. *Prereq: ECON 101*

Use of income capitalization, sales comparison and cost appraisal concepts in appraising agricultural resources. Application of underlying economic/business/management principles, especially present value, as they relate to farmland appraisal. Determination and estimation of economic impacts of special consideration and property use factors. Evaluate feasibility and profitability of investment in rural property.

ECON 370. Comparative Capitalism and Economic Transitions.(3-0) Cr. 3. *Prereq: ECON 101, ECON 102*

Theories of capitalism and the economics of transition from a planned to a market economy; the role and the creation of economic institutions supporting different economic systems. An examination of recent experiences of Eastern European countries, the former Soviet Union, China, the European Union, and the United States.

Meets International Perspectives Requirement.

ECON 371. Introductory Econometrics.(4-0) Cr. 4. F.S. *Prereq: ECON 301, ECON 302 OR ECON 353, STAT 326*

Introduction to the models and methods used to estimate relationships and test hypotheses pertaining to economic variables. Among the topics covered in the course are: Single and multiple regression analysis; functional forms; omitted variable analysis; multicollinearity; heteroskedasticity; autocorrelation; simultaneous equations; and dynamic models.

ECON 376. Rural, Urban and Regional Economics.(Cross-listed with C R P). (3-0) Cr. 3. *Prereq: ECON 101*

Firm location with respect to regional resources, transport, scale economies, externalities, and policies. Measures of local comparative advantage and specialization. Spatial markets. Population location considering jobs, wages, commuting, and local amenities. Business, residential, and farm land use and value. Migration. Other topics may include market failure, regulation, the product cycle, theories of rural and urban development, developmental policy, firm recruiting, local public goods and public finance, schools, poverty, segregation, and crime.

ECON 378. Retirement Planning and Employee Benefits.(Cross-listed with GERON, HD FS). (3-0) Cr. 3. S. *Prereq: 3 credits in Principles of Economics and 3 credits in Human Development and Family Studies*

Economic well-being in the context of demographic change, the present and future of Social Security, family retirement needs analysis, investment strategies and characteristics of retirement plans, helping others to work towards financial security, family economic issues for retired persons. Overview of employee and retirement benefits.

Meets U.S. Diversity Requirement

ECON 380. Environmental and Resource Economics.(Cross-listed with ENV S). (3-0) Cr. 3. *Prereq: ECON 101*

Natural resource availability, use, conservation, and government policy, including energy issues. Environmental quality and pollution control policies.

ECON 385. Economic Development.(Cross-listed with GLOBE). (3-0) Cr. 3. *Prereq: ECON 101, ECON 102*

Current problems of developing countries, theories of economic development, agriculture, and economic development, measurement and prediction of economic performance of developing countries, alternative policies and reforms required for satisfying basic needs of Third World countries, interrelationships between industrialized countries and the developing countries, including foreign aid.

Meets International Perspectives Requirement.

ECON 387. Economies of China and India.(3-0) Cr. 3. *Prereq: ECON 101*

The economic development of China and India within the larger historical, political, and socioeconomic contexts. The characteristics of the development paths of major industries. The drivers of and impediments for future economic development. The two economies' connections with the world economy.

Meets International Perspectives Requirement.

ECON 398. Cooperative Education.Cr. R. *Prereq: Permission of the department cooperative education coordinator; junior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

ECON 401. Topics in Microeconomics.(3-0) Cr. 3. *Prereq: ECON 301, STAT 226*

Advanced treatment of selected topics from one or more of the following areas: household production models, factor markets, game theory and imperfect competition, general equilibrium, intertemporal choice, asset markets, income distribution, externalities and public goods, etc.

ECON 402. Topics in Macroeconomics.(3-0) Cr. 3. *Prereq: ECON 301, ECON 302, STAT 226*

Advanced treatment of selected topics from one or more of the following areas: business cycle theory, growth theory, fiscal and monetary policy, coordination issues, open economy macroeconomics, and financial economics.

ECON 416. Industrial Organization.(3-0) Cr. 3. *Prereq: ECON 301*

Study of the structure of firms and markets and of their interaction, with emphasis on imperfectly competitive markets. Behavior of firms in strategic settings and insights of basic game-theoretic models. Welfare implications of alternative market organizations, consequences of market power, and scope for government regulation and antitrust/competition policies. Topics include monopoly and price discrimination, oligopoly models, product quality, product differentiation, vertical integration, information and advertising, patents, R&D and innovation, and regulation.

ECON 418. Introduction to Game Theory.(3-0) Cr. 3. *Prereq: ECON 301*

Systematic introduction to game theory and its uses in economics. Develops the basic framework, models and tools necessary to analyze games of strategy, including: Strategic and extensive-form representations of games; best response functions and Nash equilibrium, mixed strategies backward induction and subgame-perfect equilibrium, imperfect and incomplete information, Bayesian and sequential equilibria. Examples and applications taken from economics, business, political science, law and biology.

ECON 431. Managerial Economics.(3-0) Cr. 3. *Prereq: ECON 301*

Theory of the firm; organizational incentives and efficiency; moral hazard; role of information and decision making under uncertainty; ownership and control; business investment.

ECON 437. Commodity Marketing and Risk Management.(3-0) Cr. 3. *Prereq: ECON 235, ECON 301, STAT 326*

The purpose and performance of commodity markets. How commodity marketing institutions function. Merchandising arrangements. Distinguishing features of agricultural commodities. Hedging, arbitrage, and speculation in commodity spot, forward, futures, and options markets. Valuation theory.

ECON 455. International Trade.(3-0) Cr. 3. *Prereq: ECON 301*

Rigorous treatment of theories of international trade and international factor movements. Examination of the impact of trade and labor migration on domestic and world welfare and on the distribution of income. Theoretical analysis of government policies towards trade and factor movements, including quotas, tariffs, free trade areas and immigration restrictions. Discussion of contemporary issues and controversies concerning globalization, including multinational firms and labor migration.

Meets International Perspectives Requirement.

ECON 457. International Finance.(3-0) Cr. 3. *Prereq: ECON 302*

National income accounting and balance of payments; foreign exchange rates and exchange rate markets; money, interest rates, and exchange rate determination; prices, exchange rates, and output in the short run; international monetary arrangements; fixed versus flexible exchange rates; optimal currency areas; international capital flows; currency and financial crises in emerging markets. Meets International Perspectives Requirement.

ECON 458. Economic Systems for Electric Power Planning.(Cross-listed with E E). (3-0) Cr. 3. *Prereq: E E 303 or ECON 301*

Evolution of electric power industry. Power system operation and planning and related information systems. Linear and integer optimization methods. Short-term electricity markets and locational marginal prices. Risk management and financial derivatives. Basics of public good economics. Cost recovery models including tax treatment for transmission investments.

ECON 460. Agricultural, Food, and Trade Policy.(Dual-listed with ECON 560). (3-0) Cr. 3. *Prereq: ECON 301 or ECON 501*

Description and analysis of economic problems of U.S. agriculture. Explanation and economic analysis of government policies and programs to develop agriculture, conserve agricultural resources, address consumer food concerns, stabilize farm prices, and raise farm incomes. The influence of macropolicy, world economy, international trade, and bioenergy on U.S. agriculture.

ECON 466. Agricultural Finance.(3-0) Cr. 3. *Prereq: ECON 301, STAT 226, FIN 301 and ECON 353 (recommended)*

Financial analysis of agricultural businesses; liquidity, capital structure, and growth and risk of agricultural firms; capital budgeting methods; analysis of land investments, leasing, and costs of credit; financial intermediation and major financial institutions for agriculture; borrower-lender relationships, and asset-liability management techniques by financial intermediaries; public policies affecting agricultural credit markets.

ECON 480. Intermediate Environmental and Resource Economics.(Dual-listed with ECON 580). (3-0) Cr. 3. *Prereq: ECON 301 or ECON 501*

Theories of natural resource utilization and allocation. Externalities, public goods, and environmental quality. Renewable energy, biofuels, land use change and life cycle analysis of carbon, and sustainability and resource conservation. Methodologies for analyzing natural resource and environmental problems and evaluating resource policies.

ECON 490. Independent Study.Cr. 1-5. Repeatable, maximum of 6 credits. *Prereq: Junior or senior classification, 14 credits in economics*

Offered on a satisfactory-fail basis only. No more than 9 credits of Econ 490 may be used toward graduation

ECON 490E. Independent Study: Entrepreneurship.Cr. 1-5. Repeatable, maximum of 6 credits. *Prereq: Junior or senior classification, 14 credits in economics*

Offered on a satisfactory-fail basis only. No more than 9 credits of Econ 490 may be used toward graduation

ECON 490H. Independent Study: Honors.Cr. 1-5. Repeatable, maximum of 6 credits. *Prereq: Junior or senior classification, 14 credits in economics*

Offered on a satisfactory-fail basis only. No more than 9 credits of Econ 490 may be used toward graduation

ECON 492. Graduating Senior Survey.Cr. R. *Prereq: Graduating senior*

Final preparations for graduation. The final stages of job searching, interviewing, letter writing, and resume preparation. Outcomes assessment information from graduating seniors including opinion surveys, instructor/advisor/course evaluations, exit interviews, student accomplishment surveys, job placement surveys, and comprehensive skills examinations. Departmental recognition of graduating seniors. Life as an alumnus - expectations and obligations. Convocation and commencement information. Offered on a satisfactory-fail basis only.

ECON 496. Economics International Travel Course.Cr. 1-3. Repeatable, maximum of 6 credits. *Prereq: Sophomore status; permission of instructor.*

Tour and study of international agricultural and/or nonagricultural economies, markets, and institutions. Locations and duration of tours will vary. Limited enrollment.

Meets International Perspectives Requirement.

ECON 498. Cooperative Education.Cr. R. *Prereq: Permission of the department cooperative education coordinator; senior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduates:

ECON 500. Quantitative Methods in Economic Analysis I.(4-0) Cr. 4. F. *Prereq: ECON 301, 1 year of calculus, STAT 401, and permission of Director of Graduate Education*

Economic applications of selected mathematical and statistical concepts: linear models and matrix algebra; differential calculus and optimization; integral calculus and economic dynamics; probability distributions, estimation, and hypothesis testing in the analysis of economic data.

ECON 501. Microeconomics.(4-0) Cr. 4. F. *Prereq: ECON 301, credit or enrollment in ECON 500 or equivalent background in calculus and statistics*

The theory of the consumer, theory of the firm, perfect and imperfect competition, welfare economics, and selected topics in general equilibrium and uncertainty.

ECON 502. Macroeconomics.(4-0) Cr. 4. F. *Prereq: ECON 302, credit or enrollment in ECON 500 or equivalent background in calculus and statistics*

Models of aggregate supply and demand, theories of consumption and investment, money supply and demand, inflation, rational expectations, stabilization policy, financial markets, and international finance.

ECON 509. Applied Numerical Methods in Economics.(2-2) Cr. 3. *Prereq: ECON 500, ECON 501; or ECON 600, ECON 601*

Use of numerical techniques to solve economic problems. Numerical differentiation and integration numeric solutions of systems of equations, static and dynamic optimization problems including unconstrained optimization, maximum likelihood methods, general nonlinear programming methods, dynamic programming and optimal control, numerical methods for solving functional equations.

ECON 510. Experimental Economics.(3-0) Cr. 3. *Prereq: ECON 501 or ECON 601*

Introduction to experimental economics and major subject areas addressed by laboratory and field experiments. Exploration of experimental methods by concentrating on series of experiments. Applications include individual decision-making, behavioral game theory, markets, behavioral labor, public and development economics, social network, and neuroeconomics. Research project.

ECON 520. Labor Supply and Human Capital Formation.(3-0) Cr. 3. *Prereq: ECON 501 or ECON 601*

Labor supply decisions and empirical analysis for agricultural operators and other self-employed and wage-earning households; multiple job holding; resource allocation in productive households; human capital formation by households, firms, and public institutions, which includes schooling, on-the-job training, migration, health, research, raising of children, and implications for household income and welfare; applications to problems in rural areas of developing and developed countries.

ECON 521. Labor Markets.(3-0) Cr. 3. *Prereq: ECON 501 or ECON 601*

Analysis of labor demand and market determination of wages and employment; analysis of distortions in labor markets due to non-competitive forces, legislation, and discrimination; wage inequality, compensation and work incentives; compensating differentials; microeconomic analysis of unemployment and job search.

ECON 532. Managerial Economics for the Global Organization.(3-0) Cr. 3. *Prereq: ECON 101 and enrollment in MBA or BAS program; not for economics majors*

Applications of microeconomic theory and decision analysis for firms operating in U.S. and internationally. Topics include demand & supply, consumer choice theory, production and cost theory, short run and long run business decisions, input cost and human capital differences across countries, empirical estimation of demand and supply, pricing, exchange rates, government and business, market structures and strategy.

ECON 533. Economic and Business Decision Tools.(Cross-listed with BUSAD). (3-0) Cr. 3. *Prereq: ECON 501 or ECON 532*

Team taught by faculty in the Department of Economics and the College of Business, this course focuses on applied economic and business tools for decision making. The topics include: Monte Carlo analysis with applications to option pricing and insurance mechanism design, portfolio analysis using existing standard spreadsheet software and add-ons, dynamic programming tools for inventory management and sequential decisions, discrete choice modeling and statistical bootstrapping, and financial performance evaluation using commercially available software.

ECON 537. Commodity Markets: Analysis and Strategy.(3-0) Cr. 3. *Prereq: ECON 501 or ECON 532 or ECON 601, ECON 571 or STAT 326*

Analysis of exchange-traded and over-the-counter commodity markets, their functions and performance. Evaluation of hedging, speculation, and arbitrage strategies. Commodity transformation over space and time. Valuation of derivatives and comparison with derivatives on financial assets. Efficiency and the role of information in commodity markets. Market regulation.

ECON 545. Public Economics.(3-0) Cr. 3. *Prereq: ECON 501 or ECON 601*

Optimal taxation; excess burden; partial and general equilibrium analysis of tax incidence; social insurance; effects of taxation on labor supply and savings; economics of the health sector.

ECON 553. Applied Research in Monetary and Macroeconomics.(3-0) Cr. 3. *Prereq: ECON 502, ECON 571*

Application of economic theory to the analysis of contemporary issues in macroeconomics, monetary economics, and financial economics.

ECON 555. Issues in International Economics.(3-0) Cr. 3. *Prereq: ECON 501, ECON 502*

Theories of international trade and finance. Emphasis on current policy issues in international economics.

ECON 560. Agricultural, Food, and Trade Policy.(Dual-listed with ECON 460). (3-0) Cr. 3. *Prereq: ECON 301 or ECON 501*

Description and analysis of economic problems of U.S. agriculture. Explanation and economic analysis of government policies and programs to develop agriculture, conserve agricultural resources, address consumer food concerns, stabilize farm prices, and raise farm incomes. The influence of macropolicy, world economy, international trade, and bioenergy on U.S. agriculture.

ECON 571. Intermediate Econometrics.(3-0) Cr. 3. S. *Prereq: ECON 500*

Single and multiple equation regression models; dummy explanatory variables; serial correlation; heteroskedasticity; distributed lags; qualitative dependent variables; simultaneity. Use of econometric models for tests of economic theories and forecasting.

ECON 576. Spatial Economics.(3-0) Cr. 3. *Prereq: ECON 501 or ECON 601*

Analysis of location choice by firms, employees, and households emphasizing the role of spatial variations in agglomeration economies, economies of scale, distance, transport, endowments, amenities, and local government. Models of land use, urban form, spatial competition, central place theory, and migration. Techniques of discrete choice analysis, statistical analysis of categorical data, urban system modeling, and interregional computable general equilibrium.

ECON 580. Intermediate Environmental and Resource Economics.(Dual-listed with ECON 480). (3-0) Cr. 3. *Prereq: ECON 301 or ECON 501*

Theories of natural resource utilization and allocation. Externalities, public goods, and environmental quality. Renewable energy, biofuels, land use change and life cycle analysis of carbon, and sustainability and resource conservation. Methodologies for analyzing natural resource and environmental problems and evaluating resource policies.

ECON 581. Advanced Environmental Economics.(3-0) Cr. 3. *Prereq: ECON 501 or ECON 601*

Interrelationships of natural resource use and the environment. Applied welfare and benefit-cost analyses. Externalities and pollution abatement. Nonmarket valuation of resources. Property rights. Legal and social constraints. Policy approaches.

ECON 590. Special Topics.

Cr. 1-5. Repeatable.

Offered on a satisfactory-fail basis only.

ECON 599. Creative Component.

Cr. 1-5.

Offered on a satisfactory-fail basis only.

Courses for graduate students:**ECON 600. Quantitative Methods in Economic Analysis II.**(4-1) Cr. 4. F. *Prereq: ECON 500*

Unconstrained and equality- and inequality-constrained optimization; the Kuhn-Tucker formulation; abstract spaces; dynamic programming; dynamical systems.

ECON 601. Microeconomic Analysis I.(4-1) Cr. 4. F. *Prereq: ECON 301, previous or concurrent enrollment in 600 and permission of Director of Graduate Education*

Economic theory and methodology; theory of consumer behavior, theory of the competitive firm, supply and factor demand; duality relations in consumer and producer theory, welfare change measures; partial equilibrium analysis, perfect competition, monopoly; choice under uncertainty, the expected utility model, risk aversion; insurance, portfolio and production decisions under risk.

ECON 602. Macroeconomic Analysis.(4-1) Cr. 4. S. *Prereq: ECON 301, ECON 302, previous or concurrent enrollment in 600 and permission of Director of Graduate Education*

Neoclassical aggregate growth models; the overlapping generations model; endogenous growth models; equilibrium business cycle theories; equilibrium job search and matching; models of money; fiscal and monetary policy; income and wealth distribution.

ECON 603. Microeconomic Analysis II.(4-1) Cr. 4. S. *Prereq: ECON 601, ECON 602 and permission of Director of Graduate Education*

General equilibrium analysis, efficiency, and welfare; market failures, externalities, and the theory of the second best; introduction to game theory; adverse selection, signaling, screening and moral hazard.

ECON 604. Advanced Macroeconomic Analysis.

(4-1) Cr. 4. F. *Prereq:* ECON 601, ECON 602 and permission of Director of Graduate Education

Topics will be selected from: new Keynesian approaches to business cycle theory; endogenously generated business cycles; models of credit and financial intermediation; mechanism design and time inconsistency issues; political economy models; heterogeneous-agent models with strategic interaction; path dependence, network effects, and lock-in; economies as evolving self-organizing systems.

ECON 605. Advanced Topics in Microeconomics.

(3-0) Cr. 3. *Prereq:* ECON 603

Selected topics in microeconomic theory of current significance to the profession.

ECON 606. Advanced Topics in Macroeconomics.

(3-0) Cr. 3. *Prereq:* ECON 603, and credit or current enrollment in ECON 604

Selected topics in macroeconomic theory of current significance to the profession.

ECON 615. Theoretical Industrial Organization.

(3-0) Cr. 3. *Prereq:* ECON 603

Theoretical analysis of traditional topics in industrial organization. Review of game theory. Monopoly and oligopoly theory, price discrimination, product differentiation, research and development, diffusion of innovation, network externalities, and asymmetric information.

ECON 616. Empirical Methods in Industrial Organization.

(3-0) Cr. 3. *Prereq:* ECON 603, ECON 671

Empirical methods in industrial organization. Measurement of market power. Discrete choice models of product differentiation. Empirical studies of price dynamics, entry, collusion, price discrimination, technology adoption, asymmetric information, and auctions.

ECON 618. Game Theory.

(3-0) Cr. 3. *Prereq:* ECON 603, or ECON 501 and permission of instructor

Theoretical analysis and applications of strategic games, extensive form games, and cooperative games. Nash equilibrium, correlated equilibrium, Bayesian games, subgame perfect equilibrium, the core, evolutionary equilibrium, repeated games with finite automata, and common knowledge.

ECON 641. Agricultural Economics I.

(3-0) Cr. 3. *Prereq:* ECON 603

Demand and supply for agricultural products, market equilibrium models, implications of government policies on the agricultural sector, evaluation of research and development policies in agriculture, and biofuel and energy policy analysis. Commodity promotion programs, food safety and consumers' valuation of product attributes.

ECON 642. Agricultural Economics II.

(3-0) Cr. 3. *Prereq:* ECON 603

Advanced treatment of topics and models in agricultural economics with emphasis on stochastic models. Topics will include analysis of risk in decision making by consumers, firms and farms; analysis of risk management strategies for farmers; the economics of commodity storage; analysis of the impact of biofuels on commodity prices; and models of agricultural inputs and outputs.

ECON 653. Financial Economics.

(3-0) Cr. 3. *Prereq:* ECON 603, ECON 672. *Recommended:* ECON 674, STAT 551

Review of decision-making under uncertainty. Portfolio Theory. Theoretical foundations of asset valuation models: capital asset pricing model (CAPM), arbitrage pricing theory (APT), representative agent models, pricing of derivative securities. Complete and incomplete asset markets, credit markets, financial intermediaries, the role of government in the financial sector. Market frictions, crashes, bubbles. Applications of asset valuation models, with emphasis on their testable implications.

ECON 655. International Trade.

(3-0) Cr. 3. *Prereq:* ECON 603

Theories of international trade; welfare and distributional aspects of trade and commercial policies. Optimal trade policies in the presence of domestic distortions; strategic trade policy; international trade and economic growth.

ECON 657. International Finance.

(3-0) Cr. 3. *Prereq:* ECON 602

The intertemporal approach to current account determination; non-traded goods and the real exchange rate; fiscal policy in the open economy; monetary approach to balance of payments and exchange rate determination; sticky price models of the open economy; exchange-rate based stabilizations; capital inflows; financial and balance of payments crises; international business cycles.

ECON 671. Econometrics I.

(4-1) Cr. 4. F. *Prereq:* ECON 501 and STAT 447 or STAT 542

Probability and distribution theory for univariate and multivariate normal random variables, introduction to the theory of estimators for linear models, hypothesis testing and inference, introduction to large sample properties of estimators; derivation of common estimators and their properties for the classical and general multiple regression models, hypothesis testing, forecasting, implications of specification errors - missing data, left-out regressors, measurement error, stochastic regressors.

ECON 672. Econometrics II.

(4-1) Cr. 4. S. *Prereq:* ECON 671

Identification, estimation, and evaluation of systems of simultaneous equations; qualitative choice and limited dependent variable models; introduction to time series methods and applications, including alternative variance specifications.

ECON 673. Microeconometrics.

(3-0) Cr. 3. *Prereq:* ECON 672, ECON 601

Econometric treatment of models arising in microeconomic applications. Methods are primarily concerned with the analysis of cross-section data. Topics may include: systems of demand equations in panel data settings, random utility models of discrete choices, production possibilities frontier estimation, and discrete/continuous models of participation and consumption.

ECON 674. Macroeconometrics.

(3-0) Cr. 3. *Prereq:* ECON 672, ECON 602

Time-series econometric techniques and their application to macroeconomics and financial markets. Techniques may include GARCH and ARCH-M models, unit-root tests, nonlinear adjustment models, structural VARs, and cointegration tests.

ECON 675. Advanced Topics in Econometrics.

(3-0) Cr. 3. Repeatable. *Prereq:* ECON 672 or STAT 543

Advanced treatment of issues important in econometrics. Topics chosen from asymptotic theory, nonlinear estimation, Bayesian and robust econometrics, econometric time series, limited dependent variables and censored regression models, nonparametric and semiparametric methods, bootstrapping and Monte Carlo techniques, etc.

ECON 680. Advanced Resource Economics.

(3-0) Cr. 3. *Prereq:* ECON 603

Dynamic allocation of scarce, exhaustible, and renewable natural resources, including minerals and energy, soil, water, forests, and fish. Social versus private decisions. Market and nonmarket considerations. Technological change. Regulation. Dynamics and uncertainty.

ECON 690. Advanced Topics.

Cr. 1-5. Repeatable.

Offered on a satisfactory-fail basis only.

ECON 691. Third-Year Paper.

Cr. 3.

Under the direction of the major professor, Ph.D. students write a formal research paper as an introduction to the dissertation research process. Offered on a satisfactory-fail basis only.

ECON 693. Workshops.

Cr. 1-3. Repeatable. *Prereq:* 6 graduate credits in chosen field

Offered on a satisfactory-fail basis only.

ECON 699. Research for Thesis or Dissertation.

Cr. arr. Repeatable.

Offered on a satisfactory-fail basis only.

Educational Administration (EDADM)

Courses primarily for graduate students, open to qualified undergraduates:

EDADM 541. Principles of Educational Leadership.

(3-0) Cr. 3. F.S.SS. *Prereq: Teacher licensure and permission of instructor*
Basic principles of educational organizations, including an understanding of organizational behavior and theoretical approaches to administration. Exploration of substantive elements related to school reform, such as leadership, the change process, current issues in education, and developing a shared vision and mission.

EDADM 551. Supervision for Learning Environments.

(3-0) Cr. 3. F.S.SS. *Prereq: EDADM 541*
Study of effective classroom instructional practices that reflect current principles of learning. Understanding and practice of supervisory techniques that support teachers in improving the teaching and learning process, including skills in observational data collection, data analysis, collaboration, and conferencing skills.

EDADM 552. Current Issues in Site-Level Leadership.

(3-0) Cr. 3. F.S.SS. *Prereq: EDADM 541*
Essential tasks of building-level leadership and management in contemporary school settings, including: curriculum and organizational structure, theory and practice of scheduling, financial management, roles and responsibilities of governance, communication and public relations skills, home/parental involvement and relationships, project and crisis management, technology integration, school climate and culture, effective student support programs such as counseling and guidance, attendance and discipline.

EDADM 554. Leading School Reform.

(3-0) Cr. 3. F.S.SS. *Prereq: EDADM 541*
Study of principles of transformational leadership and collaborative decision-making skills. Leadership activities that facilitate the development of a school culture that embraces change and school reforms that result in high quality schools dedicated to improved student achievement.

EDADM 556. School Systems as Learning Cultures.

(3-0) Cr. 3. F.S.SS. *Prereq: EDADM 541*
Practical and theoretical perspectives on school administrative problems from critical pedagogical studies and research. Exploration of related issues such as cultural literacy, forms of authority and control, and other historical problems of schools in dealing with minorities and culturally different persons.

EDADM 557. Human Resource Development for Learning.

(3-0) Cr. 3. F.S.SS. *Prereq: EDADM 541*
Leadership theory and practice that focuses on the professional development of school staff to promote improved student learning. Principles of school personnel evaluation; legal issues related to hiring, retention, and dismissal; evaluation models for professional and classified staff; and effective professional development models to support lifelong learning and reflective practice.

EDADM 558. Diverse Learning Needs.

(3-0) Cr. 3. F.S.SS. *Prereq: EDADM 541*
Learner needs will be examined from major psycho/social perspectives with stress upon developmental phases of normal growth along with common problems encountered in schools. Issues of racism, gender bias, and socio-economic problems that influence learner responsiveness to school curricula and administrative regulations, routines, and legal requirements.

EDADM 559. Curriculum Leadership.

(3-0) Cr. 3. F.S.SS. *Prereq: EDADM 541*
Generic administrative approaches to the design and delivery of elementary and secondary school curricula including the study of the organizations for learning; cognition and learning theories; validation; concepts of balance; school goals, student assessments and reporting of progress, alignment, and professional development; development of curriculum guides; mapping; employing national standards and benchmarks.

EDADM 575. Education Law and Ethics.

(3-0) Cr. 3. F.S.SS. *Prereq: EDADM 541*
Examination of constitutional, statutory, and judicial provisions as a basis for the legal operation of educational institutions. Rights and ethical responsibilities of school leaders are examined in relation to their roles and responsibilities with boards, other school personnel, and students.

EDADM 590. Special Topics.

Cr. 1-4. Repeatable. *Prereq: 9 credits in education*

EDADM 591. Supervised Field Experience.

Cr. 1-6. Repeatable. *Prereq: EDADM 541 and admission to program and instructor's approval*
Supervised on-the-job field experience in special areas.

EDADM 591A. Supervised Field Experience: Elementary Principal.

Cr. 1-6. Repeatable. *Prereq: EDADM 541 and admission to program and instructor's approval*
Supervised on-the-job field experience in special areas.

EDADM 591B. Supervised Field Experience: Secondary Principal.

Cr. 1-6. Repeatable. *Prereq: EDADM 541 and admission to program and instructor's approval*
Supervised on-the-job field experience in special areas.

EDADM 593. Workshops.

Cr. 1-4. *Prereq: 9 credits in education*

EDADM 599. Creative Component Development.

Cr. 1-3. *Prereq: 9 credits in educational administration*

Courses for graduate students:

EDADM 615. Seminar.

Cr. 1-3. Repeatable.
In-depth study of administrative topics of contemporary interest and importance.

EDADM 615A. Seminar: Client Focus.

Cr. 1-3. Repeatable.
In-depth study of administrative topics of contemporary interest and importance.

EDADM 615B. Seminar: Research.

Cr. 1-3. Repeatable.
In-depth study of administrative topics of contemporary interest and importance.

EDADM 615C. Seminar: Quality Improvement.

Cr. 1-3. Repeatable.
In-depth study of administrative topics of contemporary interest and importance.

EDADM 615D. Seminar: Special Services.

Cr. 1-3. Repeatable.
In-depth study of administrative topics of contemporary interest and importance.

EDADM 615E. Seminar: Assessment.

Cr. 1-3. Repeatable.
In-depth study of administrative topics of contemporary interest and importance.

EDADM 615F. Seminar: Leadership.

Cr. 1-3. Repeatable.
In-depth study of administrative topics of contemporary interest and importance.

EDADM 620. Program Induction Leadership Seminar.

(3-0) Cr. 3. SS. *Prereq: EDADM 541*
Assessment of candidate skill areas, including communication, leadership, technology, and team facilitation for the development of an individualized learning plan for the program. Orientation to program expectations and leadership challenges in the context of schooling for a global society.

EDADM 621. Aligning the System for Student Achievement.

(5-0) Cr. 5. F. *Prereq: EDADM 541*
Alignment of system goals and leadership theory with student achievement, governance, systems thinking, and communication and collaboration with various publics.

EDADM 622. Maximizing Human and Financial Resources for Student Achievement.

(3-0) Cr. 3. S. *Prereq: EDADM 541*
Allocation of system resources to enhance student achievement; human resource development and negotiations; and coaching and evaluating the administrative team.

EDADM 623. Mid-Program Leadership Seminar.

(1-0) Cr. 1. SS. *Prereq: EDADM 541*
Mid-program assessment of candidate progress and exploration of leadership strategies for working with diverse populations.

EDADM 624. School Finance.

(2-0) Cr. 2. SS. *Prereq: EDADM 541*
General issues of school finance and managing school financial affairs. Role of the federal, state and local governments in educational finance, tax issues, and structures; bonding; budget procedures; and non-public school finance issues. Includes attendance at selected sessions of the Iowa School Business Management Academy in May and two additional class sessions.

EDADM 631. Achieving Results Through Accountability Strategies.

(5-0) Cr. 5. F. *Prereq: EDADM 541*

Accountability strategies for applying leadership theory to student achievement, governance, systems thinking, change agency, and communication and collaboration with various publics.

EDADM 632. Using System Assets to Create a Culture of Learning.

(3-0) Cr. 3. S. *Prereq: EDADM 541*

Leadership strategies to promote a culture of high student achievement; effective human capital management, including recruitment and induction of new personnel; and effective communication with parents and other patrons.

EDADM 633. Career Induction Leadership Seminar.

(1-0) Cr. 1. SS. *Prereq: EDADM 541*

Development of entry plan for creating a culture of collaboration; professional growth plan for first year in new position; and authentic performance assessment of values and beliefs platform.

EDADM 634. School Business Management and Accountability.

(2-0) Cr. 2. SS. *Prereq: EDADM 541*

Management of school operations; accountability and ethical business practices; risk management; school plant operations, food service and student transportation. Includes attendance at selected sessions of the Iowa School Business Management Academy in May and two additional class days.

EDADM 690. Advanced Special Topics.

Cr. 1-3. Repeatable. *Prereq: 9 credits in educational administration*

EDADM 691. Clinical Dilemmas of Practice.

Cr. 1-3. Repeatable, maximum of 3 credits. *Prereq: EDADM 541, admission to program, and instructor's approval*

Supervised on-the-job field leadership experience in clinical dilemmas of practice. Offered on a satisfactory-fail basis only.

EDADM 699. Dissertation Research.

Cr. arr. Repeatable. *Prereq: 9 credits in education*

Educational Leadership and Policy Studies (EL PS)

Courses primarily for graduate students, open to qualified undergraduates:

EL PS 591. Social Justice Field Experience.

Cr. 1-3. F.S.SS. *Prereq: EL PS 620*

Supervised field experience in equity and social justice inside/outside higher education.

Courses for graduate students:

EL PS 615. Thematic Seminars.

Cr. 1. F.S.SS. *Prereq: Admission to educational leadership doctoral program*

EL PS 615A. Thematic Seminars: Communication and Team Building.

Cr. 1. F.S.SS. *Prereq: Admission to educational leadership doctoral program*

EL PS 615B. Thematic Seminars: Governance, Politics and Policies.

Cr. 1. F.S.SS. *Prereq: Admission to educational leadership doctoral program*

EL PS 615C. Thematic Seminars: Law, Equity, Equality.

Cr. 1. F.S.SS. *Prereq: Admission to educational leadership doctoral program*

EL PS 615D. Thematic Seminars: Ethics, Justice, and Caring.

Cr. 1. F.S.SS. *Prereq: Admission to educational leadership doctoral program*

EL PS 615E. Thematic Seminars: Problem Solving and Planning.

Cr. 1. F.S.SS. *Prereq: Admission to educational leadership doctoral program*

EL PS 615F. Thematic Seminars: Critical and Creative Thinking.

Cr. 1. F.S.SS. *Prereq: Admission to educational leadership doctoral program*

EL PS 616. Capstone Experience.

Cr. 3. F.S. *Prereq: 4 credits of EL PS 615*

This experience is designed to explore a topic addressed in one of the thematic seminars. The product of the capstone experience is a written paper of sufficient quality to be submitted to a scholarly journal for review.

EL PS 620. Social Justice Theory, Research, and Practice.

(3-0) Cr. 3. F.

Introduction to social justice theory, research, and practice from a variety of theoretical perspectives in the context of higher education and broader society.

EL PS 621. Pedagogies of Dissent: Radical Theories of Education, Social Justice, and Economic Democracy.

(Cross-listed with W S). (3-0) Cr. 3. S. *Prereq: EL PS 620*

Critical examination of the philosophical foundations of education that seek to challenge the status quo and advance radical educational change. Exploration of macro-level (and some micro-level) issues relevant to educational change, in relation to how they inform practices of dissent and every day social relations.

EL PS 622. Decolonizing Praxis: Anti/post-colonial Theory, Research and Practice.

(3-0) Cr. 3. S. *Prereq: EL PS 620*

Critically probes the philosophical and historical foundations of anti/post-colonial theory. Examination of policy, social, theoretical and educational issues from an anti/post-colonial perspective.

EL PS 624. Critical Race Theory in Higher Education.

Cr. 1-3. SS.

Exploration of the central tenets of critical race theory. Examination of policy, social and educational issues from a critical race perspective.

EL PS 625. Sexual Orientation Issues in Higher Education.

Cr. 1-3. SS.

Exploration of issues related to sexual orientation in higher education. Examination of individual and environmental factors that influence students' success in college. Development of intervention strategies to enhance the college experience for lesbian, gay, and bisexual students.

EL PS 626. Social Justice and Social Change in Higher Education.

(3-0) Cr. 3. F. *Prereq: EL PS 621*

An examination of how changes in the interest of social justice have occurred historically in American higher education. Exploration of social movements and theories of social change.

Electrical Engineering (E E)

Courses primarily for undergraduates:

E E 166. Professional Programs Orientation.

(Cross-listed with CPR E). Cr. R. F.S.

(1-0) Overview of the nature and scope of electrical engineering and computer engineering professions. Overview of portfolios. Departmental rules, advising center operations, degree requirements, program of study planning, career options, and student organizations.

E E 185. Introduction to Electrical Engineering and Problem-Solving I.

(2-2) Cr. 3. F.S. *Prereq: Credit or enrollment in MATH 142*

Project based examples from electrical engineering. Systematic thinking process for engineering problem solving. Group problem solving. Mathematical, conceptual and computer based projects. Solving engineering problems and presenting solutions through technical reports and oral presentations. Solutions of engineering problems using computation tools and basic programming.

E E 186. Introduction to Electrical Engineering and Problem Solving II.

(0-2) Cr. 1. S. *Prereq: E E 185*

Project based and hands on continuation of 185. Group skills needed to work effectively in teams. Individual interactive skills for small and large groups. Learning to use tools and methods for solving electrical engineering problems.

E E 188. Bio-Electrical Engineering Fundamentals Laboratory.

(1-3) Cr. 2. *Prereq: E E 185 or equivalent*

Fundamental laboratory based course in bio-electrical engineering with an emphasis on acquiring and analyzing biomedical signals to obtain relevant information. Topics covered include an overview of basic medical terminology and anatomy, labs illustrating data acquisition from different body systems, and an introduction to statistical significance and its relationship to biological variability.

E E 201. Electric Circuits.

(3-3) Cr. 4. F.S. *Prereq: Credit or registration in MATH 267 and PHYS 222*

Emphasis on mathematical tools. Circuit elements (resistors, inductors, capacitors) and analysis methods including power and energy relationships. Network theorems. DC, sinusoidal steady-state, and transient analysis. AC power. Frequency response. Two port models. Diodes, PSPICE. Laboratory instrumentation and experimentation. Credit for only E E 201 or 442 may be used towards graduation.

E E 224. Signals and Systems I.

(3-3) Cr. 4. F.S. *Prereq: E E 201, MATH 267, PHYS 222*

Mathematical preliminaries. Introduction to signals and systems. Signal manipulations. System properties. LTI systems, impulse response and convolution. Fourier Series representation and properties. Continuous and discrete-time Fourier Transforms and properties. Sampling and reconstruction. Modulation and demodulation. Applications and demonstrations using Matlab.

E E 230. Electronic Circuits and Systems.

(3-3) Cr. 4. F.S. *Prereq: E E 201, MATH 267, PHYS 222*

Frequency domain characterization of electronic circuits and systems, transfer functions, sinusoidal steady state response. Time domain models of linear and nonlinear electronic circuits, linearization, small signal analysis. Stability and feedback circuits. Operational amplifiers, device models, linear and nonlinear applications, transfer function realizations. A/D and D/A converters, sources of distortions, converter linearity and spectral characterization, applications. Design and laboratory instrumentation and measurements.

E E 261. Transfer Orientation.

(Cross-listed with CPR E). Cr. R.

Introduction to the College of Engineering and the engineering profession specifically for transfer students. Information concerning university and college policies, procedures, and resources. Offered on a satisfactory-fail basis only.

E E 285. Problem Solving Methods and Tools for Electrical Engineering.

(3-3) Cr. 4.

Integration of field-specific computational tools for practically solving electrical engineering problems. Methods for systematically reducing problems into sequential steps compatible with computer based tools. Structuring computer programs for efficiency and maintainability. Integration of multi-platform operating systems and multi-vendor tools for solving engineering problems. Hands-on laboratory experiences using Matlab, C, and other computational tools.

E E 294. Program Discovery.

(Cross-listed with CPR E). Cr. R. *Prereq: CPR E 166 or E E 166*

The roles of professionals in computer and electrical engineering. Relationship of coursework to industry and academic careers. Issues relevant to today's world. Offered on a satisfactory-fail basis only.

E E 298. Cooperative Education.

Cr. R. F.S.S.S. *Prereq: Permission of department and Engineering Career Services*

First professional work period in the cooperative education program. Students must register for this course before commencing work.

E E 303. Energy Systems and Power Electronics.

(3-0) Cr. 3. F.S. *Prereq: MATH 267, Phys 222. Credit or registration in E E 224 and E E 230*

Structure of competitive electric energy systems. System operation and economic optimization. Mutual inductance, transformers. Synchronous generators. Balanced three-phase circuit analysis and power calculations. Network calculations and associated numerical algorithms. Two-port circuits. Voltage regulation. Resonance and power factor correction. DC and induction motors. Power electronic circuit applications to power supplies and motor drives.

E E 311. Electromagnetic Fields and Waves.

(4-0) Cr. 4. F.S. *Prereq: E E 201, MATH 265, PHYS 222, credit or registration in MATH 267*

Fundamentals and applications of electric and magnetic fields and materials. Electrostatics and magnetostatics, potentials, capacitance and inductance, energy, force, torque. Uniform plane electromagnetic waves, Poynting vector. Transmission lines: transient and sinusoidal steady-state conditions, reflection coefficient.

E E 314. Electromagnetics for non Electrical Engineers.

(3-0) Cr. 3. *Prereq: PHYS 222, PHYS 112, or equivalent*

Conceptual study of electromagnetism and its application in engineering and related fields. EM fundamentals, EM spectrum, radiation, radiating systems, wireless, modern concepts of physics, quantum computing, transmission lines, high speed effects, waveguides, GPS and other related phenomena will be discussed and explained with the application in mind.

E E 321. Communication Systems I.

(3-0) Cr. 3. F. *Prereq: E E 224*

Frequency domain analysis, spectral filtering, bandwidth. Linear modulation systems. Angle modulation systems. Phase locked loop, super-heterodyne receiver. Sampling and pulse code modulation. Digital data transmission, line coding, pulse shaping, multiplexing.

E E 322. Probabilistic Methods for Electrical Engineers.

(Cross-listed with STAT). (3-0) Cr. 3. F.S. *Prereq: E E 224*

Introduction to probability with applications to electrical engineering. Sets and events, probability space, conditional probability, total probability and Bayes' rule. Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, moments, moment generating functions, multiple random variables, functions of random variables. Elements of statistics, hypothesis testing, confidence intervals, least squares. Introduction to random processes.

E E 323. Introduction to Digital Signal Processing.

(3-3) Cr. 4. *Prereq: E E 224*

Sampling and reconstruction. Concepts and mathematical tools in discrete-time signal processing with examples from digital signal processing and communications. Discrete-time correlation and matched-filter receivers. Discrete Fourier transform (DFT). Fast Fourier algorithms. Z transforms. Design of finite impulse response (FIR) and infinite impulse response (IIR) filters. Realizations of discrete-time systems and quantization effects. Multi-rate signal processing. Laboratory experiments illustrating DSP implementations and applications.

E E 324. Signals and Systems II.

(3-3) Cr. 4. F.S. *Prereq: E E 224*

Laplace and z-Transforms, properties and inverses. Applications to LTI systems and analog/digital filters. Feedback systems and stability. State-space representation and analysis.

E E 330. Integrated Electronics.

(Cross-listed with CPR E). (3-3) Cr. 4. *Prereq: E E 201, credit or enrollment in E E 230, CPR E 281*

Semiconductor technology for integrated circuits. Modeling of integrated devices including diodes, BJTs, and MOSFETs. Physical layout. Circuit simulation. Digital building blocks and digital circuit synthesis. Analysis and design of analog building blocks. Laboratory exercises and design projects with CAD tools and standard cells.

E E 332. Semiconductor Materials and Devices.

(Cross-listed with MAT E). (3-0) Cr. 3. S. Prereq: PHYS 222; MAT E majors: MAT E 317; CPR E and E E majors: E E 230

Introduction to semiconductor material and device physics. Quantum mechanics and band theory of semiconductors. Charge carrier distributions, generation/recombination, transport properties. Physical and electrical properties and fabrication of semiconductor devices such as MOSFETs, bipolar transistors, laser diodes and LED's.

E E 336. Biomedical Instrumentation.

(2-2) Cr. 3. Prereq: E E 188, E E 224, E E 230

Principles and practices of biomedical instrumentation. Topics include: the physics and measurement of biopotentials including electrocardiography (EKG), electromyography (EMG) and electro-oculography (EOG), mechanical and chemical sensors, amplifiers and filters, recording and processing biological signals from nerve cells, muscles and human body, electrode polarization, surface electrodes, power line interference, heart sound sensors, respiratory gas concentration, blood-gas sensors, noninvasive blood-gas sensors.

E E 351. Analysis of Energy Systems.

(3-0) Cr. 3. Prereq: PHYS 222

Energy-scientific, engineering and economic foundations. Energy utilization-global and national. Sectoral analysis of energy consumption. Relationship of energy consumption and production to economic growth and environment. Technology for energy production. Economic evaluation of energy utilization and production. Scientific basis for global warming. Environmental impact of energy production and utilization. Renewable energy.

Meets International Perspectives Requirement.

E E 388. Sustainable Engineering and International Development.

(Cross-listed with A B E, C E). (2-2) Cr. 3. F. Prereq: Junior classification in engineering

Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernment organizations (NGOs). Course readings, final project/design report.

Meets International Perspectives Requirement.

E E 391. Open Laboratory and Design Studio.

(2-2) Cr. 2. Prereq: E E 224

Studio-based activity (guided problem-based learning and design) focusing on elements of design, measurement, data capture, and data interpretation. Team building, engineering professionalism, engineering process of review and critique, and presentation. Open design activities that may include working with other studios.

E E 394. Program Exploration.

(Cross-listed with CPR E). Cr. R. Prereq: CPR E 294 or E E 294

Exploration of academic and career fields for electrical and computer engineers. Examination of professionalism in the context of engineering and technology with competencies based skills. Introduction to professional portfolio development and construction. Offered on a satisfactory-fail basis only.

E E 396. Summer Internship.

Cr. R. Repeatable. SS. Prereq: Permission of department and Engineering Career Services

Summer professional work period. Students must register for this course before commencing work.

E E 397. Engineering Internship.

Cr. R. Repeatable. F.S. Prereq: Permission of department and Engineering Career Services

One semester maximum per academic year professional work period. Students must register for this course before commencing work.

E E 398. Cooperative Education.

Cr. R. F.S.SS. Prereq: E E 298, permission of department and Engineering Career Services

Second professional work period in the cooperative education program. Students must register for this course before commencing work.

E E 414. Microwave Engineering.

(Dual-listed with E E 514). (3-3) Cr. 4. F. Prereq: E E 230, E E 311

Principles, analyses, and instrumentation used in the microwave portion of the electromagnetic spectrum. Wave theory in relation to circuit parameters. S parameters, couplers, discontinuities, and microwave device equivalent circuits. RF amplifier design, microwave sources, optimum noise figure and maximum power designs. Microwave filters and oscillators.

E E 417. Electromagnetic Radiation, Antennas, and Propagation.

(Dual-listed with E E 517). (3-3) Cr. 4. S. Prereq: E E 311

Fundamental antenna concepts. Radiation from wire-and aperture-type sources. Radio transmission formulas. Wave and antenna polarization. Antenna arrays. Modern antenna topics. Practical antenna design. Antenna noise. Radiowave propagation in the presence of the earth and its atmosphere. Antenna measurements and computer aided analysis.

E E 418. High Speed System Engineering Measurement and Testing.

(Cross-listed with CPR E). (3-2) Cr. 4. F. Prereq: E E 230 and E E 311

Measurement of high speed systems and mixed signal systems. Measurement accuracy and error. Network analysis and spectrum analysis used in high speed measurement and testing. Test specification process and parametric measurement. Sampling and digital signal processing concepts. Design for testability. Testing equipment. Applications.

E E 422. Communication Systems II.

(3-0) Cr. 3. Prereq: E E 321 and enrollment in E E 423

Introduction to probability and random processes; Performance of analog systems with noise; Performance of digital communication with noise; optimum receivers, transmission impairments, and error rates; Introduction to information theory and coding: source coding, channel coding, channel capacity.

E E 423. Communication Systems Laboratory.

(0-3) Cr. 1. Prereq: E E 321, enrollment in E E 422

Construction and evaluation of modulators, demodulators and other components for analog and digital communications. Design, simulate, and evaluate wireless communication systems and their key components. Noise measurement.

E E 432. Microelectronics Fabrication Techniques.

(Dual-listed with E E 532). (Cross-listed with MAT E). (2-4) Cr. 4. Prereq: PHYS 222, MATH 267. E E 332 or MAT E 317 recommended

Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS ICs and micro-electro-mechanical systems (MEMS).

E E 435. Analog VLSI Circuit Design.

(Cross-listed with CPR E). (3-3) Cr. 4. S. Prereq: E E 324, E E 330, E E 332, and either E E 322 or STAT 330

Basic analog integrated circuit and system design including design space exploration, performance enhancement strategies, operational amplifiers, references, integrated filters, and data converters.

E E 438. Optoelectronic Devices and Applications.

(Dual-listed with E E 538). (3-0) Cr. 3. Prereq: E E 311, E E 332

Transmission and reflection of electromagnetic plane waves. Propagation in dielectric and fiber optic waveguides. LED and laser operating principles and applications. Photodetectors and solar cells. Optical modulation and switching.

E E 439. Nanoelectronics.

(3-0) Cr. 3. S. Prereq: E E 332 or MAT E 334

Concepts of quantum mechanics relevant to nanoelectronic devices, including quantization, tunneling, and transport; overview of some of the leading technologies for nanoelectronics, including carbon nanotubes, quantum dots, and molecular transistors; fabrication methods for building nanoelectronic devices.

E E 442. Introduction to Circuits and Instruments.

(3-2) Cr. 2. F.S. Prereq: PHYS 222, MATH 267

Half-semester course. Basic circuit analysis using network theorems with time domain and Laplace transform techniques for resistive, resistive-inductive, resistive-capacitive, and resistive-inductive-capacitive circuits. Transient circuit behavior. Basic operational amplifiers and applications. Familiarization with common E E instrumentation and demonstration of basic principles. Credit for only 201 or 442 may be counted toward graduation; credit for 442 will not count toward graduation for E E or Cpr E majors.

E E 448. Introduction to AC Circuits and Motors.

(3-2) Cr. 2. F.S. Prereq: E E 442

Half-semester course. Basics of DC machines, stepper motors, AC induction motors, and synchronous generators. AC steady state analysis, transformers, and three-phase circuit analysis.

E E 451. Engineering Acoustics.

(Cross-listed with E M, M E). (2-2) Cr. 3. Alt. S., offered even-numbered years. Prereq: *PHYS 221 and MATH 266 or MATH 267*

Properties of sound waves and noise metrics (pressure, power levels, etc). Sound sources and propagation. Principles of wave propagation in one-, two-, and three-dimensions. Wave reflection and transmission. Wave propagation in rectangular, cylindrical, and annular ducts. Acoustics fields for model noise sources. Introduction to aerodynamic noise sources in aircraft, aircraft engines, and wind turbines. Selected laboratory experiments.

E E 452. Electrical Machines and Power Electronic Drives.

(2-3) Cr. 3. S. Prereq: *E E 303, E E 324*

Basic concepts of electromagnetic energy conversion. DC motors and three-phase induction motors. Basic introduction to power electronics. Adjustable speed drives used for control of DC, induction, and AC motors. Experiments with converter topologies, DC motors, AC motors and adjustable speed drives.

E E 455. Introduction to Energy Distribution Systems.

(3-0) Cr. 3. F. Prereq: *E E 303, credit or registration in E E 324*

Overhead and underground distribution system descriptions and characteristics, load descriptions and characteristics, overhead line and underground cable models, distribution transformers, power flow and fault analysis, overcurrent protection, power factor correction, system planning and automation, and economics in a deregulated environment.

E E 456. Power System Analysis I.

(3-0) Cr. 3. F. Prereq: *E E 303, credit or registration in E E 324*

Power transmission lines and transformers, synchronous machine modeling, network analysis, power system representation, load flow.

E E 457. Power System Analysis II.

(3-0) Cr. 3. S. Prereq: *E E 303, credit or registration in E E 324*

Power system protection, symmetrical components, faults, stability. Power system operations including the new utility environment.

E E 458. Economic Systems for Electric Power Planning.

(Cross-listed with ECON). (3-0) Cr. 3. Prereq: *E E 303 or ECON 301*

Evolution of electric power industry. Power system operation and planning and related information systems. Linear and integer optimization methods. Short-term electricity markets and locational marginal prices. Risk management and financial derivatives. Basics of public good economics. Cost recovery models including tax treatment for transmission investments.

E E 459. Electromechanical Wind Energy Conversion and Grid Integration.

(Dual-listed with E E 559). (3-0) Cr. 3. Prereq: *Credit or enrollment in E E 452, E E 456*

Summary of industry status and expected growth; power extraction from the air stream; operation and modeling of electric machines, and power electronics topologies for wind energy conversion; analysis of machine-grid power electronic circuits, controller interface, and collector (distribution) networks; treatment of harmonics, flicker, over/under-voltages, filters, low-voltage ride-through, and reactive compensation; relaying; effects on transmission expansion, planning and grid operation and coordination including variability, frequency control, reserves, and electricity markets; overview of storage technologies and hybrid configurations.

E E 465. Digital VLSI Design.

(Cross-listed with CPR E). (3-3) Cr. 4. S. Prereq: *E E 330*

Digital design of integrated circuits employing very large scale integration (VLSI) methodologies. Technology considerations in design. High level hardware design languages, CMOS logic design styles, area-energy-delay design space characterization, datapath blocks: arithmetic and memory, architectures and systems on a chip (SOC) considerations. VLSI chip hardware design project.

E E 466. Multidisciplinary Engineering Design.

(Cross-listed with A B E, AER E, CPR E, ENGR, I E, M E, MAT E). (1-4) Cr. 3. Repeatable. F.S. Prereq: *Student must be within two semesters of graduation and permission of instructor.*

Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

E E 467. Multidisciplinary Engineering Design II.

(Cross-listed with AER E, CPR E, ENGR, I E, M E, MAT E). (1-4) Cr. 3. Repeatable, maximum of 2 times. F.S. Prereq: *Student must be within two semesters of graduation or receive permission of instructor.*

Build and test of a conceptual design. Detail design, manufacturability, test criteria and procedures. Application of design tools such as CAD and CAM and manufacturing techniques such as rapid prototyping. Development and testing of a full-scale prototype with appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

E E 475. Automatic Control Systems.

(3-0) Cr. 3. F. Prereq: *E E 324*

Stability and performance analysis of automatic control systems. The state space, root locus, and frequency response methods for control systems design. PID control and lead-lag compensation. Computer tools for control system analysis and design.

E E 476. Control System Simulation.

(2-3) Cr. 3. S. Prereq: *E E 475*

Computer aided techniques for feedback control system design, simulation, and implementation.

E E 488. Eddy Current Nondestructive Evaluation.

(Dual-listed with E E 588). (Cross-listed with MAT E). (3-0) Cr. 3. Alt. F., offered even-numbered years. Prereq: *MATH 265 and (MAT E 216 or MAT E 272 or E E 311 or PHYS 364)*

Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

E E 490. Independent Study.

Cr. arr. Prereq: *Senior classification in electrical engineering*

Investigation of an approved topic commensurate with the student's prerequisites.

E E 490H. Independent Study: Honors.

Cr. arr. Prereq: *Senior classification in electrical engineering*

Investigation of an approved topic commensurate with the student's prerequisites.

E E 491. Senior Design Project I and Professionalism.

(Cross-listed with CPR E). (2-3) Cr. 3. F.S. Prereq: *E E 322 or CPR E 308, completion of 24 credits in the E E core professional program or 29 credits in the Cpr E core professional program, ENGL 314*

Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; design review presentation. First of two-semester team-oriented, project design and implementation experience.

E E 492. Senior Design Project II.

(Cross-listed with CPR E). (1-3) Cr. 2. F.S. Prereq: *CPR E 491 or E E 491*

Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in E E 491 or Cpr E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements; project poster.

E E 494. Portfolio Assessment.

(Cross-listed with CPR E). Cr. R. Prereq: *CPR E 394 or E E 394, credit or enrollment in CPR E 491 or E E 491*

Portfolio update and evaluation. Portfolios as a tool to enhance career opportunities.

E E 496. Modern Optics.

(Cross-listed with PHYS). (3-0) Cr. 3. S. Prereq: *Credit or enrollment in PHYS 322, PHYS 365, and PHYS 480*

Review of wave and electromagnetic theory; topics selected from: reflection/refraction, interference, geometrical optics, Fourier analysis, dispersion, coherence, Fraunhofer and Fresnel diffraction, holography, quantum optics, nonlinear optics.

E E 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. Prereq: *E E 398, permission of department and Engineering Career Services*

Third and subsequent professional work periods in the cooperative education programs. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduates:

E E 501. Analog and Mixed-Signal VLSI Circuit Design Techniques.

(Cross-listed with CPR E). (3-3) Cr. 4. F. *Prereq: E E 435*
 Design techniques for analog and mixed-signal VLSI circuits. Amplifiers; operational amplifiers, transconductance amplifiers, finite gain amplifiers and current amplifiers. Linear building blocks; differential amplifiers, current mirrors, references, cascading and buffering. Performance characterization of linear integrated circuits; offset, noise, sensitivity and stability. Layout considerations, simulation, yield and modeling for high-performance linear integrated circuits.

E E 504. Power Management for VLSI Systems.

(Cross-listed with CPR E). (3-3) Cr. 4. *Prereq: E E 435, Credit or Registration for E E 501*

Theory, design and applications of power management and regulation circuits (Linear and switching regulators, battery chargers, and reference circuits) including: Architectures, Performance metrics and characterization, Noise and stability analysis, Practical implementation and on-chip integration issues, design considerations for portable, wireless, and RF SoCs.

E E 505. CMOS and BiCMOS Data Conversion Circuits.

(Cross-listed with CPR E). (3-3) Cr. 4. Alt. S., offered even-numbered years. *Prereq: E E 501*

Theory, design and applications of data conversion circuits (A/D and D/A converters) including: architectures, characterization, quantization effects, conversion algorithms, spectral performance, element matching, design for yield, and practical comparators, implementation issues.

E E 506. Design of CMOS Phase-Locked Loops.

(Cross-listed with CPR E). (3-3) Cr. 4. *Prereq: E E 435 or E E 501 or instructor approval*

Analysis and design of phase-locked loops implemented in modern CMOS processes including: architectures, performance metrics, and characterization; noise and stability analysis; and design issues of phase-frequency detectors, charge pumps, loop filters (passive and active), voltage controlled oscillators, and frequency dividers.

E E 507. VLSI Communication Circuits.

(Cross-listed with CPR E). (3-3) Cr. 4. Alt. S., offered odd-numbered years. *Prereq: E E 435 or E E 501*

Phase-locked loops, frequency synthesizers, clock and data recovery circuits, theory and implementation of adaptive filters, low-noise amplifiers, mixers, power amplifiers, transmitter and receiver architectures.

E E 508. Filter Design and Applications.

(3-3) Cr. 4. *Prereq: E E 501*

Filter design concepts. Approximation and synthesis. Transformations. Continuous-time and discrete time filters. Discrete, active and integrated synthesis techniques.

E E 509. Mixed-Signal IC Testing and Built In Self Test.

(3-0) Cr. 3. *Prereq: E E 323 or equivalent and E E 435 or E E 501*

Introduction to mixed-signal IC testing; measurement uncertainty and test validity; IEEE standard test algorithms; high performance test and built-in self test challenges; new mixed-signal test algorithms and techniques to reduce data acquisition to relax instrumentation requirements, to simplify test setup, to improve test validity, and/or to enable co-testing of heterogeneous functions.

E E 510. Topics in Electromagnetics.

Cr. 1-3. Repeatable. *Prereq: E E 311*

E E 511. Modern Optical Communications.

(3-0) Cr. 3. S. *Prereq: E E 311*

Propagation in optical media. Optical fibers. Optical sources and detectors. Fiber optic communications systems. DWDM considerations.

E E 512. Advanced Electromagnetic Field Theory I.

(3-0) Cr. 3. F. *Prereq: E E 311*

Review of static electric and magnetic fields. Maxwell's equations. Circuit concepts and impedance elements. Propagation and reflection of plane waves in isotropic media. Guided electromagnetic wave. Characteristics of common waveguides and transmission lines. Propagation in anisotropic media. Special theorems and concepts. Radiation and scattering.

E E 513. Advanced Electromagnetic Field Theory II.

(3-0) Cr. 3. S. *Prereq: E E 512*

Green's functions, perturbational and variational techniques. Analysis of microstrip lines and interconnects. Spectral domain approach, waves in layered media. Integral equations and method of moments. Inverse scattering. Electromagnetic applications.

E E 514. Microwave Engineering.

(Dual-listed with E E 414). (3-3) Cr. 4. F. *Prereq: E E 230, E E 311*

Principles, analyses, and instrumentation used in the microwave portion of the electromagnetic spectrum. Wave theory in relation to circuit parameters. S parameters, couplers, discontinuities, and microwave device equivalent circuits. RF amplifier design, microwave sources, optimum noise figure and maximum power designs. Microwave filters and oscillators.

E E 516. Computational Methods in Electromagnetics.

(3-0) Cr. 3. S. *Prereq: E E 311*

Maxwell's equations. Differential equation based methods. Finite difference and finite difference time domain methods, boundary conditions. Finite element method and applications to the analysis of practical devices. Integral equation based methods. Electric and magnetic field integral equations. Matrix solvers. Fast solution methods.

E E 517. Electromagnetic Radiation, Antennas, and Propagation.

(Dual-listed with E E 417). (3-3) Cr. 4. S. *Prereq: E E 311*

Fundamental antenna concepts. Radiation from wire-and aperture-type sources. Radio transmission formulas. Wave and antenna polarization. Antenna arrays. Modern antenna topics. Practical antenna design. Antenna noise. Radiowave propagation in the presence of the earth and its atmosphere. Antenna measurements and computer aided analysis.

E E 518. Microwave Remote Sensing.

(Cross-listed with AGRON, MTEOR). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: Math 265 or equivalent*

Microwave remote sensing of Earth's surface and atmosphere using satellite-based or ground-based instruments. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, ocean salinity, and soil moisture.

E E 519. Magnetism and Magnetic Materials.

(Cross-listed with M S E). (3-0) Cr. 3. F. *Prereq: E E 311 or MAT E 317 or PHYS 364*

Magnetic fields, flux density and magnetization. Magnetic materials, magnetic measurements. Magnetic properties of materials. Domains, domain walls, domain processes, magnetization curves and hysteresis. Types of magnetic order, magnetic phases and critical phenomena. Magnetic moments of electrons, theory of electron magnetism. Technological application, soft magnetic materials for electromagnets, hard magnetic materials, permanent magnets, magnetic recording technology, magnetic measurements of properties for materials evaluation.

E E 520. Selected Topics in Communications and Signal Processing.

(3-0) Cr. 3. Repeatable.

Space-time processing. Multiuser communications, Wireless Communications, Statistical signal processing. Pattern recognition. Coding theory. Multirate communications and signal processing. Signal processing and communications applications.

E E 521. Advanced Communications.

(3-0) Cr. 3. F. *Prereq: E E 422, credit or enrollment in E E 523*

Digital communication systems overview. Characterization of communication channels. Digital modulation and demodulation design and performance analysis. Channel capacity and error-control coding concepts. Waveform design for band-limited channels. Equalization. Wireless fading channels and performance.

E E 523. Random Processes for Communications and Signal Processing.

(3-0) Cr. 3. *Prereq: E E 322, MATH 317*

Axioms of probability; Repeated trials; Functions of a random variable and multiple random variables: covariance matrix, conditional distribution, joint distribution, moments, and joint moment generating function; Mean square estimation; stochastic convergence; Some important stochastic processes: Random walk, Poisson, Wiener, and shot noise; Markov chains; Power spectral analysis; Selected applications.

E E 524. Digital Signal Processing.

(3-0) Cr. 3. F. *Prereq: E E 322, E E 323, MATH 317*

Review: sampling and reconstruction of signals; discrete-time signals, systems, and transforms. Multi-rate digital signal processing and introduction to filter banks. Optimal linear filtering and prediction. Introductions to adaptive filtering and spectral estimation. Applications.

E E 527. Detection and Estimation Theory.

(3-0) Cr. 3. S. *Prereq: E E 422*

Statistical estimation theory and performance measures: maximum likelihood estimation, Cramer-Rao bound, Bayesian estimation, optimal demodulation, signal design. Introduction to graphical models. Hidden Markov models and Kalman filter. Classical statistical decision theory, decision criteria, binary and composite hypothesis tests. Error probability and Chernoff bound. Applications.

E E 528. Digital Image Processing.(3-0) Cr. 3. S. Prereq: *E E 322, E E 323*

Review of sampling, linear algebra and probability. Classical image processing topics such as image sampling and quantization, image transforms (2D Fourier, KLT, DCT, etc), image enhancement, restoration and filtering. Image analysis topics including edge detection, segmentation, registration and tracking (uses least squares estimation, EM, Kalman filter). Medical image reconstruction from tomographic projections (Radon transform, Fourier slice theorem and reconstruction algorithms using them) and Magnetic Resonance Imaging (MRI). Basic introduction to image and video compression methods.

E E 530. Selected Topics in Electronics, Microelectronics and Photonics.(3-0) Cr. 3. Repeatable. Prereq: *E E 332***E E 532. Microelectronics Fabrication Techniques.**(Dual-listed with E E 432). (2-4) Cr. 4. Prereq: *PHYS 222, MATH 267, E E 332 or MAT E 317 recommended*

Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS ICs and micro-electro-mechanical systems (MEMS).

E E 535. Physics of Semiconductors.(Cross-listed with PHYS). (3-3) Cr. 4. Prereq: *E E 311 and E E 332*

Basic elements of quantum theory, Fermi statistics, motion of electrons in periodic structures, crystal structure, energy bands, equilibrium carrier concentration and doping, excess carriers and recombination, carrier transport at low and high fields, space charge limited current, photo-conductivity in solids, phonons, optical properties, amorphous semiconductors, heterostructures, and surface effects. Laboratory experiments on optical properties, carrier lifetimes, mobility, defect density, doping density, photo-conductivity, diffusion length of carriers.

E E 536. Physics of Semiconductor Devices.(Cross-listed with PHYS). (3-0) Cr. 3. Prereq: *E E 535*

P-n junctions, band-bending theory, tunneling phenomena, Schottky barriers, heterojunctions, bipolar transistors, field-effect transistors, negative-resistance devices and optoelectronic devices.

E E 538. Optoelectronic Devices and Applications.(Dual-listed with E E 438). (3-0) Cr. 3. Prereq: *E E 311, E E 332*

Transmission and reflection of electromagnetic plane waves. Propagation in dielectric and fiber optic waveguides. LED and laser operating principles and applications. Photodetectors and solar cells. Optical modulation and switching.

E E 539. Electronic Properties of Materials.(Cross-listed with M S E). (3-0) Cr. 3. Prereq: *E E 332 or MAT E 334 or PHYS 322*

Review of classical and quantum mechanical descriptions of electrons in solids, band theory, metallic conduction, lattice vibrations, semiconductors, semiconductor devices, dielectrics, polarization, dielectric relaxation, crystal anisotropy, ferroelectricity, piezoelectricity, superconductivity, magnetism, device applications.

E E 547. Pattern Recognition.(3-0) Cr. 3. F. Prereq: *E E 324*

Mathematical formulation of pattern recognition problems and decision functions. Statistical approaches: Bayes classifier, probability density function estimation and expectation minimization. Clustering (supervised and unsupervised), learning, and neural network algorithms. Fuzzy recognition systems. Feature selection systems. Classifier comparison. Current applications.

E E 552. Energy System Planning.(3-0) Cr. 3. Prereq: *E E 456, E E 457 or equivalent*

Characteristics of bulk energy conversion, storage, and transport technologies. Environmental legislation. Modeling of electricity markets. Evaluation of sustainability and resiliency. Types of planning analyses: economic, multi-sector, long-term, national. Planning tools and associated optimization methods.

E E 553. Steady State Analysis.(3-0) Cr. 3. F. Prereq: *E E 456, E E 457*

Power flow, economic dispatch, unit commitment, electricity markets, automatic generation control, sparse matrix techniques, interconnected operation, voltage control.

E E 554. Power System Dynamics.(3-0) Cr. 3. S. Prereq: *E E 456, E E 457, E E 475*

Dynamic performance of power systems with emphasis on stability. Modeling of system components and control equipment. Analysis of the dynamic behavior of the system in response to small and large disturbances.

E E 555. Advanced Energy Distribution Systems.(3-0) Cr. 3. Prereq: *E E 455*

Transient models of distribution components, automated system planning and distribution automation, surge protection, reliability, power quality, power electronics and intelligent systems applications.

E E 556. Power Electronic Systems.(3-0) Cr. 3. Prereq: *E E 452*

Converter topologies, AC/DC, DC/DC, DC/AC, AC/AC. Converter applications to do motor drives, power supplies, AC motor drives, power system utility applications (var compensators) and power quality.

E E 559. Electromechanical Wind Energy Conversion and Grid Integration.(Dual-listed with E E 459). (3-0) Cr. 3. Prereq: *Credit or enrollment in E E 452, E E 456*

Summary of industry status and expected growth; power extraction from the air stream; operation and modeling of electric machines, and power electronics topologies for wind energy conversion; analysis of machine-grid power electronic circuits, controller interface, and collector (distribution) networks; treatment of harmonics, flicker, over/under-voltages, filters, low-voltage ride-through, and reactive compensation; relaying; effects on transmission expansion, planning and grid operation and coordination including variability, frequency control, reserves, and electricity markets; overview of storage technologies and hybrid configurations.

E E 565. Systems Engineering and Analysis.(Cross-listed with AER E, I E). (3-0) Cr. 3. Prereq: *Coursework in basic statistics*

Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated systems. Life cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test and evaluation, and systems engineering planning and organization. Not available for degrees in industrial engineering.

E E 566. Avionics Systems Engineering.(Cross-listed with AER E). (3-0) Cr. 3. S. Prereq: *E E 565*

Avionics functions. Applications of systems engineering principles to avionics. Top down design of avionics systems. Automated design tools.

E E 570. Systems Engineering Analysis and Design.(3-0) Cr. 3. Prereq: *E E 475, E E 577*

Selected topics in abstract algebra, linear algebra, real analysis, functional analysis, and optimization methods in electrical engineering.

E E 571. Introduction to Convex Optimization.

(3-0) Cr. 3.

Introduction to convex optimization problems emerging in electrical engineering. Efficiently solving convex optimization problems with the use of interior point algorithms software. Review of linear algebra, convex functions, convex sets, convex optimization problems, duality, disciplined convex programming, applications to optimal filtering, estimation, control and resources allocations, sensor network, distributed systems.

E E 573. Random Signal Analysis and Kalman Filtering.(Cross-listed with AER E, M E). (3-0) Cr. 3. F. Prereq: *E E 324 or AER E 331 or M E 370 or M E 411 or MATH 341*

Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

E E 574. Optimal Control.(Cross-listed with AER E, M E). (3-0) Cr. 3. S. Prereq: *E E 577*

The optimal control problem. Variational approach. Pontryagin's principle, Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

E E 575. Introduction to Robust Control.(Cross-listed with AER E, M E). (3-0) Cr. 3. Prereq: *E E 577*

Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H2, H_∞, and I1 control problems. Tools for robustness analysis and synthesis.

E E 576. Digital Feedback Control Systems.

(Cross-listed with AER E, M E). (3-0) Cr. 3. F. *Prereq: E E 475 or AER E 432 or M E 411 or MATH 415; and MATH 267*

Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods: root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

E E 577. Linear Systems.

(Cross-listed with AER E, M E, MATH). (3-0) Cr. 3. F. *Prereq: E E 324 or AER E 331 or MATH 415; and MATH 207*

Linear algebra review. Least square method and singular value decomposition. State space modeling of linear continuous-time systems. Solution of linear systems. Controllability and observability. Canonical description of linear equations. Stability of linear systems. State feedback and pole placements. Observer design for linear systems.

E E 578. Nonlinear Systems.

(Cross-listed with AER E, M E, MATH). (3-0) Cr. 3. S. *Prereq: E E 577*

Linear vs nonlinear systems. Phase plane analysis. Bifurcation and center manifold theory. Lyapunov stability. Absolute stability of feedback systems. Input-output stability. Passivity theory and feedback linearization. Nonlinear control design techniques.

E E 588. Eddy Current Nondestructive Evaluation.

(Dual-listed with E E 488). (Cross-listed with M S E). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: MATH 265 and (MAT E 216 or MAT E 272 or E E 311 or PHYS 364)*

Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

E E 590. Special Topics.

Cr. 1-6. Repeatable.

Formulation and solution of theoretical or practical problems in electrical engineering.

E E 590A. Special Topics: Electromagnetic Theory.

Cr. 1-6. Repeatable.

Formulation and solution of theoretical or practical problems in electrical engineering.

E E 590B. Special Topics: Control Systems.

Cr. 1-6. Repeatable.

Formulation and solution of theoretical or practical problems in electrical engineering.

E E 590C. Special Topics: Communication Systems.

Cr. 1-6. Repeatable.

Formulation and solution of theoretical or practical problems in electrical engineering.

E E 590E. Special Topics: Computer Engineering.

Cr. 1-6. Repeatable.

Formulation and solution of theoretical or practical problems in electrical engineering.

E E 590F. Special Topics: Electric Power.

Cr. 1-6. Repeatable.

Formulation and solution of theoretical or practical problems in electrical engineering.

E E 590G. Special Topics: Electrical Materials.

Cr. 1-6. Repeatable.

Formulation and solution of theoretical or practical problems in electrical engineering.

E E 590H. Special Topics: Electronic Devices and Circuits.

Cr. 1-6. Repeatable.

Formulation and solution of theoretical or practical problems in electrical engineering.

E E 590I. Special Topics: Signal Processing.

Cr. 1-6. Repeatable.

Formulation and solution of theoretical or practical problems in electrical engineering.

E E 591. Seminar in Electronics, Microelectronics, and Photonics.

Cr. 1-3. Repeatable.

E E 594. Seminar in Electric Power.

Cr. 1-3. Repeatable.

E E 596. Seminar in Control Systems.

Cr. 1-3. Repeatable.

E E 597. Seminar in Communications and Signal Processing.

Cr. 1. Repeatable.

Offered on a satisfactory-fail basis only.

E E 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:**E E 621. Coding Theory.**

(3-0) Cr. 3. *Prereq: E E 521*

Fundamentals of error-control coding techniques: coding gain, linear block codes. Galois fields. Cyclic codes: BCH, Reed-Solomon. Convolutional codes and the Viterbi algorithm. Trellis-coded modulation. Iterative decoding. Recent developments in coding theory.

E E 622. Information Theory.

(3-0) Cr. 3. *Prereq: E E 521, E E 523*

Information system overview. Entropy and mutual information. Data Compression and source encoding. Discrete memoryless channel capacity. Noisy channel coding theorem. Rate distortion theory. Waveform channels. Advanced topics in information theory.

E E 653. Advanced Topics in Electric Power System Engineering.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

Advanced topics of current interest in electric power system engineering.

E E 674. Advanced Topics in Systems Engineering.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

Advanced topics of current interest in the areas of control theory, stochastic processes, digital signal processing, and image processing.

E E 697. Engineering Internship.

(Cross-listed with CPR E). Cr. R. Repeatable.

One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

E E 699. Research.

Cr. arr. Repeatable.

Engineering (ENGR)

Courses primarily for undergraduates:

ENGR 101. Engineering Orientation.

Cr. R. F.S.

Introduction to the College of Engineering and the engineering profession. Information concerning university and college policies, procedures, and resources. Undeclared sections: Considerations in choosing an engineering curriculum. Opportunities to interact with departments. Declared sections: Introduction to major-specific topics. Offered on a satisfactory-fail basis only.

ENGR 104. LEAD Program Orientation.

(1-0) Cr. 1. F.

Orientation for LEAD Learning/Living Community participants. Introduction to college and university resources, tools and techniques to promote academic, professional and social/cultural development and success. Focus on building support networks with peers, faculty, and staff. Introduction to core engineering competencies including but not limited to initiative, communication, teamwork, and cultural adaptability. Offered on a satisfactory-fail basis only.

ENGR 105. LEAD Program Seminar.

(1-0) Cr. 1. S.

Seminar for LEAD Learning/Living Community participants. Focus on professional development and exposure to various engineering disciplines through hands-on lab experiences, industry visits and networking opportunities with alumni, faculty, and staff. Development of core competencies: engineering/technical knowledge, communication and teamwork. Offered on a satisfactory-fail basis only.

ENGR 131. Learning Community Seminar.

Cr. R. F.S.

Peer-mentored review of course topics in engineering undeclared learning communities. Offered on a satisfactory-fail basis only.

ENGR 150. Foundations of Leadership Development and Learning.

(1-0) Cr. 1. F.S. *Prereq: ELP students only*

Leadership development with focus on global context and awareness of events shaping the context. Exposure to theory of leadership with examples. Necessary characteristics of a leader, and strategies for leadership skills development. Exposure to non-traditional career paths for engineers. Outline of personalized leadership development. Offered on a satisfactory-fail basis only.

ENGR 160. Engineering Problems with Computer Applications Laboratory.

(2-2) Cr. 3. F.S.SS. *Prereq: MATH 143 or satisfactory scores on mathematics placement examinations; credit or enrollment in MATH 165*

Solving engineering problems and presenting solutions through technical reports. Significant figures. Use of SI units. Graphing and curve-fitting. Flowcharting. Introduction to mechanics, statistics and engineering economics. Use of spreadsheet programs to solve and present engineering problems. Solution of engineering problems using computer programming languages. (The honors section includes application of programming to mobile robotics).

ENGR 160H. Engineering Problems with Computer Applications Laboratory.

(2-2) Cr. 3. F.S.SS. *Prereq: MATH 143 or satisfactory scores on mathematics placement examinations; credit or enrollment in MATH 165*

Solving engineering problems and presenting solutions through technical reports. Significant figures. Use of SI units. Graphing and curve-fitting. Flowcharting. Introduction to mechanics, statistics and engineering economics. Use of spreadsheet programs to solve and present engineering problems. Solution of engineering problems using computer programming languages. (The honors section includes application of programming to mobile robotics).

ENGR 260. Engineering: Getting from Thought to Thing.

(3-0) Cr. 3. F.S.

What is engineering, technology and their roles in society? Investigation of engineering methods through case studies of everyday objects. Explore questions about the impact of technology in society. Apply engineering methods to design and failure analysis.

ENGR 265. Survey of the Impacts of Engineering Activity.

(3-0) Cr. 3. F.S.

Survey of the economic, environmental, societal, and political benefits and problems resulting from engineering activity. Effects of engineering projects on human health, social structures, and the environment. Examination of improvements in economic opportunities and quality of life resulting from engineering activity. Case studies of the effects of engineering activity.

ENGR 270. Survey of How Things Work.

(3-0) Cr. 3. F.S.

Removing mysteries surrounding science and technology. Identify key concepts from applied science and technology to obtain better understanding on how things work. Review and explain the principles behind the technologies which define our modern way of life. A survey of broad range of technology could include: cell phones, GPS, radio, television, computers, ultrasound, microwave ovens, automobile, bioengineering and other industrial and consumer technologies. Common day technology examples illustrating scientific knowledge and applications.

ENGR 320. International Experience Report.

Cr. 3. F.S. *Prereq: Satisfactory completion of international work experience of at least ten weeks or nine credits of approved course work taken abroad. Permission of student's department prior to departure*

Critique of work/study abroad experience as it relates to professional development. Taken the semester after completion of work abroad or study abroad. Written report and presentation. Offered on a satisfactory-fail basis only. Meets International Perspectives Requirement.

ENGR 327. Voices of Public Policy.

(3-0) Cr. 3. F. *Prereq: Sophomore classification in engineering*

Role and impact of legislative process, partisan politics, government, lobbyists, the media, expert testimony and grassroots activism on public policy. Critical analysis of context; of claims, assumptions, premises, and evidence of both sides; represented and disenfranchised populations; the ethical issues to develop personal position and courses of action to impact public policy process.

ENGR 340. Introduction to Wind Energy: System Design & Delivery.

(3-0) Cr. 3. F. *Prereq: MATH 166, PHYS 222*

Introduction to wind energy. Economic analysis related to wind energy. Electrical power generation, transmission, and grid operations. Tower, blade and nacelle materials and manufacturing. Tower design. Construction, transportation, supply chain and life cycle analysis for wind turbine components.

ENGR 350. Dean's Leadership Seminar.

(1-0) Cr. 1. F.S. *Prereq: Selection based on demonstrated commitment to leadership development. Sophomore or higher.*

Understanding the complexities of leadership in building an organization, decision-making styles, communication, managing change, building trust, shared responsibility leadership, creating legacy, prioritizing, effective use of authority, conflict, ethics, integrity, transparency, accountability. Offered on a satisfactory-fail basis only. May not apply toward a degree in Engineering

ENGR 396. Summer Internship.

Cr. R. Repeatable. SS. *Prereq: Permission of adviser and Engineering Career Services*

Professional or interdisciplinary work period in engineering or career-related field of a minimum of 10 weeks during the summer. Offered on a satisfactory-fail basis only.

ENGR 397. Professional Internship.

Cr. R. F.S.SS. *Prereq: Permission of adviser and Engineering Career Services*

Professional or interdisciplinary work period in engineering or career-related field. Enrollment limited to one semester and/or one summer per academic year. Offered on a satisfactory-fail basis only.

ENGR 466. Multidisciplinary Engineering Design.

(Cross-listed with A B E, AER E, CPR E, E E, I E, M E, MAT E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and permission of instructor.*

Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

ENGR 467. Multidisciplinary Engineering Design II.

(Cross-listed with AER E, CPR E, E E, I E, M E, MAT E). (1-4) Cr. 3. Repeatable, maximum of 2 times. F.S. *Prereq: Student must be within two semesters of graduation or receive permission of instructor.*

Build and test of a conceptual design. Detail design, manufacturability, test criteria and procedures. Application of design tools such as CAD and CAM and manufacturing techniques such as rapid prototyping. Development and testing of a full-scale prototype with appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

ENGR 490E. Entrepreneurship.

Cr. 1-3. Repeatable, maximum of 3 credits. *Prereq: Junior or senior classification in engineering, college approval*

ENGR 490L. Independent Study.

Cr. 1-3. Repeatable, maximum of 3 credits. F.S.SS.
Leadership.

Engineering Mechanics (E M)

Courses primarily for undergraduates:

E M 274. Statics of Engineering.

(3-0) Cr. 3. F.S.SS. *Prereq: Credit or enrollment in MATH 166; credit or enrollment in PHYS 111 or PHYS 221*

Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, second moments of areas, principal second moments of area, radius of gyration, internal forces, shear and bending moment diagrams.

E M 274H. Statics of Engineering: Honors.

(3-0) Cr. 3. F.S.SS. *Prereq: Credit or enrollment in MATH 166; credit or enrollment in PHYS 111 or PHYS 221*

Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, second moments of areas, principal second moments of area, radius of gyration, internal forces, shear and bending moment diagrams.

E M 324. Mechanics of Materials.

(3-0) Cr. 3. F.S.SS. *Prereq: E M 274*

Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Application of stress and deformation analysis to members subject to centric, torsional, flexural, and combined loadings. Elementary considerations of theories of failure, buckling.

E M 327. Mechanics of Materials Laboratory.

(0-2) Cr. 1. F.S.SS. *Prereq: E M 324*

Experimental determination of mechanical properties of selected engineering materials. Experimental verification of assumptions made in 324. Use of strain measuring devices. Preparation of reports.

E M 345. Dynamics.

(3-0) Cr. 3. F.S.SS. *Prereq: E M 274, credit or enrollment in MATH 266 or MATH 267*

Particle and rigid body kinematics, Newton's laws of motion, kinetics of plane motion, rigid body problems using work-energy, linear, and angular impulse-momentum principles, vibrations.

E M 350. Introduction to Nondestructive Evaluation Engineering.

(3-0) Cr. 3. S. *Prereq: E M 324, MATH 266 or MATH 267, PHYS 222*

The physics of ultrasonic, eddy current, and x-ray testing. Introduction to linear system concepts, wave propagation, electromagnetics and radiation. Models of the generation, scattering and reception of waves in ultrasonics, the electrical impedance changes of eddy current testing, and image formation process for x-rays. Pattern recognition methods for the interpretation of measured responses.

E M 362. Principles of Nondestructive Testing.

(Cross-listed with MAT E). (3-0) Cr. 3. S. *Prereq: PHYS 112 or PHYS 222*

Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other techniques. Physical bases of tests; materials to which applicable; types of defects detectable; calibration standards, and reliability safety precautions.

E M 362L. Nondestructive Testing Laboratory.

(Cross-listed with MAT E). (0-3) Cr. 1. S. *Prereq: Credit or enrollment in MAT E 362*

Application of nondestructive testing techniques to the detection and sizing of flaws in materials and to the characterization of material's microstructure. Included are experiments in hardness, dye penetrant, magnetic particle, x-ray, ultrasonic and eddy current testing. Field trips to industrial laboratories.

E M 378. Mechanics of Fluids.

(2-2) Cr. 3. F.S.SS. *Prereq: E M 274*

Properties of fluids. Fluid statics. Kinematics and kinetics of fluid flow. Mass, momentum, and energy conservation laws; dimensional analysis; flow in pipes and channels. Selected laboratory experiments.

E M 417. Experimental Mechanics.

(Cross-listed with AER E). (2-2) Cr. 3. Alt. F., offered even-numbered years. *Prereq: E M 324*

Introduction of different aspects of measuring deformation, strains, and stress for practical engineering problems. Strain gage theory and application. Selected laboratory experiments.

E M 424. Intermediate Mechanics of Materials.

(3-0) Cr. 3. F.S. *Prereq: E M 324*

Analysis of stresses, strains, and deflections. Torsion and bending of unsymmetrical members. Analysis of thick wall pressure vessels and shrink fit problems. Dynamic load effects, fatigue and fracture mechanics introduction. Work-strain energy methods.

E M 425. Introduction to the Finite Element Method.

(3-0) Cr. 3. S. *Prereq: E M 324, MATH 266 or MATH 267*

Introduction of finite element analysis through applications to one-dimensional, steady-state problems such as elastic deformation, heat and fluid flow, consolidation, beam bending, and mass transport. Transient heat conduction and wave propagation. Two-dimensional triangular and quadrilateral elements. Plane problems of torsion, thermal and potential flow, stress analysis. Simple computer programs for one- and two-dimensional problems.

E M 451. Engineering Acoustics.

(Cross-listed with E E, M E). (2-2) Cr. 3. Alt. S., offered even-numbered years.

Prereq: PHYS 221 and MATH 266 or MATH 267

Properties of sound waves and noise metrics (pressure, power levels, etc). Sound sources and propagation. Principles of wave propagation in one-, two-, and three-dimensions. Wave reflection and transmission. Wave propagation in rectangular, cylindrical, and annular ducts. Acoustics fields for model noise sources. Introduction to aerodynamic noise sources in aircraft, aircraft engines, and wind turbines. Selected laboratory experiments.

E M 480. Introduction to Nondestructive Evaluation Engineering.

(Cross-listed with AER E). (3-0) Cr. 3. S. *Prereq: E M 324, MATH 266 or MATH 267, PHYS 222*

Introduction to stress/strain, Hooke's law, and elastic wave propagation in two dimensions in isotropic media. Ultrasonic plane-wave reflection and transmission; and simple straight-crested guided waves. Transducer construction, behavior, and performance. Simple signal analysis and discrete signal processing. The last few weeks of the course are devoted to case studies.

E M 490. Independent Study.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

E M 490H. Independent Study: Honors.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

Courses primarily for graduate students, open to qualified undergraduates:

E M 510. Continuum Mechanics.

(3-0) Cr. 3. F. *Prereq: MATH 385*

Introduction to Cartesian tensors as linear vector transformations. Kinematics of continuous deformations, Lagrangian and Eulerian descriptions of motion. Fundamental equations or balance laws of continuous media, linear and angular momentum balance. Conservation laws of momentum and energy. Introduction to constitutive equations of classical elastic solids and simple fluids. Formulations and solutions of some canonical problems.

E M 514. Advanced Mechanics of Materials.

(Cross-listed with AER E). (3-0) Cr. 3. F. *Prereq: E M 324*

Theory of stress and strain, stress-strain relationships. Unsymmetrical bending, curved beams, shear center. Torsion of thin-walled noncircular sections. Equilibrium, compatibility equations. Airy stress functions. Membrane stresses in shells, thick-walled cylinders.

E M 516. Applied Elasticity and Mechanics of Deformable Solids.

(3-0) Cr. 3. S. *Prereq: E M 510*

Fundamental mechanics of linear elasticity, formulation and solution of simple elastostatic boundary value problems. Kinematics of small deformations, constitutive equations for isotropic and anisotropic media. Field equations for elastic solids, plane strain/plane stress and some classic analytical solutions such as Boussinesq, Hertz, Kirsch, Lamé, and Mitchell. Stress functions and potential methods and introduction to finite elements.

E M 517. Experimental Mechanics.

(Cross-listed with AER E). (3-2) Cr. 4. Alt. S., offered even-numbered years.

Prereq: E M 510 or E M 514 or E M 516

Fundamental concepts for force, displacement, stress, and strain measurements. Strain gages. Full field deformation measurements with laser interferometry and digital image processing. Advanced experimental concepts at the micro and nano scale regimes.

E M 518. Waves in Elastic Solids with Applications to Ultrasonic Nondestructive Evaluation.(3-0) Cr. 3. F. *Prereq: MATH 385*

Propagation of bulk waves, surface waves, and guided waves in isotropic and anisotropic elastic media. Transmission and reflection of waves at plane and curved interfaces. Radiation of sources with application to ultrasonic transducer beam modeling. Elastic wave scattering from cracks and inclusions. Reciprocity principles and their use in the development of an ultrasonic measurement model. Characterization and measurement of material attenuation.

E M 525. Finite Element Analysis.

(Cross-listed with AER E). (3-0) Cr. 3. S. *Prereq: E M 425, MATH 385*
Variational and weighted residual approach to finite element equations. Emphasis on two- and three-dimensional problems in solid mechanics. Isoparametric element formulation, higher order elements, numerical integration, imposition of constraints and penalty, convergence, and other more advanced topics. Use of two- and three-dimensional computer programs. Dynamic and vibrational problems, eigenvalues, and time integration. Introduction to geometric and material nonlinearities.

E M 526. Boundary Element Methods in Engineering.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: E M 514 or E M 516*
Introductory boundary element methods through plane problems. Singular integrals, Cauchy principal values, integral representations and boundary integrals in one dimension. Direct and indirect formulations. Plane potential and elastostatic problems. Higher order elements, numerical integration. Regularizations. Body forces and infinite regions. Specialized fundamental solutions, half-plane and axisymmetric problems. Diffusion and wave problems. Coupling with finite elements.

E M 543. Introduction to Random Vibrations and Nonlinear Dynamics.(Cross-listed with M E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: 444*

Vibrations of continuous systems. Nonlinear vibration phenomena, perturbation expansions; methods of multiple time scales and slowly-varying amplitude and phase. Characteristics of random vibrations; random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process. Transmission of random vibration, response of simple single and two-degree-of-freedom systems to stationary random excitation. Fatigue failure due to random excitation.

E M 548. Advanced Engineering Dynamics.(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: E M 345, MATH 266 or MATH 267*

3-D kinematics and dynamics of particles and rigid bodies. Coordinate systems, calculus of variations. Lagrange's equations with constraints, modified Euler's equations, torque-free motion of rigid bodies in 3-D, moment equations with constraints.

E M 550. Nondestructive Evaluation.(Cross-listed with M S E). (3-2) Cr. 4. S. *Prereq: E M 324, MATH 385*

Principles of five basic NDE methods and their application in engineering inspections. Materials behavior and simple failure analysis. NDE reliability, and damage-tolerant design. Advanced methods such as acoustic microscopy, laser ultrasonics, thermal waves, and computed tomography are analyzed. Computer-based experiments on a selection of methods: ultrasonics, eddy currents, x-rays are assigned for student completion.

E M 552. Advanced Acoustics.(Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: E M 451*

Theoretical acoustics: wave propagation in fluids; acoustic radiation, diffraction and scattering; nonlinear acoustics; radiation force; cavitation; and ray acoustics.

E M 564. Fracture and Fatigue.(Cross-listed with AER E, M E, M S E). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: E M 324 and either MAT E 216 or MAT E 273 or MAT E 392.**Undergraduates: Permission of instructor*

Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

E M 566. Phase Transformation in Elastic Materials.(Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: EM 510 or EM 516 or EM 514*

Continuum thermodynamics and kinetics approaches to phase transformations. Phase field approach to stress- and temperature-induced martensitic transformations and twinning at the nanoscale. Nucleation and growth. Nanostructural evaluation. Analytical and numerical solutions. Surface stresses and energy. Surface-induced phase transformations. Large Strain formulation.

E M 569. Mechanics of Composite and Combined Materials.(Cross-listed with AER E, M S E). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: E M 324*

Mechanics of fiber-reinforced materials. Micromechanics of lamina. Macromechanical behavior of lamina and laminates. Strength and interlaminar stresses of laminates. Failure criteria. Stress analysis of laminates. Thermal moisture and residual stresses. Joints in composites.

E M 570. Wind Engineering.

(Cross-listed with AER E). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: E M 378, E M 345

Atmospheric circulations, atmospheric boundary layer wind, bluff-body aerodynamics, aeroelastic phenomena, wind-tunnel and full-scale testing, wind-load code and standards, effect of tornado and thunderstorm winds, design applications.

E M 590. Engineering Mechanics Special Topics.Cr. 1-4. Repeatable. *Prereq: Permission of instructor***E M 590F. Engineering Mechanics Special Topics: Introduction to Dislocation and Plasticity.**Cr. 1-4. Repeatable. *Prereq: Permission of instructor***E M 590H. Engineering Mechanics Special Topics: Mechanics of Thin Films and Adhesives.**Cr. 1-4. Repeatable. *Prereq: Permission of instructor***E M 590I. Engineering Mechanics Special Topics: Mechanics of Cellular and Porous Media.**Cr. 1-4. Repeatable. *Prereq: Permission of instructor***E M 590J. Engineering Mechanics Special Topics: Other.**Cr. 1-4. Repeatable. *Prereq: Permission of instructor***E M 599. Creative Component.**

Cr. arr. Repeatable.

Courses for graduate students:**E M 690. Engineering Mechanics Special Topics.**Cr. 1-6. Repeatable. *Prereq: Permission of instructor***E M 690N. Engineering Mechanics Special Topics: Advanced Experimental Methods.**Cr. 1-6. Repeatable. *Prereq: Permission of instructor***E M 690O. Engineering Mechanics Special Topics: Advanced Wave Propagation.**Cr. 1-6. Repeatable. *Prereq: Permission of instructor***E M 690P. Engineering Mechanics Special Topics: Advanced Materials.**Cr. 1-6. Repeatable. *Prereq: Permission of instructor***E M 690Q. Engineering Mechanics Special Topics: Advanced Computational Methods.**Cr. 1-6. Repeatable. *Prereq: Permission of instructor***E M 690R. Engineering Mechanics Special Topics: Reliability and Failure.**Cr. 1-6. Repeatable. *Prereq: Permission of instructor***E M 690S. Engineering Mechanics Special Topics: Other.**Cr. 1-6. Repeatable. *Prereq: Permission of instructor***E M 697. Engineering Internship.**Cr. R. Repeatable. *Prereq: Permission of DOGE (Director of Graduate Education), graduate classification*

One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

E M 699. Research.

Cr. arr. Repeatable.

English (ENGL)

Courses primarily for undergraduates:

ENGL 010. Intensive English and Orientation Program.

(21-0) Cr. 0. F.S.SS. *Prereq: Recommendation of the English Department*
Full-time study of English for speakers of other languages. Brochure available from the IEOP Office, 102 Landscape Architecture, or at www.ieop.iastate.edu. Offered on a satisfactory-fail basis only.

ENGL 099. Strategies for Nonnative Speakers of English.

Cr. 0. F.S. *Prereq: Recommendation of English Department; placement in sections L and R is determined by examination; section S is open to all interested international students. Available P/NP to graduate students at their department's option*

ENGL 099L. Strategies for Nonnative Speakers of English: Strategies for Listening.

Cr. 0. F.S. *Prereq: Recommendation of English Department; placement in sections L and R is determined by examination; section S is open to all interested international students. Available P/NP to graduate students at their department's option*

ENGL 099R. Strategies for Nonnative Speakers of English: Strategies for Reading.

Cr. 0. F.S. *Prereq: Recommendation of English Department; placement in sections L and R is determined by examination; section S is open to all interested international students. Available P/NP to graduate students at their department's option*

ENGL 099S. Strategies for Nonnative Speakers of English: Academic Speaking and Pronunciation.

Cr. 0. F.S. *Prereq: Recommendation of English Department; placement in sections L and R is determined by examination; section S is open to all interested international students. Available P/NP to graduate students at their department's option*

ENGL 101. English for Native Speakers of Other Languages.

(3-0) Cr. 3. F.S. *Prereq: Recommendation of English Department; placement in various sections is determined by examination. (See English Requirement for International Students in Index.)*

For undergraduates: Completion of ENGL 101 requirement prepares students for ENGL 150. For graduates: Completion of ENGL 101 satisfies the English requirement of the Graduate College. ENGL 101 courses are limited to students who are nonnative speakers of English. Credit from ENGL 101 does not count toward graduation.

ENGL 101B. English for Native Speakers of Other Languages: Academic English.

(3-0) Cr. 3. F.S. *Prereq: Recommendation of English Department; placement in various sections is determined by examination. (See English Requirement for International Students in Index.)*

For undergraduates: Completion of ENGL 101 requirement prepares students for ENGL 150. For graduates: Completion of ENGL 101 satisfies the English requirement of the Graduate College. ENGL 101 courses are limited to students who are nonnative speakers of English. Credit from ENGL 101 does not count toward graduation.

ENGL 101C. English for Native Speakers of Other Languages: Academic English II--Undergraduates.

(3-0) Cr. 3. F.S. *Prereq: Recommendation of English Department; placement in various sections is determined by examination. (See English Requirement for International Students in Index.)*

For undergraduates: Completion of ENGL 101 requirement prepares students for ENGL 150. For graduates: Completion of ENGL 101 satisfies the English requirement of the Graduate College. ENGL 101 courses are limited to students who are nonnative speakers of English. Credit from ENGL 101 does not count toward graduation.

ENGL 101D. English for Native Speakers of Other Languages: Academic English II--Graduates.

(3-0) Cr. 3. F.S. *Prereq: Recommendation of English Department; placement in various sections is determined by examination. (See English Requirement for International Students in Index.)*

Available P/NP to graduate students at their department's option. For undergraduates: Completion of ENGL 101 requirement prepares students for ENGL 150. For graduates: Completion of ENGL 101 satisfies the English requirement of the Graduate College. ENGL 101 courses are limited to students who are nonnative speakers of English. Credit from ENGL 101 does not count toward graduation.

ENGL 120. Computers and Language.

(Cross-listed with LING). (3-0) Cr. 3.
Introduction to the use of linguistic knowledge in computer applications today and the basic computational techniques used in such applications. The development of these techniques throughout the history of computational linguistics. How the study of language has contributed to the advancement of technology and how certain computational problems have influenced the way linguists study language.

ENGL 150. Critical Thinking and Communication.

(3-0) Cr. 3. F.S.SS. *Prereq: Concurrent enrollment in LIB 160 is recommended.*
Application of critical reading and thinking abilities to topics of civic and cultural importance. Introduction of basic oral, visual, and electronic communication principles to support writing development. Initiation of communication portfolio.

ENGL 180. Communication Skills for International Teaching Assistants.

Cr. 1-3. Repeatable, maximum of 2 times. F.S.
Placement based upon OECT test results. Persons whose native language is English cannot take ENGL 180 for credit. No more than one section of ENGL 180 may be taken per semester; up to two sections total. Offered on a satisfactory-fail basis only. Credit for ENGL 180 does not apply toward graduation.

ENGL 180A. Communication Skills for International Teaching Assistants: Speaking Skills.

Cr. 3. Repeatable, maximum of 2 times. F.S.
Emphasis on pronunciation improvement and greater fluency in spoken English. Placement based upon OECT test results. Persons whose native language is English cannot take ENGL 180 for credit. No more than one section of ENGL 180 may be taken per semester; up to two sections total. Offered on a satisfactory-fail basis only. Credit for ENGL 180 does not apply toward graduation.

ENGL 180B. Communication Skills for International Teaching Assistants: Intermediate Spoken English.

Cr. 3. Repeatable, maximum of 2 times. F.S.
Placement based upon OECT test results. Persons whose native language is English cannot take ENGL 180 for credit. No more than one section of ENGL 180 may be taken per semester; up to two sections total. Offered on a satisfactory-fail basis only. Credit for ENGL 180 does not apply toward graduation.

ENGL 180C. Communication Skills for International Teaching Assistants: Advanced Spoken English.

Cr. 3. Repeatable, maximum of 2 times. F.S.
For students who have completed ENGL 180A or ENGL 180b but have not reached the passing level on the OECT test. Placement based upon OECT test results. Persons whose native language is English cannot take ENGL 180 for credit. No more than one section of ENGL 180 may be taken per semester; up to two sections total. Offered on a satisfactory-fail basis only. Credit for ENGL 180 does not apply toward graduation.

ENGL 180D. Communication Skills for International Teaching Assistants: Presentation Skills.

Cr. 3. Repeatable, maximum of 2 times. F.S.
Developing explanations, leading discussions and handling questions in a teaching environment. Placement based upon OECT test results. Persons whose native language is English cannot take ENGL 180 for credit. No more than one section of ENGL 180 may be taken per semester; up to two sections total. Offered on a satisfactory-fail basis only. Credit for ENGL 180 does not apply toward graduation.

ENGL 180E. Communication Skills for International Teaching Assistants: Supervised Independent Study.

Cr. 1-3. Repeatable, maximum of 2 times. F.S.
Seminar with individual observation and consultation. Placement based upon OECT test results. Persons whose native language is English cannot take 180 for credit. No more than one section of ENGL 180 may be taken per semester; up to two sections total. Offered on a satisfactory-fail basis only. Credit for ENGL 180 does not apply toward graduation.

ENGL 201. Introduction to Literature.

(3-0) Cr. 3. *Prereq: Credit in or exemption from 150*
Study of selected examples of drama, poetry, short fiction, and the novel drawn from both British and American literature. Recommended for nonmajors.

ENGL 207. Introduction to Creative Writing.

(3-0) Cr. 3. F.S. *Prereq: Credit in or exemption from 150*
Course introduces students to the fundamentals of writing fiction, poetry, and creative nonfiction. Extensive readings in all three genres. Students learn creative processes through writing exercises, workshops, and conferences.

ENGL 219. Introduction to Linguistics.

(Cross-listed with LING). (3-0) Cr. 3. F.S. *Prereq: Sophomore classification*
Introduction to linguistic concepts and principles of linguistic analysis with English as the primary source of data. Sound and writing systems, sentence structure, vocabulary, and meaning. Issues in the study of usage, regional and social dialects, language acquisition, and language change.

ENGL 220. Descriptive English Grammar.

(Cross-listed with LING). (3-0) Cr. 3. F.S. *Prereq: ENGL 250*
Overview of grammatical structures and functions. Parts of speech; phrase, clause, and sentence structure; sentence types and sentence analysis; rhetorical grammar and sentence style; terminology. Not a remedial, English composition, or ESL course.

ENGL 225. Survey of British Literature to 1800.

(3-0) Cr. 3. *Prereq: ENGL 250*
Representative works of British literature from the origins to 1800 in historical, cultural, and literary contexts. Will include multiple genres.

ENGL 226. Survey of British Literature since 1800.

(3-0) Cr. 3. *Prereq: ENGL 250*
Representative works from 1800 to the present in historical, cultural, and literary contexts. Will include multiple genres and may include texts that reflect and/or critique the impact and legacy of the British empire on its former colonies, i.e., postcolonial literature.

ENGL 227. Survey of American Literature to 1865.

(3-0) Cr. 3. *Prereq: ENGL 250*
Representative works of American literature from its origins (including indigenous and conquest literatures) through the end of the Civil War in historical, cultural, and literary contexts. Will include multiple genres.

ENGL 228. Survey of American Literature since 1865.

(3-0) Cr. 3. *Prereq: ENGL 250*
Representative works written in the United States since the Civil War in historical, cultural, and literary contexts, with attention to the cultural and ethnic diversity of Americans. Will include multiple genres.

ENGL 237. Survey of Film History.

(3-0) Cr. 3. F. *Prereq: Credit in or exemption from 150*
A survey of the history of film, both U.S. and international, from the beginnings in the late nineteenth century to the present.

ENGL 240. Introduction to American Indian Literature.

(Cross-listed with AM IN). (3-0) Cr. 3. F. *Prereq: Credit in or exemption from ENGL 150*
Appreciation of oral and written forms of American Indian literatures. Tropes and techniques in oral, visual and written texts. Focus on the role of American Indians in interdisciplinary approaches to modern social and environmental issues as expressed in literary works.
Meets U.S. Diversity Requirement

ENGL 250. Written, Oral, Visual, and Electronic Composition.

(3-0) Cr. 3. F.S.SS. *Prereq: ENGL 150 or exemption from ENGL 150; sophomore classification or exemption from ENGL 150; credit for or concurrent enrollment in LIB 160*
Analyzing, composing, and reflecting on written, oral, visual, and electronic (WOVE) discourse within academic, civic, and cultural contexts. Emphasis on supporting a claim and using primary and secondary sources. Continued development of communication portfolio.

ENGL 250H. Written, Oral, Visual, and Electronic Composition: Honors.

(3-0) Cr. 3. F. *Prereq: Exemption from ENGL 150 and admission to Freshman Honors Program; credit for or concurrent enrollment in LIB 160*
In-depth analysis, composition, and reflection on written, oral, visual, and electronic (WOVE) discourse within academic, civic, and cultural contexts. Emphasis on argumentation: developing claims, generating reasons, providing evidence. Individual sections organized by special topics. Development of communication portfolio.

ENGL 260. Introduction to Literary Study.

(3-0) Cr. 3. *Prereq: Credit in or exemption from 150*
Basic principles of literary study. Emphasis on writing of interpretive and critical essays. Particular attention to poetry. Designed for English majors.

ENGL 275. Analysis of Popular Culture Texts.

(Cross-listed with SP CM). (3-0) Cr. 3. F.S. *Prereq: Credit in or equivalent of 250*
Analysis of how information and entertainment forms persuade and manipulate audiences. Study of several forms that may include newspapers, speeches, television, film, advertising, fiction, and magazines. Special attention to verbal and visual devices.

ENGL 302. Business Communication.

(3-0) Cr. 3. F.S.SS. *Prereq: ENGL 250, junior classification*
Theory, principles and processes of effective written, oral, visual, and electronic communication typically encountered in business and the professions. Extensive practice in many areas of workplace communication, including letter, memo, and email correspondence; short proposals and reports; policies and procedures; job packet including letters of application and resumes; website analysis; brochures; and individual and team presentations.

ENGL 302H. Business Communication: Honors.

(3-0) Cr. 3. F.S.SS. *Prereq: ENGL 250, junior classification*
Theory, principles and processes of effective written, oral, visual, and electronic communication typically encountered in business and the professions. Extensive practice in many areas of workplace communication, including letter, memo, and email correspondence; short proposals and reports; policies and procedures; job packet including letters of application and resumes; website analysis; brochures; and individual and team presentations.

ENGL 303. Free-Lance Writing for Popular Magazines.

(3-0) Cr. 3. S. *Prereq: ENGL 250, not open to freshmen*
Practical workshop in writing nonfiction articles for popular magazines. Emphasis on writing, market research, preparation of manuscripts, methods of submission. Major goal of the course is production of marketable material.

ENGL 304. Creative Writing: Fiction.

(3-0) Cr. 3. F.S. *Prereq: ENGL 250, not open to freshmen*
Progresses from practice in basic techniques of fiction writing to fully developed short stories. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

ENGL 305. Creative Writing: Nonfiction.

(3-0) Cr. 3. F.S. *Prereq: ENGL 250, not open to freshmen*
Workshop in writing imaginative essays, both critical and personal. Analytical reading, development of literary techniques. Individual and small group conferences.

ENGL 306. Creative Writing: Poetry.

(3-0) Cr. 3. F.S. *Prereq: ENGL 250, not open to freshmen*
Progresses from traditional to contemporary forms. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

ENGL 308. Write Like a Woman.

(3-0) Cr. 3. F. *Prereq: ENGL 250*
Writing and reading interpretive fiction written by women. Emphasis on stories that embody a female literary life, gender-specific ways of creating characters and conflicts, analytical reading and writing, workshop criticism and shared commentaries. Includes multi-modal projects.

ENGL 309. Report and Proposal Writing.

(3-0) Cr. 3. F.S. *Prereq: ENGL 250, junior classification*
Introduction to the theory and practice of preparing and analyzing reports and proposals intended for businesses, governmental agencies, and/or private and corporate foundations. Individual assignments and group projects include textual and visual elements of print and electronic documents as well as oral presentations.

ENGL 310. Rhetorical Analysis.

(3-0) Cr. 3. F.S. *Prereq: ENGL 250*
Fundamental principles of rhetorical criticism. Focus on selected theories for analyzing cultural texts, including essays, speeches, film, technical and scientific documents, and websites. Emphasis on identifying artifacts, formulating research questions, applying methodologies, and understanding and practicing critical analysis through discussion and in writing.

ENGL 312. Biological Communication.

(3-0) Cr. 3. F.S. *Prereq: ENGL 250*
Emphasis on effective writing and communication methods in the biological sciences, presentation of research data, methods of bibliographic citation, ethical communication, use of oral and visual presentation methods for biological information, manuscript and report preparation. For students in the biological and related life sciences.

ENGL 313. Rhetorical Website Design.

(3-0) Cr. 3. *Prereq: ENGL 250*
Rhetorical principles of multimodal composing in hypertextual environments. Focus on writing according to web style guidelines, employing cascading stylesheets for layout and design, and using principles of information architecture to determine optimal site structure. Final project involves constructing interactive client site using latest web standards.

ENGL 314. Technical Communication.(3-0) Cr. 3. F.S.SS. *Prereq: ENGL 250, junior classification*

Theories, principles, and processes of effective written, oral, visual, and electronic communication of technical information. Attention to major strategies for analyzing and adapting to audiences in various communication situations and composing technical discourse including organizing visual and verbal information. Extensive practice in many areas of technical communication, including instructions and procedures, proposals and reports, website analysis and design, and individual and team presentations.

ENGL 314H. Technical Communication: Honors.(3-0) Cr. 3. F.S.SS. *Prereq: ENGL 250, junior classification*

Theories, principles, and processes of effective written, oral, visual, and electronic communication of technical information. Attention to major strategies for analyzing and adapting to audiences in various communication situations and composing technical discourse including organizing visual and verbal information. Extensive practice in many areas of technical communication, including instructions and procedures, proposals and reports, website analysis and design, and individual and team presentations.

ENGL 315. Creative Writing: Screenplays.(3-0) Cr. 3. F. *Prereq: ENGL 250, not open to freshmen*

Stresses master scene technique of writing fully developed screenplays. Emphasis on movie techniques, writing, workshop criticism, analytical reading and viewing, and individual conferences.

ENGL 316. Creative Writing: Playwriting.(Cross-listed with THTR). (3-0) Cr. 3. S. *Prereq: ENGL 250, not open to freshmen*

Progresses from production of scenes to fully developed one-act plays. Emphasis on action, staging, writing, analytical reading, workshop criticism, and individual conferences.

ENGL 330. Science Fiction.(3-0) Cr. 3. *Prereq: ENGL 250*

Study of science fiction from its origins in nineteenth-century to the present. May include study of specific types of science fiction, such as classic, cyberpunk, feminist, or apocalyptic narratives; and may include consideration of science fiction film and/or theory.

ENGL 332. Visual Communication of Quantitative Information.

(Cross-listed with STAT). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 101, STAT 104, STAT 201 or STAT 226; ENGL 250

Communicating quantitative information using visual displays; visualizing data; interactive and dynamic data displays; evaluating current examples in the media; color, perception, and representation in graphs; interpreting data displays.

ENGL 335. Studies in Film.(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250*

Principles of film art and the traditional vocabulary of literature as applied to film. Influence of film on modes of thought and behavior.

ENGL 339. Literary Theory and Criticism.(3-0) Cr. 3. *Prereq: ENGL 260 and 3 additional credits in literature*

Study of selected texts of literary criticism, with attention to the purposes and practices of criticism.

ENGL 340. Women's Literature.(Cross-listed with W S). (3-0) Cr. 3. *Prereq: ENGL 250*

Historical and thematic survey of literature by and about women. May include autobiographies, journals, letters, poetry, fiction, and drama. Meets U.S. Diversity Requirement

ENGL 342. American Indian Women Writers.(Cross-listed with AM IN, W S). (3-0) Cr. 3. *Prereq: ENGL 250*

Literature of American Indian women writers which examines their social, political, and cultural roles in the United States. Exploration of American Indian women's literary, philosophical, and artistic works aimed at recovering elements of identity, redescribing stereotypes, resisting colonization, and constructing femininity. Meets U.S. Diversity Requirement

ENGL 344. U.S. Latino/a Literature.(Cross-listed with US LS). (3-0) Cr. 3. S. *Prereq: ENGL 250*

An introduction to the literature of Mexican Americans, Puerto Ricans, Cuban Americans and other Latino/a sub-groups. Special emphasis on themes such as ethnic relations and comparisons with EuroAmerican literary traditions. Meets U.S. Diversity Requirement

ENGL 345. Women and Literature: Selected Topics.(Cross-listed with W S). (3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250*

Literature by women and/or dealing with the images of women, e.g., study of individual authors or related schools of authors; exploration of specific themes or genres in women's literature; analysis of recurrent images of women in literature. Meets U.S. Diversity Requirement

ENGL 346. American Indian Literature.(Cross-listed with AM IN). (3-0) Cr. 3. *Prereq: ENGL 250*

Survey of literature by Native Americans from pre-Columbian tales and songs to contemporary novels and poetry. Meets U.S. Diversity Requirement

ENGL 347. Studies in African American Literature.(Cross-listed with AF AM). (3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250*

Literature by African Americans, which may include study of individual authors, movements, themes, genres. Meets U.S. Diversity Requirement

ENGL 349. Topics in Multicultural Literatures of the United States.(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250*

Literature by writers from U.S. multicultural groups. May include literature of several groups or focus upon one of the following: Asian Americans, African Americans, Latino/a Americans, American Indians. Meets U.S. Diversity Requirement

ENGL 350. Rhetorical Traditions.(Cross-listed with CL ST, SP CM). (3-0) Cr. 3. S. *Prereq: ENGL 250*

Ideas about the relationship between rhetoric and society in contemporary and historical contexts. An exploration of classical and contemporary rhetorical theories in relation to selected topics that may include politics, gender, race, ethics, education, science, or technology.

ENGL 351. Scientific Thought and Literary Imagination.

(3-0) Cr. 3.

Study of texts across time periods and genres that may address the following topics: the influence of scientific thought on literature or literary imagination on science, representations of scientific discovery or disaster in literature, the origins of scientific thought as represented in literature, portrayals of scientific figures in literature.

ENGL 352. Gay and Lesbian Literature.(Cross-listed with W S). (3-0) Cr. 3. *Prereq: ENGL 250*

Literary portrayals of gay and lesbian lives and relationships from many different genres. Attention to changing definitions and representations of sexual orientation and gender identity over time. Meets U.S. Diversity Requirement

ENGL 353. World Literature: Western Foundations through Renaissance.(Cross-listed with CL ST). (3-0) Cr. 3. F.S. *Prereq: ENGL 250*

Representative works from the drama, epics, poetry, and prose of the Ancient World through the late sixteenth century. May include Homer, Aeschylus, Sappho, Catullus, Dante, Marie de France, Boccaccio, Christine de Pizan, Cervantes, and others.

Meets International Perspectives Requirement.

ENGL 354. World Literature: Seventeenth Century to the Present.(3-0) Cr. 3. F. *Prereq: ENGL 250*

Global literatures in their various cultural and aesthetic contexts. Representative works, oral and written literature, including poetry, fiction, nonfiction, and drama. Meets International Perspectives Requirement.

ENGL 355. Literature and the Environment.(Cross-listed with ENV S). (3-0) Cr. 3. *Prereq: ENGL 250*

Study of literary texts that address the following topics, among others: the relationship between people and natural/urban environments, ecocriticism, and the importance of place in the literary imagination.

ENGL 358. Myth and Fairytale.(3-0) Cr. 3. *Prereq: ENGL 250*

Study of traditional fairytales, myths, and legends from diverse cultures.

ENGL 359. Literature and the Arts.(3-0) Cr. 3. *Prereq: ENGL 250*

Study of texts that may include the following topics: the relationship between literature and other art forms (including painting, sculpture, dance, music, photography, and film); the representation of the arts in literature; the influences of other art forms on literature; the interrelation of art theory and literary theory.

ENGL 360. Studies in American Literature to 1800.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250; sophomore classification*

Selected readings in American literature from its beginnings through the colonial period; may reflect themes, genres, or social and cultural contexts.

ENGL 362. Studies in 19th Century American Literature.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250; sophomore classification*

Selected readings in American literature of the 19th century; may reflect themes, genres, or social and cultural contexts.

ENGL 364. Studies in American Literature: 1900 to the Present.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250; sophomore classification*

Selected readings in American literature since 1900; may reflect themes, genres, or social and cultural contexts.

ENGL 370. Shakespeare.

(3-0) Cr. 3. F.S. *Prereq: ENGL 250*

Reading and analysis of selected plays. Development of Shakespeare's dramatic art in its social and intellectual context.

Meets International Perspectives Requirement.

ENGL 373. Studies in British Literature: The Middle Ages.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250; sophomore classification*

Selected readings in medieval literature from its beginnings through the fifteenth century; may reflect themes, genres, or social and cultural contexts.

ENGL 374. Studies in British Literature: The Renaissance.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250; sophomore classification*

Selected readings in British literature from 1500 to 1660; may reflect themes, genres, or social and cultural contexts.

Meets International Perspectives Requirement.

ENGL 375. Studies in British Literature: The Restoration and 18th Century.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250; sophomore classification*

Selected readings in British literature from 1660 to 1800; may reflect themes, genres, or social and cultural contexts.

Meets International Perspectives Requirement.

ENGL 376. Studies in British Literature.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250; sophomore classification*

Selected readings from British literature from the late eighteenth century to about 1900; may reflect themes, genres, or social and cultural contexts.

Meets International Perspectives Requirement.

ENGL 376A. Studies in British Literature: Romantic.

(3-0) Cr. 3. *Prereq: ENGL 250; sophomore classification*

Selected readings from British literature from the late eighteenth century to about 1900; may reflect themes, genres, or social and cultural contexts.

Meets International Perspectives Requirement.

ENGL 376B. Studies in British Literature: Victorian.

(3-0) Cr. 3. *Prereq: ENGL 250; sophomore classification*

Selected readings from British literature from the late eighteenth century to about 1900; may reflect themes, genres, or social and cultural contexts.

Meets International Perspectives Requirement.

ENGL 378. Studies in British Literature: 1900 to the Present.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250; sophomore classification*

Selected readings in British literature since 1900; may reflect themes, genres, or social and cultural contexts.

ENGL 389. Postcolonial Literature.

(3-0) Cr. 3. *Prereq: ENGL 250; sophomore classification*

Historical, thematic and theoretical study of postcolonial literatures from one or more of the following areas: Africa, South Asia, the Caribbean, and the Middle East. Irish and immigrant British writers may also be included.

Meets International Perspectives Requirement.

ENGL 393. The History of Children's Literature.

(3-0) Cr. 3. F. *Prereq: ENGL 250*

Origin and development of English and American children's literature through the early twentieth century. Special emphasis on nature, structure, and enduring themes of fantasy literature.

ENGL 395. Study and Travel.

Cr. arr. SS. *Prereq: Permission of instructor*

Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

Meets International Perspectives Requirement.

ENGL 395A. Study and Travel: Literature.

Cr. arr. SS. *Prereq: Permission of instructor*

Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 395B. Study and Travel: Creative Writing.

Cr. arr. SS. *Prereq: Permission of instructor*

Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 395C. Study and Travel: Linguistics.

Cr. arr. SS. *Prereq: Permission of instructor*

Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 395D. Study and Travel: Rhetoric and Professional Communication.

Cr. arr. SS. *Prereq: Permission of instructor*

Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 395E. Study and Travel: Teacher Education.

Cr. arr. SS. *Prereq: Permission of instructor*

Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 396. Teaching the Reading of Young Adult Literature.

(3-0) Cr. 3. S. *Prereq: ENGL 250*

Critical study and evaluation of themes, genres, and cultures found in young adult literature. Strategies of effective reading; instructional strategies including discussion techniques and use of technology; matching texts to reader needs and proficiencies. Evaluation of fiction, nonfiction, and media-based materials for use in school programs. Lesson planning.

ENGL 397. Practice and Theory of Teaching Writing in the Secondary Schools.

(3-0) Cr. 3. F.S. *Prereq: ENGL 219 or ENGL 220; application process initiated for admission to university teacher education program; concurrent enrollment in C 1280 (cr. 2); and background check initiated with state of Iowa Department of Criminal Investigation*

Introduction to teaching secondary language arts. Current theories and practices in the teaching of writing to secondary school students. Theories of rhetoric, approaches to teaching, lesson design and planning. Evaluating writing. Professional portfolio preparation.

ENGL 404. Creative Writing Workshop: Fiction.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. F.S. *Prereq: ENGL 304*

Individual projects in short fiction on a workshop and conference basis. Readings in short fiction. Discussion of elements of narrative such as plot, point of view, characterization, theme, setting.

ENGL 405. Creative Writing Workshop: Nonfiction.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. F.S. *Prereq: ENGL 305*

Individual projects in memoir, immersion journalism, character studies, and/or the personal essay on a workshop and conference basis. Readings in creative nonfiction.

ENGL 406. Creative Writing Workshop--Poetry.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. F.S. *Prereq: ENGL 306*

Individual projects in poetry on a workshop and conference basis. Readings in poetry. Discussion of poetic elements such as image, sound, internal structure, rhythm, tone, figurative language.

ENGL 411. Technology, Rhetoric, and Professional Communication.

(3-0) Cr. 3. *Prereq: ENGL 310; ENGL 302, ENGL 309, ENGL 313, or ENGL 314; junior classification*

Seminar course on the implication of technologies, especially computer technology, for the writing and reading of business, technical, and academic texts. Extensive reading, discussion, and writing on selected technology-related topics.

ENGL 415. Business and Technical Editing.

(3-0) Cr. 3. S. *Prereq: ENGL 302, ENGL 309, or ENGL 314; junior classification*

Editing journal articles, research reports, technical manuals, newsletters, and proposals. Attention to editorial levels and styles, project management, editor-author relationships, and electronic editing.

ENGL 416. Visual Aspects of Business and Technical Communication.
(3-0) Cr. 3. F. Prereq: ENGL 302, ENGL 309, or ENGL 314; junior classification
Rhetoric of visual elements in business and technical communication. Issues in the design of text, charts, graphs, diagrams, schematics, illustrations, and other visual displays.

ENGL 417. Student Teaching.

Cr. arr. F.S. Prereq: admission to teacher education, approval of coordinator the semester prior to student teaching

Full-time teaching in content licensure area: long term and unit planning, lesson planning, classroom teaching practice.

ENGL 417E. Student Teaching: English and Literature.

(Cross-listed with C I). Cr. arr. F.S. Prereq: ENGL 494, admission to teacher education, approval of coordinator the semester prior to student teaching

Full-time teaching in secondary English: long term and unit planning, lesson planning, classroom teaching practice in English language arts.

ENGL 418. Seminar in Argumentation.

(3-0) Cr. 3. S. Prereq: ENGL 310, junior classification

Advanced seminar in theory and analysis with extensive practice in various modes of argument.

ENGL 420. History of the English Language.

(Cross-listed with LING). (3-0) Cr. 3. F.S. Prereq: ENGL 219 or LING 219, ENGL 220 or LING 220

Comparison of English to other languages by family background and by type. Analysis of representative Old, Middle, Early Modern and present-day English texts, including both literary works and non-literary documents.

ENGL 422. Women, Men, and the English Language.

(Cross-listed with LING, W S). (3-0) Cr. 3. S. Prereq: ENGL 219 or LING 219

The ways men and women differ in using language in varied settings and the ways in which language both creates and reflects gender divisions.

Meets U.S. Diversity Requirement

ENGL 425. Second Language Learning and Teaching.

(Cross-listed with LING). (3-0) Cr. 3. S. Prereq: ENGL 219 or LING 219; junior classification

The process of second language learning and principles and techniques of teaching second languages. Learning and teaching in specific situations and for particular purposes. Current applications of technology in teaching and assessment.

ENGL 437. Grammatical Analysis.

(Cross-listed with LING). (3-0) Cr. 3. F. Prereq: ENGL 220 or LING 220; ENGL 219 or LING 219 or introductory course in linguistics; junior classification

Theories and methods for analysis of syntax and morphology.

ENGL 440. Seminar in British Literature.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in ENGL 339; junior classification

Selected authors, movements, eras, or genres in British literature. Readings in criticism; required research paper.

ENGL 441. Seminar in American Literature.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in ENGL 339; junior classification

Selected authors, movements, eras, or genres in American literature. Readings in criticism; required research paper.

ENGL 445. Seminar: Literature Crossing Boundaries.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in ENGL 339; junior classification

Intensive study of selected literature that bridges traditional genre, period, national, or disciplinary boundaries. Readings in criticism; required research paper.

ENGL 450. Seminar in Literary Genres.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in ENGL 339; junior classification

Intensive study of drama, film, fiction, poetry, or prose. Selected movements, eras, or national traditions. Readings in criticism; required research paper.

ENGL 460. Seminar in Gender and Ethnicity.

(Cross-listed with W S). (3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in ENGL 339; junior classification

Selected readings of various authors, movements, eras, or genres. Readings in criticism; required research paper.

ENGL 477. Seminar in Technical Communication.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: ENGL 302, ENGL 309, or ENGL 314

Intensive study of a selected topic that bridges theory and practice in technical communication. Required project that contributes to the understanding of an emerging issue in the profession.

ENGL 487. Internship in Business, Technical, and Professional Communication.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. Prereq: 9 credits in ENGL 302, ENGL 309, ENGL 313, ENGL 314, ENGL 415 (preferred), ENGL 416, or ENGL 477; junior classification; and permission of coordinator

An opportunity to write, edit, and design business and technical documents in a professional setting. Projects include reports, proposals, manuals, brochures, newsletters.

ENGL 489. Undergraduate Seminar.

(Cross-listed with LING). (3-0) Cr. 3. Repeatable. F. Prereq: 9 credits in English beyond ENGL 250

Intensive study of a selected topic in literature, criticism, rhetoric, writing, or language. Cross-listing with linguistics acceptable only when offered as a course in linguistics.

ENGL 490. Independent Study.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits of ENGL 490 may be used toward graduation.

ENGL 490A. Independent Study: Literature.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits of ENGL 490 may be used toward graduation.

ENGL 490B. Independent Study: Linguistics.

(Cross-listed with LING). Cr. arr. Repeatable, maximum of 9 credits. F.S. Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee or Linguistics Adviser

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits of ENGL 490 may be used toward graduation.

ENGL 490C. Independent Study: Rhetoric, Teaching of Composition.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits of ENGL 490 may be used toward graduation.

ENGL 490D. Independent Study: Criticism and Theory of Literature.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits of ENGL 490 may be used toward graduation.

ENGL 490E. Independent Study: Instructional Methods and Research.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits of ENGL 490 may be used toward graduation.

ENGL 490F. Independent Study: Creative Writing.

Cr. arr. Repeatable, maximum of 9 credits. F.S. Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits of ENGL 490 may be used toward graduation.

ENGL 490G. Independent Study: Business/Technical Communication.

Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee*

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits of ENGL 490 may be used toward graduation.

ENGL 490H. Independent Study: Honors.

Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee*

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of ENGL 490 may be used toward graduation.

ENGL 492. Undergraduate Teaching Experience.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee*

Teaching assistant experience.

ENGL 494. Practice and Theory of Teaching Literature in the Secondary Schools.

(Cross-listed with C I). (3-0) Cr. 3. F.S. *Prereq: ENGL 310, ENGL 397, 9 other credits in English beyond ENGL 250, PSYCH 333, admission to teacher education program*

Portfolio review. Current theories and practices in the teaching of literature to secondary school students. Integrating literary study and writing. Preparation and selection of materials. Classroom presentation. Unit planning. (Taken concurrently with C I 280, Cr. 2, and Sp Ed 450).

ENGL 497. Capstone Assessment.

Cr. 1. F.S. *Prereq: Junior status*

Must be taken in conjunction with a 400-level English course.

Courses primarily for graduate students, open to qualified undergraduates:**ENGL 500. Proseminar: Teaching English Composition.**

(3-0) Cr. 3. F. *Prereq: Graduate classification; must be teaching Engl 150 or Engl 250 concurrently*

Required of all new English teaching assistants. Introduction to the teaching of ISUComm Foundation Courses. Foundational and relevant newer composition theory and pedagogical methods related to ISUComm Foundation Courses objectives and their classroom enactment, including development of assignments and supporting activities, and evaluation of student projects.

ENGL 501. Research Methods in Rhetoric and Professional Communication.

(3-0) Cr. 3. *Prereq: 6 graduate credits in English*

Survey of the major qualitative and quantitative methods used in research on communication and language in academic and nonacademic settings.

ENGL 503. Theory and Research in Composition.

(3-0) Cr. 3. *Prereq: 6 graduate credits in English*

In-depth consideration of the theory and practice of composition pedagogy. Opportunities for actual classroom application.

ENGL 504. Teaching Business and Technical Communication.

(3-0) Cr. 3. F.S.SS. *Prereq: MA in English or closely related field and must be teaching ENGL 302, ENGL 309, or ENGL 314 concurrently*

Practicum in teaching college courses in business and technical communication. Emphasis on curriculum planning, textbook selection, assignment design, materials development, and assessment of student work.

ENGL 505. Technology in Business, Technical, and Professional Communication.

(3-0) Cr. 3. *Prereq: Graduate classification*

Seminar course examining the role of technology, especially computer technology, in communication practices within academic and workplace settings.

ENGL 506. Theory and Research in Professional Communication.

(3-0) Cr. 3. *Prereq: Admission to English Department graduate degree program*

Introduction to professional communication as a discipline, with emphasis on theories of communication and discourse that inform professional communication research and on trends and developments in that research and the field.

ENGL 507. Writing and Analyzing Professional Documents.

(3-0) Cr. 3. *Prereq: Admission to English Department graduate degree program*

Introduction to the theory and practice of planning, preparing, and presenting information in written, oral, and visual forms prepared for business, science, industry, and government. Guided readings. Team projects. Individual projects.

ENGL 508. Advanced Workshop in Academic Writing.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: 6 graduate credits*

Hands-on practice in writing academic discourse for publication; rhetorical analyses of student-selected academic journals; discussion of current trends in academic writing; professional perspectives on the referee process and on journal editorial decision making. Focus on the writing of selected short pieces (opinion essays, standard reviews, conference-length papers) and of article-length manuscripts.

ENGL 509. Writing Proposals and Grant Applications.

(3-0) Cr. 3. *Prereq: Graduate classification*

Introduction to the theory and practice of preparing and analyzing proposals and grant applications intended for businesses, governmental agencies, and/or private and corporate foundations. Individual assignments and group projects include text documents and oral presentations.

ENGL 510. Introduction to Computers in Applied Linguistics.

(Cross-listed with LING). (3-0) Cr. 3. F. *Prereq: Graduate classification*

Use of software and web applications for language teaching, linguistic analysis, and statistical analysis. Issues and problems in applied linguistics related to computer methods.

ENGL 511. Introduction to Linguistic Analysis.

(Cross-listed with LING). (3-0) Cr. 3. F. *Prereq: Graduate classification*

Principles and methods of linguistic analysis with emphasis on phonology, morphology, and syntax. Description of linguistic variation and current theoretical approaches to linguistics.

ENGL 512. Second Language Acquisition.

(Cross-listed with LING). (3-0) Cr. 3. F. *Prereq: ENGL 511 or LING 511 or an introductory course in linguistics*

Theory, methods, and results of second language acquisition research with emphasis on approaches relevant to second language teaching.

ENGL 513. Language Assessment Practicum.

(Cross-listed with LING). (3-0) Cr. 3. F.S.SS. *Prereq: ENGL 519 or LING 519*

Advanced practicum in language assessment.

ENGL 514. Sociolinguistics.

(Cross-listed with LING). (3-0) Cr. 3. S. *Prereq: ENGL 511 or LING 511 or an introductory course in linguistics*

Theories and methods of examining language in its social setting. Analysis of individual characteristics (e.g., age, gender, ethnicity, social class, region), interactional factors (e.g., situation, topic, purpose) and national policies affecting language use.

ENGL 515. Statistical Natural Language Processing.

(Cross-listed with HCI, LING). (3-0) Cr. 3. F. *Prereq: STAT 330 or equivalent, recommended ENGL 219 or LING 219, or ENGL 511 or LING 511*

Introduction to computational techniques involving human language and speech in applications such as information retrieval and extraction, automatic text categorization, word prediction, intelligent Web searching, spelling and grammar checking, speech recognition and synthesis, statistical machine translation, n-grams, POS-tagging, word-sense disambiguation, on-line lexicons and thesauri, markup languages, corpus analysis, and Python programming language.

ENGL 518. Teaching English as a Second Language Methods and Materials.

(Cross-listed with LING). (3-0) Cr. 3. F. *Prereq: ENGL 511 or LING 511 or an introductory course in linguistics*

Introduction to approaches, methods, techniques, materials, curricular design, and assessment for various levels of ESL instruction. Attention to issues related to the teaching of listening, speaking, reading, writing, vocabulary, pronunciation, and culture.

ENGL 519. Second Language Assessment.

(Cross-listed with LING). (3-0) Cr. 3. S. *Prereq: ENGL 511 or LING 511*

Principles of second language assessment including reliability, validity, authenticity and practicality. Constructing, scoring, interpreting, and evaluating second language tests for a variety of situations.

ENGL 520. Computational Analysis of English.

(Cross-listed with HCI, LING). (3-0) Cr. 3. S. *Prereq: ENGL 510 or LING 510, and ENGL 511 or LING 511*

Concepts and practices for analysis of English by computer with emphasis on the applications of computational analysis to problems in applied linguistics such as corpus analysis and recognition of learner language in computer-assisted learning and language assessment.

ENGL 521. Teaching of Literature and the Literature Curriculum.

(3-0) Cr. 3. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Examination of the roles of the literary work, reader, and teacher in literary study. Responses to literature. Place of literature in language arts. Study and development of curriculum materials for middle school, high school, and college levels of instruction.

ENGL 522. Literary Theory and Criticism.

(3-0) Cr. 3. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Examination of the history, logic, and rhetoric of contemporary literary criticism and analysis.

ENGL 523. Introduction to Old English Language and Literature.

(3-0) Cr. 3. Prereq: Course in medieval literature or history or history of the English language recommended

Introductory study of Old English language and literature in prose and poetry, including extracts from Beowulf. Some attention to Anglo-Saxon culture.

ENGL 524. Literacy: Issues and Methods for Nonnative Speakers of English.

(Cross-listed with LING). (3-0) Cr. 3. F. Prereq: ENGL 511 or LING 511 or an introductory course in linguistics

Theoretical and practical issues and techniques in the teaching of literacy in a variety of contexts, involving children and adults at basic skill levels and teens and adults in academic and vocational programs.

ENGL 525. Methods in Teaching Listening and Speaking Skills to Nonnative Speakers of English.

(Cross-listed with LING). (3-0) Cr. 3. S. Prereq: ENGL 511 or LING 511 or an introductory course in linguistics

Theoretical and practical issues and techniques in the teaching of second language pronunciation, listening, and speaking skills. Topics will be relevant to those intending to teach in various contexts involving both K-12 and adult learners.

ENGL 526. Computer-Assisted Language Learning.

(Cross-listed with LING). (3-0) Cr. 3. S. Prereq: ENGL 511 or LING 511 or equivalent

Theory, research, and practice in computer use for teaching nonnative speakers of English. Methods for planning and evaluating computer-based learning activities.

ENGL 527. Discourse Analysis.

(Cross-listed with LING). (3-0) Cr. 3. S. Prereq: ENGL 511 or LING 511 or an introductory course in linguistics

Methods and theoretical foundations for linguistic approaches to discourse analysis. Applications of discourse analysis to the study of texts in a variety of settings, including academic and research contexts.

ENGL 528. English for Specific Purposes.

(Cross-listed with LING). (3-0) Cr. 3. Prereq: ENGL 511 or LING 511 or an introductory course in linguistics

Issues and techniques in analyzing, teaching, and assessing English for specific purposes. Topics include theories of specific purpose language use, analysis of learner needs in target language contexts, and corpus-informed syllabus and materials development for teaching and assessment.

ENGL 529. Multimedia Content Management.

(3-0) Cr. 3. Prereq: ENGL 313

Strategies for developing and delivering multimodal content via digital media. Focus on the principles of database design, interface development, usability testing, and collaborative content management within professional communication settings.

ENGL 531. Topics in the Study of Literature.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Intensive study of literary genres, periods, movements, or themes; e.g., Literature and Historicism, Narrating the Feminine, Allegory.

ENGL 532. American Literature to 1865.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Selected texts in American literature from Beginnings to the Civil War. Study may include Native American literature, the literature of European conquest, Colonial and Revolutionary periods, Early Republic, and Jacksonian Era, in critical and cultural contexts.

ENGL 533. British Literature to 1830.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Selected texts from the Medieval, Renaissance, Restoration, Eighteenth-Century, and/or Romantic periods, in critical and cultural contexts.

ENGL 534. American Literature 1865 to the Present.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Selected texts in American literature from the Civil War to the present. Study may include Realism, Naturalism, Modernism, and Postmodernism, with significant attention to race/ethnicity, gender, and identity, and to contemporary critical views. Range of authors and genres.

ENGL 535. British Literature 1830 to the Present.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Selected texts from the Victorian, Edwardian, Modernist, and/or Contemporary periods, in critical and cultural contexts.

ENGL 537. Corpus Approaches to Grammatical Analysis.

(Cross-listed with LING). (3-0) Cr. 3. F. Prereq: ENGL 220 or LING 220; ENGL 219, LING 219, ENGL 511, LING 511, or introductory course in linguistics; graduate classification

Corpus-informed analysis of syntax in authentic writing and speech, with emphasis on approaches used in applied linguistics: rationalist, empirical, functional, cognitive, and pedagogical.

ENGL 538. Fiction.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Selected fiction writers in English; range of authors and genres. Emphasis on both male and female writers; attention to the relationships between fiction and cultural change.

ENGL 539. Poetry.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Selected poets writing in English, considered in representative groups.

ENGL 540. Drama.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Primary texts in dramatic genres from various literary periods, in critical and cultural contexts. Frequently concentrates on the English Renaissance and the Shakespearean stage.

ENGL 541. Autobiography, Biography, Memoir.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Study of lifewriting, e.g., autobiography, biography, memoir, cross-genre writing, autobiographical criticism. Readings may be arranged by period, nationality, or subgenre (e.g., autobiography of childhood experience, celebrity auto/biography).

ENGL 542. Production Processes for Technical Documents.

(3-0) Cr. 3. Prereq: Senior classification

Overview of the principles of desktop publishing as practiced in the field of technical communication. Focus on theories of print document design and project management, as well as digital prepress techniques employed to produce documents using external print services. Requires extensive use of current desktop publishing software.

ENGL 543. The Study of Environmental Literature.

(3-0) Cr. 3. Prereq: Graduate classification

Intensive study of environmental literary genres, periods, figures, movements, or themes: e.g., Ecofeminism, Imagining Natural Disaster, Material Ecocriticism, Environmental Justice, Posthumanism.

ENGL 544. Postcolonial or Multicultural Literatures.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

U.S. multicultural literatures or colonial and postcolonial Anglophone literatures from various locations, in critical and cultural contexts. Development of literary traditions, discourses of race and gender, counter-storytelling, myths of origin, literary phases and movements. Readings in several genres.

ENGL 545. Women's Literature.

(Cross-listed with W S). (3-0) Cr. 3. Repeatable, maximum of 6 credits. Prereq: Graduate classification or 6 credits in literature at 300 level or above

Primary texts by women writers; historical, thematic, formal, or theoretical approaches; secondary readings; e.g., Nineteenth-Century Women Writers; American Women's Personal Narratives; Southern Women Writers of the U.S.

ENGL 546. Issues in the Study of Literature.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: Graduate classification or 6 credits in literature at 300 level or above*

Intensive study of current and emerging topics and problems concerning literature and its relationship to theory and to language study; e.g., Theory of Metaphor; Renegotiating the Canon; Feminist Theory.

ENGL 547. The History of Rhetorical Theory I: From Plato to Bacon.

(Cross-listed with SP CM). (3-0) Cr. 3. *Prereq: 6 credits in English*

Rhetorical theory from the classical period of ancient Greece and Rome through the Middle Ages to the early Renaissance; attention to its relation to the nature of knowledge, communication, practice, and pedagogy.

ENGL 548. The History of Rhetorical Theory II: From Bacon to the Present.

(Cross-listed with SP CM). (3-0) Cr. 3. *Prereq: 6 credits in English*

Rhetorical theory from the early modern period (Bacon, Descartes, and Locke) to the present; attention to its relation to the nature of knowledge, communication practice, and pedagogy.

ENGL 549. Multimedia Design in Professional Communication.

(3-0) Cr. 3. *Prereq: Senior classification*

Rhetorical principles of information-based multimedia design. Practical understanding of computer applications used in multimedia development. Focus on theoretical and practical elements of producing multimedia training programs in both education and industry. Work with interactive hypertext, digital audio, and non-linear video editing.

ENGL 550. Creative Writing: Craft and Professional Practice.

(3-0) Cr. 3. F. *Prereq: Admission into MFA Program in Creative Writing and Environment*

A multigenre craft course required of all incoming students in the MFA Program in Creative Writing and Environment. Students develop an understanding of craft and environmental writing across genres (poetry, fiction, nonfiction) as well as learn about editing and publication practice through the lens of a working literary journal, "Flyway: A Journal of Writing and Environment." Other course activities include presentations on the production practices of leading literary journals, individual editing projects, pragmatic tips for finding publication outlets for polished creative work, and a field trip to publishing houses.

ENGL 551. Master Workshop.

(3-0) Cr. 3. S. *Prereq: Fourth-semester or equivalent standing in the Creative Writing and Environment MFA program*

An advanced multi-genre creative writing workshop. Students work intensively on book-length manuscripts of fiction, creative nonfiction, or poetry.

ENGL 553. Workshop: Writing The Long Project.

(3-0) Cr. 3. Repeatable, maximum of 12 credits. *Prereq: ENGL 550 and graduate classification. Open to graduate students outside MFA in Creative Writing and Environment with permission of instructor*

Individual long creative writing project ideas developed in course. Portions of long creative writing project workshoped, revised, and discussed in conferences.

ENGL 554. Workshop: Fiction.

(3-0) Cr. 3. Repeatable, maximum of 12 credits. *Prereq: ENGL 550 and graduate classification. Open to graduate students outside MFA in Creative Writing and Environment with permission of instructor*

Individual projects in fiction on a workshop and conference basis. Readings in short fiction. Discussion of elements of narrative such as plot, point of view, characterization, theme, setting.

ENGL 555. Workshop: Nonfiction.

Cr. arr. Repeatable, maximum of 12 credits. *Prereq: ENGL 550 and graduate classification. Open to graduate students outside MFA in Creative Writing and Environment with permission of instructor*

Individual projects in memoir, immersion journalism, character studies, and/or the personal essay on a workshop and conference basis. Readings in creative nonfiction.

ENGL 556. Workshop: Poetry.

(3-0) Cr. 3. Repeatable, maximum of 12 credits. *Prereq: ENGL 550 and graduate classification. Open to graduate students outside MFA in Creative Writing and Environment with permission of instructor*

Individual projects in poetry on a workshop and conference basis. Readings in poetry. Discussion of poetic elements such as image, sound, internal structure, rhythm, tone, figurative language.

ENGL 557. Studies in Creative Writing.

(3-0) Cr. 3. Repeatable, maximum of 12 credits. *Prereq: Graduate classification.*

Open to graduate students outside MFA in Creative Writing and Environment with permission of instructor.

Special topics course on ideas, issues, and techniques in creative writing. Subject matter may include specific genres, aspects of the creative writing process, or themes of particular interest. Significant readings and written work required; previous workshop experience helpful.

ENGL 558. Teaching Creative Writing.

(3-0) Cr. 3. *Prereq: Graduate classification*

Pedagogical approaches that are effective for grade-school through adult-education creative writing teaching. Writing exercises, workshops, text evaluation, and visits from creative writers.

ENGL 559. Creative Writing Teaching Internship.

Cr. 1-3. Repeatable. *Prereq: Permission of participating instructors*

Students assist in an introductory creative writing class. Some supervised teaching but mainly evaluation of submissions and individual conferences. Requirements and grades determined by participating instructors.

ENGL 560. Environmental Field Experience.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 550 and graduate classification. Open to graduate students outside MFA in Creative Writing and Environment with permission of instructor*

Students spend a term on a project that requires fieldwork. Projects might include working for a federal, state, or private non-profit environmental organization or farm, or living and working in a specified natural area.

ENGL 582. Advanced Rhetorical Analysis.

(Cross-listed with SP CM). (3-0) Cr. 3.

Extended practice in close textual analysis of various kinds of rhetorical artifacts. Attention to important theoretical concepts used in rhetorical analysis and to historical controversies over the scope and function of rhetorical analysis.

ENGL 586. Visual Rhetoric in Professional Communication.

(3-0) Cr. 3. *Prereq: A course in professional communication*

Rhetorical theory and research in graphics, document design, and related principles of visual communication. Methods of designing texts, data displays, illustrations, and other visual elements in business and technical communication.

ENGL 587. Internship in Business, Technical, and Professional Communication.

(3-0) Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: ENGL 507 plus 3 additional graduate credits in business and technical writing or composition and rhetoric, permission of instructor. Limited to master's and doctoral degree candidates in the field of rhetoric and professional communication*

An opportunity to write, edit, and design business and technical documents in a professional setting.

ENGL 588. Supervised Practice Teaching in Teaching English as a Second Language.

(Cross-listed with LING). (1-5) Cr. 3. F.S.SS. *Prereq: 9 credits toward the TESL/TEFL Certificate, 15 credits toward the TESL/AL master's degree, or 18 credits completed toward the ESL Endorsement option.*

Intensive observation of ESL instruction and supervised practice in teaching learners of English in a context appropriate to the student teacher's goals. ENGL 588 cannot be used for teacher licensure and cannot be taken during student teaching.

ENGL 589. Supervised Practicum in Literary Editing.

(3-0) Cr. 3. S. *Prereq: ENGL 550, at least one graduate creative writing workshop, permission of instructor*

Students assume editorial duties for "Flyway: A Journal of Writing and Environment," a nationally distributed literary journal: overseeing a staff, screening submissions, corresponding with authors, editing and proofing, assisting with layout, communicating with the printer, overseeing a contest, and promoting the magazine.

ENGL 590. Special Topics.

Cr. arr. Repeatable. *Prereq: Permission of the Director of Graduate Education according to guidelines available online*

ENGL 590A. Special Topics: Literature.

Cr. arr. Repeatable. *Prereq: Permission of the Director of Graduate Education according to guidelines available online*

ENGL 590B. Special Topics: Teaching English as a Second Language (TESL)/Applied Linguistics.

(Cross-listed with LING). Cr. arr. Repeatable. *Prereq: PERMISSION of the Director of Graduate Education according to guidelines available online*

ENGL 590C. Special Topics: Composition and Rhetoric.

Cr. arr. Repeatable. *Prereq: Permission of the Director of Graduate Education according to guidelines available online*

ENGL 590E. Special Topics: Rhetoric and Professional Communication.

Cr. arr. Repeatable. *Prereq: Permission of the Director of Graduate Education according to guidelines available online*

ENGL 590F. Special Topics: Creative Writing.

Cr. arr. Repeatable. *Prereq: Permission of the Director of Graduate Education according to guidelines available online*

ENGL 590G. Special Topics: Applied Linguistics and Technology.

(Cross-listed with LING). Cr. arr. Repeatable. *Prereq: Permission of the Director of Graduate Education according to guidelines available online*

ENGL 591. Directed Readings.

Cr. arr. Repeatable.

ENGL 591A. Directed Readings: Literature.

Cr. arr. Repeatable.

ENGL 591B. Directed Readings: Teaching English as a Second Language (TESL)/Applied Linguistics.

(Cross-listed with LING). Cr. arr. Repeatable.

ENGL 591C. Directed Readings: Composition and Rhetoric.

Cr. arr. Repeatable.

ENGL 591E. Directed Readings: Rhetoric and Professional Communication.

Cr. arr. Repeatable.

ENGL 591F. Directed Readings: Creative Writing.

Cr. arr. Repeatable.

ENGL 591G. Directed Readings: Applied Linguistics and Technology.

(Cross-listed with LING). Cr. arr. Repeatable.

ENGL 592. Core Studies in Rhetoric and Professional Communication.

(Cross-listed with SP CM). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 12 credits in rhetoric, linguistics, or literature, excluding ENGL 150 and ENGL 250* Seminar on topics central to the fields of rhetoric and professional communication or composition.

ENGL 592A. Core Studies in Rhetoric and Professional Communication: Rhetoric of Science and Technology.

(Cross-listed with SP CM). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 12 credits in rhetoric, linguistics, or literature, excluding ENGL 150 and ENGL 250* Seminar on topics central to the fields of rhetoric and professional communication or composition.

ENGL 592B. Core Studies in Rhetoric and Professional Communication: Visual Rhetoric.

(Cross-listed with SP CM). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 12 credits in rhetoric, linguistics, or literature, excluding ENGL 150 and ENGL 250* Seminar on topics central to the fields of rhetoric and professional communication or composition.

ENGL 592C. Core Studies in Rhetoric and Professional Communication: Multimodal Theory and Pedagogy.

(Cross-listed with SP CM). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 12 credits in rhetoric, linguistics, or literature, excluding ENGL 150 and ENGL 250* Seminar on topics central to the fields of rhetoric and professional communication or composition.

ENGL 592D. Core Studies in Rhetoric and Professional Communication: Critical Cultural Rhetorics.

(Cross-listed with SP CM). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 12 credits in rhetoric, linguistics, or literature, excluding ENGL 150 and ENGL 250* Seminar on topics central to the fields of rhetoric and professional communication or composition.

ENGL 595. Graduate Study and Travel.

Cr. arr. *Prereq: Permission of instructor* Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 595A. Graduate Study and Travel: Literature.

Cr. arr. *Prereq: Permission of instructor* Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 595B. Graduate Study and Travel: Creative Writing.

Cr. arr. *Prereq: Permission of instructor* Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 595C. Graduate Study and Travel: Linguistics.

Cr. arr. *Prereq: Permission of instructor* Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 595D. Graduate Study and Travel: Rhetoric and Professional Communication.

Cr. arr. *Prereq: Permission of instructor* Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 595E. Graduate Study and Travel: Teacher Education.

Cr. arr. *Prereq: Permission of instructor* Supervised study of an appropriate area of the discipline while traveling in a foreign country or in the U.S. Special fees apply.

ENGL 599. Creative Component.

Cr. 3. F.S.SS. *Prereq: Graduate classification, permission of major professor*

Courses for graduate students:**ENGL 602. Research Design in Rhetoric and Professional Communication.**

(3-0) Cr. 3-6. Repeatable, maximum of 6 credits. A workshop for advanced graduate students in rhetoric and professional communication.

ENGL 603. Seminar in Advanced Pedagogy in Rhetoric and Composition: Theory and Research.

(3-0) Cr. 3. *Prereq: ENGL 503* Exploration of relationships between theory and practice in current pedagogy. Intensive examination of contemporary theories of poststructuralism, new media, feminism, postcolonialism, or cultural studies and their impact on current pedagogical practice. Participation in pedagogical research and theory building.

ENGL 611. Topics in Rhetorical Theory.

(3-0) Cr. 3. Repeatable. *Prereq: ENGL 547 or ENGL 548* Rhetorical theory, criticism, and/or practice in relation to an historical period or a particular theoretical issue.

ENGL 623. Research Methods in Applied Linguistics.

(Cross-listed with LING). (3-0) Cr. 3. F. *Prereq: ENGL 511 or LING 511, ENGL 517 or LING 517, ENGL 519 or LING 519* Survey of research traditions in applied linguistics. Focus on theoretical and practical aspects of quantitative and qualitative approaches to applied linguistic study, including experimental and quasiexperimental methods, classroom observation and research, introspective methods, elicitation techniques, case studies, interactional analysis, ethnography, and program evaluation. Computational tools and resources for linguistic research will be highlighted.

ENGL 626. Computer-Assisted Language Testing.

(Cross-listed with LING). (3-0) Cr. 3. F. *Prereq: ENGL 510 or LING 510, ENGL 511 or LING 511, ENGL 519 or LING 519* Principles and practice for the use and study of computers and the Internet in second language assessment.

ENGL 630. Seminar in Technology and Applied Linguistics.

(Cross-listed with LING). (3-0) Cr. 3. Repeatable. *Prereq: ENGL 510 or LING 510, ENGL 511 or LING 511* Topic changes each semester. Topics include advanced methods in natural language processing, technology and literacy in a global context, feedback in CALL programs, technology and pronunciation, and advances in language assessment.

ENGL 631. Organization and Administration of Multimodal Writing Programs.

(3-0) Cr. 3. *Prereq: ENGL 500, ENGL 503, ENGL 504, or ENGL 603* Survey of the major components of writing instruction in academic and nonacademic settings. History, theory, organization, and evaluation of writing programs. Guided observation of writing program functions at various institutions and businesses.

ENGL 688. Practicum in Technology and Applied Linguistics.

(Cross-listed with LING). (1-5) Cr. 3. F.S.SS. *Prereq: ENGL 510 or LING 510, ENGL 626 or LING 626, or equivalent; at least 2nd year PhD student in Applied Linguistics and Technology* Focus on integrating theoretical knowledge with practical expertise. Assess client needs; develop, integrate, and evaluate solutions. Practical understanding of computer applications used in multimedia development. Create web-based or CD-ROM-based multimedia materials. Work with advanced authoring applications.

ENGL 699. Research.

Cr. arr. Repeatable. F.S.SS. *Prereq: Graduate classification, permission of major professor* Research.

Entomology (ENT)

Courses primarily for undergraduates:

ENT 201. Introduction to Insects.

(1-0) Cr. 1. F.S.SS.

5 weeks. Classroom section spring only. World Wide Web section of course offered summer and fall semesters. Biological and ecological aspects of insects.

ENT 211. Insects and Society.

(2-0) Cr. 2. F.S. *Prereq:* ENT 201

11 weeks. Classroom section spring only. World Wide Web section offered fall semester. The importance of insects in human well-being. Insect-human interactions. Primarily for nonscience and nonagriculture majors.

ENT 283. Pesticide Application Certification.

(Cross-listed with AGRON, FOR, HORT). (2-0) Cr. 2. S.

Core background and specialty topics in agricultural, and horticultural pesticide applicator certification. Students can select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

ENT 370. Insect Biology.

(2-3) Cr. 3. F. *Prereq:* BIOL 101 or BIOL 211

Structure, physiology, evolution, behavior, life histories, and recognition of insects. Collection required.

ENT 371I. Introduction to Insect Ecology.

(Cross-listed with IA LL). (3-3) Cr. 4. Alt. SS., offered odd-numbered years.

Field and laboratory study of insects, their diversity, life history; emphasis on ecology and behavior.

ENT 372. Livestock Entomology.

(2-0) Cr. 2. Alt. S., offered odd-numbered years.

Classroom and off-campus videotape sections. 12 weeks. Recognition, biology, behavior, economic importance, and management of insects and other arthropods affecting livestock and poultry production.

ENT 374. Insects and Our Health.

(Cross-listed with MICRO). (3-0) Cr. 3. S. *Prereq:* 3 credits in biological sciences

Identification, biology, and significance of insects and arthropods that affect the health of humans and animals, particularly those that are vectors of disease. Meets International Perspectives Requirement.

ENT 374L. Insects and Our Health Laboratory.

(Cross-listed with MICRO). (0-3) Cr. 1. Alt. S., offered even-numbered years.

Prereq: Credit or enrollment in ENT 374

Laboratory and field techniques for studying medical or public health entomology, including: collection, identification and maintenance of medically significant arthropods and experimental design and execution related to the biology of arthropods or arthropod-pathogen interactions.

ENT 375. Plant Protection Using Natural Enemies.

(Dual-listed with ENT 575). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: ENT 370 or ENT 376

Overview of the biology, ecology, and classification of insect pathogens, predators, and parasitoids. Discussion of the use of these organisms in plant protection, including an emphasis on genetic alteration of natural enemies.

ENT 376. Fundamentals of Entomology and Pest Management.

(2-3) Cr. 3. S. *Prereq:* BIOL 101 or BIOL 211

Introduction to entomology and insect-pest management, including life processes, ecology, economics, tactics of population suppression, and ecological backlash.

ENT 410. Insect-Virus Interactions: a Molecular Perspective.

(Dual-listed with ENT 510). (Cross-listed with MICRO). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* Permission of an instructor.

Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

ENT 425. Aquatic Insects.

(Dual-listed with ENT 525). (Cross-listed with A ECL). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* BIOL 312 or equivalent

Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

ENT 452. Integrated Management of Diseases and Insect Pests of Turfgrasses.

(Dual-listed with ENT 552). (Cross-listed with HORT, PL P). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* HORT 351

Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

ENT 466. Ecosystem Service Management.

(Dual-listed with ENT 566). (Cross-listed with ENSCI, NREM). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* permission of instructor

Land use and conservation techniques for improving ecosystem services including: pollination of crops, biological control of pests, prevention of erosion and water quality improvement.

ENT 471. Insect Ecology.

(Dual-listed with ENT 571). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: 9 credits biological sciences

The contribution of insects to ecosystem function is staggering. This course will focus on insect population ecology, predator-prey interaction and chemical ecology. The role of insects in nutrient cycling, pollination and pest management will be discussed with case studies used to highlight the applied nature of insect ecology and its relationship to agriculture.

ENT 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq:* 15 credits in biological sciences, junior or senior classification

A maximum of 9 credits of all (university-wide) 490 credits may be applied toward graduation.

ENT 490E. Independent Study: Research or work experience..

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq:* 15 credits in biological sciences, junior or senior classification

A maximum of 9 of all (university-wide) 490 credits may be used toward graduation.

ENT 490U. Independent Study: Laboratory teaching experience.

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq:* 15 credits in biological sciences, junior or senior classification. For students registering to be undergraduate laboratory assistants.

A maximum of 9 of all (university-wide) 490 credits may be used toward graduation.

Courses primarily for graduate students, open to qualified undergraduates:

ENT 510. Insect-Virus Interactions: a Molecular Perspective.

(Dual-listed with ENT 410). (Cross-listed with MICRO). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* Permission of an instructor.

Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

ENT 511. Integrated Management of Tropical Crops.

(Cross-listed with HORT, PL P). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: PL P 408 or PL P 416 or ENT 370 or ENT 376 or HORT 221

Applications of Integrated Crop Management principles (including plant pathology, entomology, and horticulture) to tropical cropping systems. Familiarization with a variety of tropical agroecosystems and Costa Rican culture is followed by 10-day tour of Costa Rican agriculture during spring break, then writeup of individual projects.

Meets International Perspectives Requirement.

ENT 525. Aquatic Insects.

(Dual-listed with ENT 425). (Cross-listed with A ECL). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* BIOL 312 or equivalent

Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

ENT 530. Ecologically Based Pest Management Strategies.

(Cross-listed with AGRON, PL P, SUSAG). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

ENT 550. Pesticides in the Environment.

(Cross-listed with TOX). (2-0) Cr. 2. S. *Prereq:* 9 credits of biological sciences

Fate and significance of pesticides in soil, water, plants, animals, and the atmosphere.

ENT 552. Integrated Management of Diseases and Insect Pests of Turfgrasses.

(Dual-listed with ENT 452). (Cross-listed with HORT, PL P). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: HORT 351*

Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

ENT 555. Insect Physiology.

(3-3) Cr. 4. S. *Prereq: ENT 370*

Life processes of the insects, including reviews of current problems in insect physiology.

ENT 566. Ecosystem Service Management.

(Dual-listed with ENT 466). (Cross-listed with ENSCI, NREM). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: permission of instructor*

Land use and conservation techniques for improving ecosystem services including: pollination of crops, biological control of pests, prevention of erosion and water quality improvement.

ENT 568. Advanced Systematics.

(Cross-listed with EEOB). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Permission of instructor*

Principles and practice of systematic biology; taxonomy, nomenclature and classification of plants and animals; sources and interpretation of systematic data; speciation; fundamentals of phylogenetic systematics.

ENT 570. Plant-Insect Interaction.

(2-0) Cr. 2. Alt. F., offered odd-numbered years. *Prereq: 9 credits in biological sciences*

Physiological, behavioral, ecological, and evolutionary factors that govern interactions between insects and plants, applications of this knowledge to agriculture, and important results from the study of natural systems. Additional topics covered during the semester include: tritrophic interactions, biological control of plants by insects, and pollination biology. Student-led discussions and draws on both the primary and secondary literature.

ENT 571. Insect Ecology.

(Dual-listed with ENT 471). (2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 9 credits biological sciences*

The contribution of insects to ecosystem function is staggering. This course will focus on insect population ecology, predator-prey interaction and chemical ecology. The role of insects in nutrient cycling, pollination and pest management will be discussed with case studies used to highlight the applied nature of insect ecology and its relationship to agriculture.

ENT 574. Medical Entomology.

(3-3) Cr. 4. Alt. S., offered even-numbered years. *Prereq: 9 credits in biological sciences*

Identification, biology, and significance of insects and other arthropods that attack people and animals, particularly those that are vectors of disease.

ENT 575. Plant Protection Using Natural Enemies.

(Dual-listed with ENT 375). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: ENT 370 or ENT 376*

Overview of the biology, ecology, and classification of insect pathogens, predators, and parasitoids. Discussion of the use of these organisms in plant protection, including an emphasis on genetic alteration of natural enemies.

ENT 576. Systematic Entomology.

(3-6) Cr. 5. Alt. F., offered even-numbered years. *Prereq: ENT 370*

Classification, distribution, and natural history of insects, including fundamentals of phylogenetic systematics, biogeography, taxonomic procedures, and insect collection and curation.

ENT 590. Special Topics.

Cr. 1-3. Repeatable. *Prereq: 15 credits in biological sciences.*

ENT 590A. Special Topics: Biological Control and Pathology..

Cr. 1-3. Repeatable.

ENT 590B. Special Topics: Chemical Ecology and Behavior..

Cr. 1-3. Repeatable.

ENT 590C. Special Topics: Ecology and Pest Management..

Cr. 1-3. Repeatable.

ENT 590D. Special Topics: Evolution and Systematics..

Cr. 1-3. Repeatable.

ENT 590E. Special Topics: Special Research Topics..

Cr. 1-3. Repeatable.

ENT 590F. Special Topics: Medical and Veterinary Entomology..

Cr. 1-3. Repeatable.

ENT 590G. Special Topics: Molecular Entomology..

Cr. 1-3. Repeatable. Alt. F., offered even-numbered years. *Prereq: 15 credits in biological sciences.*

ENT 590H. Special Topics: Physiology and Biochemistry..

Cr. 1-3. Repeatable.

ENT 590I. Special Topics: Toxicology.

Cr. 1-3. Repeatable.

ENT 590K. Special Topics: Teaching Experience..

Cr. 1-3. Repeatable.

ENT 590L. Special Topics: Extension Internship..

Cr. 1-3. Repeatable.

ENT 590M. Special Topics: Immature Insects..

Cr. 1-3. Repeatable.

ENT 590N. Special Topics: Population Genetics..

Cr. 1-3. Repeatable.

Courses for graduate students:**ENT 600. Seminar.**

Cr. 1. F.S.SS.

Presentation of research results.

ENT 675. Insecticide Toxicology.

(Cross-listed with TOX). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: ENT 555 or TOX 501*

Principles of insecticide toxicology; classification, mode of action, metabolism, and environmental effects of insecticides.

ENT 699. Research.

Cr. arr. Repeatable.

Environmental Science (ENSCI)

Courses primarily for undergraduates:

ENSCI 110. Orientation to Environmental Science.

(1-0) Cr. 1. F. *Prereq:* Freshman classification in EnSci
Overview of Environmental Science curriculum and discussion of professional opportunities. Offered on a satisfactory-fail basis only.

ENSCI 201. Introduction to Environmental Issues.

(Cross-listed with BIOL, ENV S). (2-0) Cr. 2. F.
Discussion of current and emerging environmental issues such as human population growth, energy use, loss of biodiversity, water resources, and climate change.

ENSCI 202. Exploration of Environmental and Sustainability Issues.

(1-0) Cr. 1. F. *Prereq:* Credit or enrollment in ENSCI 201
Exploration of specific environmental and sustainability issues; designed to complement ENSCI 201. Offered on a satisfactory-fail basis only.

ENSCI 203. Exploration of Environmental Science.

(1-0) Cr. 1. S. *Prereq:* ENSCI 202.
Continued exploration of specific environmental science issues developed in ENSCI 202. Topics may vary in different years. Offered on a satisfactory-fail basis only.

ENSCI 250. Environmental Geography.

(Cross-listed with ENV S). (3-0) Cr. 3. F.
The distribution, origins and functions of the earth's physical systems and the spatial relationship between human activity and the natural world.

ENSCI 251. Biological Processes in the Environment.

(Cross-listed with BIOL). (3-0) Cr. 3. S.
Plant and microbial processes in environmental systems including their interactions with human activities.

ENSCI 301. Natural Resource Ecology and Soils.

(Cross-listed with NREM). (3-3) Cr. 4. F. *Prereq:* BIOL 211, BIOL 211L; FOR 201 or a second course in biology
Effects of environmental factors on ecosystem structure and function using forest, prairie and agricultural ecosystems as models. Special emphasis is given to soil-forming factors and the role of soil in nutrient and water cycling and ecosystem dynamics. Additional emphasis is given to human influences on natural ecosystems and the role of perennial plant communities in agricultural landscapes.

ENSCI 312. Ecology.

(Cross-listed with A ECL, BIOL). (3-3) Cr. 4. F.SS. *Prereq:* BIOL 211, BIOL 211L, BIOL 212, and BIOL 212L
Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

ENSCI 312I. Ecology.

(Cross-listed with A ECL, IA LL). Cr. 4. SS.
An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

ENSCI 324. Energy and the Environment.

(Cross-listed with ENV S, GEOL, MTEOR). (3-0) Cr. 3. S.
Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, geothermal, biomass, hydroelectric, and solar energy. Biofuels. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, coal ash, mountaintop removal mining, oil drilling, hydraulic fracturing, groundwater contamination, nuclear waste disposal, and global climate change. Carbon sequestration and geoengineering solutions for reducing atmospheric CO₂ concentrations.

ENSCI 345. Natural Resource Photogrammetry and Geographic Information Systems.

(Cross-listed with NREM). (2-3) Cr. 3. F. *Prereq:* Junior classification
Measurement and interpretation of aerial photos in resource management. Introduction to Geographic Information Systems (GIS) using ArcGIS including digitizing, development and query of attribute tables, georeferencing, and use of multiple GIS layers in simple spatial analyses.

ENSCI 360. Environmental Soil Science.

(Cross-listed with AGRON). (2-3) Cr. 3. S. *Prereq:* AGRON 154 or ENSCI 250 or GEOL 201
Application of soil science to contemporary environmental problems; comparison of the impacts that different management strategies have on short- and long-term environmental quality and land development. Emphasis on participatory learning activities.

ENSCI 381. Environmental Systems I: Introduction to Environmental Systems.

(Dual-listed with ENSCI 581). (Cross-listed with BIOL, ENV S, MICRO). Cr. 3-4. F. *Prereq:* 12 credits of natural science including biology and chemistry
Introduction to the structure and function of natural environmental systems. Emphasis on the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

ENSCI 382. Environmental Systems II: Analysis of Environmental Systems.

(Dual-listed with ENSCI 582). (Cross-listed with BIOL). (2-2) Cr. 3. S. *Prereq:* ENSCI 381
Continuation of EnSci 381. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

ENSCI 384. Introduction to Ecosystems.

(3-0) Cr. 3. S. *Prereq:* 12 credits of natural science including biology and chemistry
Biological and physical processes affecting material and energy flows in natural and managed ecosystems. Understanding and predicting climate and management impacts on ecosystem services and sustainability.

ENSCI 390. Internship in Environmental Science.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Approval of the Environmental Science coordinator
Supervised off-campus work experience in the field of environmental science. Offered on a satisfactory-fail basis only.

ENSCI 391. Apprenticeship.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Approval of the Environmental Science Coordinator
Practical experience in an approved setting such as a research laboratory, government office, or private office. Offered on a satisfactory-fail basis only.

ENSCI 402. Watershed Hydrology.

(Dual-listed with ENSCI 502). (Cross-listed with GEOL, MTEOR, NREM). (3-3) Cr. 4. F. *Prereq:* Four courses in physical or biological sciences or engineering; junior standing
Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

ENSCI 402I. Watershed Hydrology and Surficial Processes.

(Cross-listed with AGRON, IA LL). Cr. 4. SS. *Prereq:* Four courses in physical or biological sciences or engineering
Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminants) in watersheds. Fieldwork will emphasize investigations of the Iowa Great Lakes watershed.

ENSCI 404. Global Change.

(Dual-listed with ENSCI 504). (Cross-listed with AGRON, ENV S, MTEOR). (3-0) Cr. 3. S. *Prereq:* Four courses in physical or biological sciences or engineering; junior standing
Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Also offered online Alt. F, even-numbered years.

ENSCI 405. Environmental Biophysics.

(Dual-listed with ENSCI 505). (Cross-listed with AGRON, MTEOR). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* MATH 165 or MATH 182 or equivalent and some computer programming experience (any language)
A description of the physical microenvironment in which organisms live. Emphasis on the movement of energy (heat and radiation) and mass (water and carbon) among organisms, the soil, and atmosphere. Applications to humans, other animals, plants, and plant communities.

ENSCI 406. World Climates.

(Cross-listed with AGRON, MTEOR). (3-0) Cr. 3. S. *Prereq:* AGRON 206/MTEOR 206

Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required.

Meets International Perspectives Requirement.

ENSCI 407. Watershed Management.

(Dual-listed with ENSCI 507). (Cross-listed with ENV S, NREM). (3-3) Cr. 4. S.

Prereq: A course in general biology

Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

ENSCI 408. GIS and Natural Resources Management.

(Dual-listed with ENSCI 508). (Cross-listed with A B E). (2-2) Cr. 3. F. *Prereq:*

Working knowledge of computers and Windows environment

Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS.

ENSCI 409. Field Methods in Hydrogeology.

(Dual-listed with ENSCI 509). (Cross-listed with GEOL). (0-4) Cr. 3. Alt. SS., offered even-numbered years. *Prereq:* GEOL/ENSCI 402 or GEOL/ENSCI 411 or C E 473

Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, and electronic instrumentation for data collection. Field trips to investigate water resource, water quality, and remediation projects.

ENSCI 411. Hydrogeology.

(Dual-listed with ENSCI 511). (Cross-listed with GEOL). (3-2) Cr. 4. F. *Prereq:*

Four courses in biological or physical sciences

Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations.

ENSCI 414. Applied Groundwater Flow Modeling.

(Dual-listed with ENSCI 514). (Cross-listed with GEOL). (2-2) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* GEOL 411 or C E 473; MATH 165 or MATH 181

Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course.

ENSCI 415. Paleoclimatology.

(Dual-listed with ENSCI 515). (Cross-listed with GEOL). (3-0) Cr. 3. Alt. S., offered

odd-numbered years. *Prereq:* Four courses in biological or physical science

Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~1 million years).

ENSCI 416. Hydrologic Modeling and Analysis.

(Dual-listed with ENSCI 516). (Cross-listed with GEOL, MTEOR). (2-3) Cr. 3.

Alt. S., offered odd-numbered years. *Prereq:* Four courses in Earth science, meteorology, or engineering; junior standing

Study of the basic principles of hydrologic modeling, including rainfall-runoff analysis, lumped and distributed modeling, conceptual and physical models, parameter estimation and sensitivity analysis, input and validation data, uncertainty analysis, and the use of models in surface water hydrology. A range of common models are applied to study hydrologic topics such as flood forecasting and land use change impacts. Previous experience with Matlab or other programming language is needed.

ENSCI 418. Stream Ecology.

(Dual-listed with ENSCI 518). (Cross-listed with A ECL). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* A ECL 486

Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

ENSCI 419. Environmental Geochemistry.

(Dual-listed with ENSCI 519). (Cross-listed with GEOL). (2-2) Cr. 3. F. *Prereq:*

GEOL 402 or GEOL 411 or equivalent

Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling.

ENSCI 420. Environmental Engineering Chemistry.

(Dual-listed with ENSCI 520). (Cross-listed with C E). (2-3) Cr. 3. F. *Prereq:* C E

326, CHEM 177 and CHEM 178, MATH 166

Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilibria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions, and mass transfer principles. Individual laboratory practicals and group projects required.

ENSCI 422I. Prairie Ecology.

(Cross-listed with IA LL). Cr. 4. SS. *Prereq:* Familiarity with basic principles in

biological sciences and ecology

Basic patterns and underlying physical and biotic causes of both regional and local distributions of plants and animals of North American prairies; field and laboratory analyses and projects.

ENSCI 424. Air Pollution.

(Dual-listed with ENSCI 524). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq:*

Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.

Senior classification or above

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

ENSCI 424A. Air Pollution: Air quality and effects of pollutants.

(Dual-listed with ENSCI 524A). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq:*

Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.

Senior classification or above

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

ENSCI 424B. Air Pollution: Climate change and causes.

(Dual-listed with ENSCI 524B). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq:*

Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.

Senior classification or above

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

ENSCI 424C. Air Pollution: Transportation Air Quality.

(Dual-listed with ENSCI 524C). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq:*

C E 524A; PHYS 221 or CHEM 178; MATH 166 or 3 credits in statistics.

Senior classification or above.

ENSCI 424D. Air Pollution: Off-gas treatment technology.

(Dual-listed with ENSCI 524D). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq:*

Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.

Senior classification or above

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

ENSCI 424E. Air Pollution: Agricultural sources of pollution.

(Dual-listed with ENSCI 524E). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq:*

Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics.

Senior classification or above

1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

ENSCI 426. Stable Isotopes in the Environment.

(Dual-listed with ENSCI 526). (Cross-listed with GEOL). (3-0) Cr. 3. Alt. S., offered

even-numbered years. *Prereq:* Four courses in biological or physical science

Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance.

ENSCI 431. Design and Evaluation of Soil and Water Conservation Systems. (Dual-listed with ENSCI 531). (Cross-listed with A B E). (2-2) Cr. 3. F. *Prereq:* E M 378 or CH E 356

Hydrology and hydraulics in agricultural and urbanizing watersheds. Design and evaluation of systems for the conservation and quality preservation of soil and water resources. Use and analysis of hydrologic data in engineering design; relationship of topography, soils, crops, climate, and cultural practices in conservation and quality preservation of soil and water for agriculture. Small watershed hydrology, water movement and utilization in the soil-plant-atmosphere system, agricultural water management, best management practices, and agricultural water quality.

ENSCI 434. Contaminant Hydrogeology.

(Dual-listed with ENSCI 534). (Cross-listed with GEOL). (3-0) Cr. 3. S. *Prereq:* GEOL 411 or equivalent; GEOL 511 or equivalent for 500 level course

Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies.

ENSCI 446. Integrating GPS and GIS for Natural Resource Management.

(Dual-listed with ENSCI 546). (Cross-listed with NREM). (2-3) Cr. 3. S. *Prereq:* 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS

Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

ENSCI 451. Applied and Environmental Geophysics.

(Dual-listed with ENSCI 551). (Cross-listed with GEOL). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* GEOL 100 or GEOL 201, college algebra and trigonometry

Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic - and resistivity-imaging systems and radar.

ENSCI 452. GIS for Geoscientists.

(Dual-listed with ENSCI 552). (Cross-listed with AGRON, GEOL). (2-2) Cr. 3. F. *Prereq:* GEOL 100, GEOL 201 or equivalent

Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

ENSCI 459. Environmental Soil and Water Chemistry.

(Dual-listed with ENSCI 559). (Cross-listed with AGRON). (3-3) Cr. 4. F. *Prereq:* Two semesters of college-level chemistry, MATH 140, AGRON 154 or AGRON 360; GEOL 100 and AGRON 354 recommended.

An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, and applications to contemporary environmental issues.

ENSCI 461I. Introduction to GIS.

(Cross-listed with ENV S, IA LL, L A). Cr. 4. SS.

Descriptive and predictive GIS modeling techniques, spatial statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management.

ENSCI 463. Soil Formation and Landscape Relationships.

(Dual-listed with ENSCI 563). (Cross-listed with AGRON). (2-4) Cr. 4. S. *Prereq:* AGRON 154 or AGRON 260

Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of AGRON 463 or AGRON 463I may be applied for graduation.

ENSCI 463I. Soil Formation and Landscape Relationships.

(Dual-listed with ENSCI 563I). (Cross-listed with AGRON, IA LL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq:* AGRON 154 or AGRON 260

Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only Agron 563 or 563I may be applied for graduation.

ENSCI 464. Wetland Ecology.

(Dual-listed with ENSCI 564). (Cross-listed with BIOL). (3-0) Cr. 3. S. *Prereq:* 15 credits in biological sciences.

Ecology, classification, creation and restoration, and management of wetlands. Emphasis on North American temperate wetlands.

ENSCI 466. Ecosystem Service Management.

(Dual-listed with ENSCI 566). (Cross-listed with ENT, NREM). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* permission of instructor

Land use and conservation techniques for improving ecosystem services including: pollination of crops, biological control of pests, prevention of erosion and water quality improvement.

ENSCI 477. Soil Physics.

(Dual-listed with ENSCI 577). (Cross-listed with AGRON). (3-0) Cr. 3. S. *Prereq:* Recommended: AGRON 154 MATH 166

The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

ENSCI 479. Surficial Processes.

(Dual-listed with ENSCI 579). (Cross-listed with GEOL). (2-2) Cr. 3. F. *Prereq:* GEOL 100 or GEOL 201 or equivalent experience

The study of physical processes that shape Earth's surface. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory includes topographic map interpretation and local field trips.

ENSCI 480. Engineering Analysis of Biological Systems.

(Cross-listed with A B E). (2-2) Cr. 3. F. *Prereq:* A B E 380 or permission of the instructor

Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues.

ENSCI 484. Ecosystem Ecology.

(Cross-listed with BIOL). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* Combined 12 credits in biology, chemistry, and physics.

Introduction of the study of ecosystems and the biological and physical factors that influence their properties and dynamics. Conceptual foundations for ecosystem studies. Interactions among organisms, biological diversity, and ecosystem attributes. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems. Global change issues.

ENSCI 485. Soil and Environmental Microbiology.

(Dual-listed with ENSCI 585). (Cross-listed with AGRON, MICRO). (2-3) Cr. 3. F. *Prereq:* AGRON 154 or AGRON 402, MICRO 201 (MICRO 201L recommended)

The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

ENSCI 486. Aquatic Ecology.

(Cross-listed with A ECL, BIOL). (3-0) Cr. 3. F. *Prereq:* Biol 312 or EnSci 381 or EnSci 402 or NREM 301

Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology.

ENSCI 486L. Aquatic Ecology Laboratory.

(Cross-listed with A ECL, BIOL). (0-3) Cr. 1. F. *Prereq:* Concurrent enrollment in BIOL 486

Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts.

ENSCI 487. Microbial Ecology.

(Dual-listed with ENSCI 587). (Cross-listed with BIOL, MICRO). (3-0) Cr. 3. F. *Prereq:* Six credits in biology and 6 credits in chemistry

Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

ENSCI 488. GIS for Geoscientists II.

(Dual-listed with ENSCI 588). (Cross-listed with AGRON, GEOL). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* GIS course, such as GEOL 452, CRP 451, CRP 452, NREM 345, NREM 446, AE 408 or equivalent

GIS course with focus on the spatial analysis and modeling of raster data and triangulated irregular network (TIN) data. Uses ArcGIS and various extensions, such as Spatial Analyst, 3D Analyst, and ArcScene. Includes practical exercises during lectures, lab exercises, homework assignments, and (for GEOL 588) a class project.

ENSCI 490. Independent Study.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Permission of the instructor and approval of the Environmental Science coordinator

ENSCI 490H. Independent Study: Honors.

Cr. arr. Repeatable. F.S.SS.

Permission of instructor and approval of Environmental Science coordinator.

ENSCI 495. Current Topics and Case Studies in Environmental Science.Cr. 1-3. *Prereq: Junior classification in Environmental Science, permission of instructor*

Current topics and case studies related to the analysis and management of environmental systems. Individual and/or group projects.

ENSCI 496. Travel Course.Cr. arr. Repeatable. *Prereq: Permission of instructor*

Extended field trips to study environmental topics in varied locations. Location and duration of trips will vary. Trip expenses paid by students. Check with department for current offerings. A. International Tour B. Domestic Tour.

ENSCI 498. Cooperative Education.Cr. R. Repeatable. F.S.SS. *Prereq: Permission of Environmental Science Coordinator*

Required of all cooperative education students. Students must register prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduates:**ENSCI 502. Watershed Hydrology.**(Dual-listed with ENSCI 402). (Cross-listed with GEOL, MTEOR, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

ENSCI 504. Global Change.(Dual-listed with ENSCI 404). (Cross-listed with AGRON, MTEOR). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Also offered online Alt. F, even-numbered years.

ENSCI 505. Environmental Biophysics.(Dual-listed with ENSCI 405). (Cross-listed with AGRON, MTEOR). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: MATH 165 or MATH 182 or equivalent and some computer programming experience (any language)*

A description of the physical microenvironment in which organisms live. Emphasis on the movement of energy (heat and radiation) and mass (water and carbon) among organisms, the soil, and atmosphere. Applications to humans, other animals, plants, and plant communities.

ENSCI 507. Watershed Management.(Dual-listed with ENSCI 407). (Cross-listed with NREM). (3-3) Cr. 4. S. *Prereq: A course in general biology*

Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

ENSCI 508. GIS and Natural Resources Management.(Dual-listed with ENSCI 408). (Cross-listed with A B E). (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment*

Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS.

ENSCI 508I. Aquatic Ecology.(Cross-listed with IA LL, NREM). Cr. 4. SS. *Prereq: Courses in ecology, chemistry, and physics*

Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

ENSCI 509. Field Methods in Hydrogeology.(Dual-listed with ENSCI 409). (Cross-listed with GEOL). (0-4) Cr. 3. Alt. SS., offered even-numbered years. *Prereq: GEOL/ENSCI 402 or GEOL/ENSCI 411 or C E 473*

Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, and electronic instrumentation for data collection. Field trips to investigate water resource, water quality, and remediation projects.

ENSCI 511. Hydrogeology.(Dual-listed with ENSCI 411). (Cross-listed with GEOL). (3-2) Cr. 4. F. *Prereq: Four courses in biological or physical sciences*

Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations.

ENSCI 514. Applied Groundwater Flow Modeling.(Dual-listed with ENSCI 414). (Cross-listed with GEOL). (2-2) Cr. 3. Alt. S., offered even-numbered years. *Prereq: GEOL 411 or C E 473; MATH 165 or MATH 181* Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course.**ENSCI 515. Paleoclimatology.**(Dual-listed with ENSCI 415). (Cross-listed with GEOL). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Four courses in biological or physical science*

Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~ 1 million years).

ENSCI 516. Hydrologic Modeling and Analysis.(Dual-listed with ENSCI 416). (Cross-listed with GEOL, MTEOR). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Four courses in earth science, meteorology, or engineering; junior standing*

Study of the basic principles of hydrologic modeling, including rainfall-runoff analysis, lumped and distributed modeling, conceptual and physical models, parameter estimation and sensitivity analysis, input and validation data, uncertainty analysis, and the use of models in surface water hydrology. A range of common models are applied to study hydrologic topics such as flood forecasting and land use change impacts. Previous experience with Matlab or other programming language is needed.

ENSCI 518. Stream Ecology.(Dual-listed with ENSCI 418). (Cross-listed with A ECL). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: A ECL 486*

Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

ENSCI 519. Environmental Geochemistry.(Dual-listed with ENSCI 419). (Cross-listed with GEOL). (2-2) Cr. 3. F. *Prereq: GEOL 402 or GEOL 411 or equivalent*

Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling.

ENSCI 520. Environmental Engineering Chemistry.(Dual-listed with ENSCI 420). (Cross-listed with C E). (2-3) Cr. 3. F. *Prereq: C E 326, CHEM 177 and CHEM 178, MATH 166*

Principles of chemical and physical phenomena applicable to the treatment of water and wastewater and natural waters; including chemical equilibria, reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions, and mass transfer principles. Individual laboratory practicals and group projects required.

ENSCI 521. Environmental Biotechnology.(Cross-listed with C E). (2-2) Cr. 3. F. *Prereq: C E 326*

Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens and parasites, and disinfection. Term paper and oral presentation.

ENSCI 522. Water Pollution Control Processes.(Cross-listed with C E). (2-2) Cr. 3. *Prereq: C E 521*

Fundamentals of biochemical processes, aerobic growth in a single CSTR, multiple events in complex systems, and techniques for evaluating kinetic parameters; unit processes of activated sludge system, attached growth systems, stabilization and aerated lagoon systems, biosolids digestion and disposal, nutrient removal, and anaerobic treatment systems.

ENSCI 523. Physical-Chemical Treatment Process.

(Cross-listed with C E). (2-2) Cr. 3. *Prereq: C E 520*
Material and energy balances. Principles and design of physical-chemical unit processes; including screening, coagulation, flocculation, chemical precipitation, sedimentation, filtration, lime softening and stabilization, oxidation, adsorption, membrane processes, ion exchange and disinfection; recovery of resources from residuals and sludges; laboratory exercises and demonstrations; case studies in mineral processing and secondary industries.

ENSCI 524. Air Pollution.

(Dual-listed with ENSCI 424). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*
1 cr. per module. Module A prereq for all modules; module B prereq for D and E.

ENSCI 524A. Air Pollution: Air quality and effects of pollutants.

(Dual-listed with ENSCI 424A). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq: Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

ENSCI 524B. Air Pollution: Climate change and causes.

(Dual-listed with ENSCI 424B). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq: C E 524A; Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

ENSCI 524C. Air Pollution: Transportation Air Quality.

(Dual-listed with ENSCI 424C). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq: C E 524A; PHYS 221 or CHEM 178; MATH 166 or 3 credits in statistics. Senior classification or above.*

ENSCI 524D. Air Pollution: Off-gas treatment technology.

(Dual-listed with ENSCI 424D). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq: C E 524A, C E 524B; Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

ENSCI 524E. Air Pollution: Agricultural sources of pollution.

(Dual-listed with ENSCI 424E). (Cross-listed with A B E, C E). (1-0) Cr. 1. *Prereq: C E 524A, C E 524B; Either PHYS 221 or CHEM 178 and either MATH 166 or 3 credits in statistics. Senior classification or above*

ENSCI 526. Stable Isotopes in the Environment.

(Dual-listed with ENSCI 426). (Cross-listed with GEOL). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: Four courses in biological or physical science*
Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance.

ENSCI 528. Solid and Hazardous Waste Management.

(Cross-listed with C E). (3-0) Cr. 0. *Prereq: C E 326 or background courses in both environmental chemistry and microbiology; junior or higher standing*
Evaluation, characterization, assessment, planning and design of solid and hazardous waste management systems, regulatory requirements, material characterization and collection, minimization and recycling, energy and materials recovery, composting, off-gas treatment, incineration, stabilization, and landfill design. Design of treatment and disposal systems, including physical, chemical, and biological treatment, solidification, incineration, secure landfill design, and final disposal site closure plus restoration.

ENSCI 531. Design and Evaluation of Soil and Water Conservation Systems.

(Dual-listed with ENSCI 431). (Cross-listed with A B E). (2-2) Cr. 3. F. *Prereq: E M 378 or CHE 356*

Hydrology and hydraulics in agricultural and urbanizing watersheds. Design and evaluation of systems for the conservation and quality preservation of soil and water resources. Use and analysis of hydrologic data in engineering design; relationship of topography, soils, crops, climate, and cultural practices in conservation and quality preservation of soil and water for agriculture. Small watershed hydrology, water movement and utilization in the soil-plant-atmosphere system, agricultural water management, best management practices, and agricultural water quality.

ENSCI 533. Erosion and Sediment Transport.

(Cross-listed with A B E). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: C E 372, MATH 266*

Soil erosion processes, modified universal soil loss equation and its application to conservation planning, sediment properties, initiation of sediment motion and over land flow, flow in alluvial channels and theory of sediment transport, channel stability, reserves sedimentation, wind erosion, BMPs for controlling erosion.

ENSCI 534. Contaminant Hydrogeology.

(Dual-listed with ENSCI 434). (Cross-listed with GEOL). (3-0) Cr. 3. S. *Prereq: GEOL 411 or equivalent; GEOL 511 or equivalent for 500 level course*
Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies.

ENSCI 535. Restoration Ecology.

(Cross-listed with EEOB, NREM). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: BIOL 366 or BIOL 474 or graduate standing*
Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies.

ENSCI 535I. Restoration Ecology.

(Cross-listed with A ECL, EEOB, IA LL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: A course in ecology*
Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

ENSCI 546. Integrating GPS and GIS for Natural Resource Management.

(Dual-listed with ENSCI 446). (Cross-listed with NREM). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS*
Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

ENSCI 551. Applied and Environmental Geophysics.

(Dual-listed with ENSCI 451). (Cross-listed with GEOL). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: GEOL 100 or GEOL 201, college algebra and trigonometry*
Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic - and resistivity-imaging systems and radar.

ENSCI 552. GIS for Geoscientists.

(Dual-listed with ENSCI 452). (Cross-listed with AGRON, GEOL). (2-2) Cr. 3. F. *Prereq: GEOL 100, GEOL 201 or equivalent*
Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

ENSCI 553. Soil-Plant Relationships.

(Cross-listed with AGRON). (3-0) Cr. 3. F. *Prereq: AGRON 354*
Composition and properties of soils in relation to the nutrition and growth of plants.

ENSCI 558. Laboratory Methods in Soil Chemistry.

(Cross-listed with AGRON). (2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq: AGRON 354 and CHEM 211*
Experimental and descriptive inorganic and organic analyses. Operational theory and principles of applicable instruments, including spectrophotometry, atomic and molecular absorption and emission spectroscopy, mass spectrometry, X-ray diffraction and fluorescence, gas and ion chromatography, and ion-selective electrodes.

ENSCI 559. Environmental Soil and Water Chemistry.

(Dual-listed with ENSCI 459). (Cross-listed with AGRON). (3-3) Cr. 4. F. *Prereq: Two semesters of college-level chemistry, MATH 140, AGRON 154 or AGRON 360; GEOL 100 and AGRON 354 recommended.*
An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, and applications to contemporary environmental issues.

ENSCI 563. Soil Formation and Landscape Relationships.

(Dual-listed with ENSCI 463). (Cross-listed with AGRON). (2-4) Cr. 4. S. *Prereq: AGRON 154 or AGRON 260*
Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of AGRON 463 or AGRON 463I may be applied for graduation.

ENSCI 563I. Soil Formation and Landscape Relationships.

(Dual-listed with ENSCI 463I). (Cross-listed with AGRON, IA LL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq:* AGRON 154 or AGRON 260 Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only Agron 563 or 563I may be applied for graduation.

ENSCI 564. Wetland Ecology.

(Dual-listed with ENSCI 464). (Cross-listed with EEOB). (3-0) Cr. 3. S. *Prereq:* 15 credits in biological sciences Ecology, classification, creation and restoration, and management of wetlands. Emphasis on North American temperate wetlands.

ENSCI 564I. Wetland Ecology.

(Cross-listed with EEOB, IA LL). Cr. 4. SS. *Prereq:* IA LL 312I Ecology, classification, creation, restoration, and management of wetlands. Field studies will examine the composition, structure and functions of local natural wetlands and restored prairie pothole wetlands. Individual or group projects.

ENSCI 566. Ecosystem Service Management.

(Dual-listed with ENSCI 466). (Cross-listed with ENT, NREM). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* permission of instructor Land use and conservation techniques for improving ecosystem services including: pollination of crops, biological control of pests, prevention of erosion and water quality improvement.

ENSCI 571. Surface Water Hydrology.

(Cross-listed with C E). (3-0) Cr. 3. *Prereq:* C E 372 Analysis of hydrologic data including precipitation, infiltration, evapotranspiration, direct runoff and streamflow; theory and use of frequency analysis; theory of streamflow and reservoir routing; use of deterministic and statistical hydrologic models. Fundamentals of surface water quality modeling, point and non-point sources of contamination. Design project.

ENSCI 572. Analysis and Modeling Aquatic Environments.

(Cross-listed with C E). (3-0) Cr. 3. *Prereq:* C E 372 Principles of surface water flows and mixing. Introduction to hydrologic transport and water quality simulation in natural water systems. Advection, diffusion and dispersion, chemical and biologic kinetics, and water quality dynamics. Applications to temperature, dissolved oxygen, primary productivity, and other water quality problems in rivers, lakes and reservoirs. Deterministic vs. stochastic models.

ENSCI 573. Groundwater Hydrology.

(Cross-listed with C E). (3-0) Cr. 3. F. *Prereq:* C E 372 Principles of groundwater flow, hydraulics of wells, superposition, slug and pumping tests, streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Design project. Extra assignments required for graduate students.

ENSCI 575. Soil Formation and Transformation.

(Cross-listed with AGRON). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* AGRON 463 or equivalent Advanced study of soil formation, emphasizing relationships among soils, landscapes, environment, humans, and land use.

ENSCI 577. Soil Physics.

(Dual-listed with ENSCI 477). (Cross-listed with AGRON). (3-0) Cr. 3. S. *Prereq:* Recommended: AGRON 154 MATH 166 The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

ENSCI 578. Laboratory Methods in Soil Physics.

(Cross-listed with AGRON). (0-3) Cr. 1. S. *Prereq:* concurrent enrollment in AGRON 477 or 577 Methods of measuring soil physical properties such as texture, density, and water content, and transport of heat, water, and gases.

ENSCI 579. Surficial Processes.

(Dual-listed with ENSCI 479). (Cross-listed with GEOL). (2-2) Cr. 3. F. *Prereq:* GEOL 100 or GEOL 201 or equivalent experience The study of physical processes that shape Earth's surface. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory includes topographic map interpretation and local field trips.

ENSCI 581. Environmental Systems I: Introduction to Environmental Systems.

(Dual-listed with ENSCI 381). (Cross-listed with EEOB). Cr. 3-4. F. *Prereq:* 12 credits of natural science including biology and chemistry Introduction to the structure and function of natural environmental systems. Emphasis on the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

ENSCI 582. Environmental Systems II: Analysis of Environmental Systems.

(Dual-listed with ENSCI 382). (Cross-listed with EEOB). (2-2) Cr. 3. S. *Prereq:* ENSCI 381 Continuation of EnSci 381. Systems approach to the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

ENSCI 584. Advanced Ecosystem Ecology.

(Cross-listed with EEOB). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* Combined 12 credits in biology, chemistry, and physics. Advanced studies of ecosystems and the biological and physical factors that influence their properties and dynamics. Conceptual foundations and modern approaches to ecosystem studies. Interactions among organisms, biological diversity, and ecosystem attributes. Quantitative analyses of accumulations, transformations, and fluxes of nutrients, water, and energy within and among ecosystems. Global change issues.

ENSCI 585. Soil and Environmental Microbiology.

(Dual-listed with ENSCI 485). (Cross-listed with AGRON, MICRO). (2-3) Cr. 3. F. *Prereq:* AGRON 154 or AGRON 402, MICRO 201 (MICRO 201L recommended) The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

ENSCI 586. Aquatic Ecology.

(Dual-listed with ENSCI 486). (Cross-listed with EEOB). (3-0) Cr. 3. F. *Prereq:* ENSCI 301 or ENSCI 312 or ENSCI 381 or ENSCI 402 (Dual-listed with Biol 486.) Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine and wetland ecology.

ENSCI 586L. Aquatic Ecology Laboratory.

(Dual-listed with ENSCI 486L). (Cross-listed with EEOB). (0-3) Cr. 1. F. *Prereq:* Concurrent enrollment in EEOB 586 (Dual-listed with Biol 486L.) Field trips and laboratory exercises to accompany 586. Hands-on experience with aquatic research and monitoring techniques and concepts.

ENSCI 587. Microbial Ecology.

(Dual-listed with ENSCI 487). (Cross-listed with EEOB, MICRO). (3-0) Cr. 3. F. *Prereq:* Six credits in biology and 6 credits in chemistry Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

ENSCI 588. GIS for Geoscientists II.

(Dual-listed with ENSCI 488). (Cross-listed with AGRON, GEOL). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* GIS course, such as GEOL 452, CRP 451, CRP 452, NREM 345, NREM 446, AE 408 or equivalent GIS course with focus on the spatial analysis and modeling of raster data and triangulated irregular network (TIN) data. Uses ArcGIS and various extensions, such as Spatial Analyst, 3D Analyst, and ArcScene. Includes practical exercises during lectures, lab exercises, homework assignments, and (for GEOL 588) a class project.

ENSCI 590. Special Topics.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Permission of major professor in Environmental Science faculty Literature reviews and conference in accordance with needs and interest of the student.

ENSCI 599. Creative Component.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Permission of major professor in Environmental Science faculty Creative component for nonthesis master of science degree.

Courses for graduate students:**ENSCI 685. Advanced Soil Biochemistry.**

(Cross-listed with AGRON, MICRO). (2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq:* AGRON 585 Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

ENSCI 690. Advanced Topics in Environmental Science.

Cr. 1. Repeatable. F.S. Reports and discussion of recent research and literature.

ENSCI 698. Seminar in Environmental Science.

Cr. R. Repeatable. F.S.

Reports and discussion of recent research and literature.

ENSCI 699. Research.

Cr. arr. Repeatable. F.S.SS.

Environmental Studies (ENV S)

Courses primarily for undergraduates:

ENV S 101. Environmental Geology: Earth in Crisis.

(Cross-listed with GEOL). (3-0) Cr. 3. F.S.

An introduction to geologic processes and the consequences of human activity from local to global scales. Discussion of human population growth, resource depletion, pollution and waste disposal, global warming and ozone depletion, desertification, and geologic hazards such as earthquakes, landslides, flooding, and volcanism.

ENV S 108. Introduction to Oceanography.

(Cross-listed with GEOL). (3-0) Cr. 3. F.

Introduction to study of the oceans. Ocean exploration. Waves and currents. Shape, structure, and origin of the ocean basins. Sedimentary record of oceanic life. Composition of seawater and its significance for life. Ocean circulation and its influence on climate. Life of the oceans, including coral reefs. Use and misuse of ocean resources. Anthropogenic impacts on the oceanic environment.

ENV S 111. Geological Disasters.

(Cross-listed with GEOL). (1-0) Cr. 1. F.S.SS.

Introduction to the catastrophic geologic processes that disrupt ecosystems and human activity. Includes a discussion on the role of plate tectonics, the hydrologic cycle, and humans as the driving forces behind selected case studies on volcanic eruptions, earthquakes, tsunamis, landslides, and floods. Summer - online only.

ENV S 120. Introduction to Renewable Resources.

(Cross-listed with AGRON, NREM). (3-0) Cr. 3. F.S.

Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

ENV S 130. Natural Resources and Agriculture.

(Cross-listed with NREM). (3-0) Cr. 3. S.

Survey of the ecology and management of fish, forest, and wildlife resources in areas of intensive agriculture, with emphasis on Iowa. Conservation and management practices for private agricultural lands. Designed for nonmajors.

ENV S 160. Water Resources of the World.

(Cross-listed with AGRON, GEOL, MTEOR). (3-0) Cr. 3. S.

Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in society and the environment.

ENV S 173. Environmental Biology.

(Cross-listed with BIOL). (3-0) Cr. 3. F.S.

An introduction to the structure and function of natural systems at scales from the individual to the biosphere and the complex interactions between humans and their environment. Discussions of human population growth, biodiversity, sustainability, resource use, and pollution. Does not satisfy biology major requirements.

ENV S 201. Introduction to Environmental Issues.

(Cross-listed with BIOL, ENSCI). (2-0) Cr. 2. F.

Discussion of current and emerging environmental issues such as human population growth, energy use, loss of biodiversity, water resources, and climate change.

ENV S 204. Biodiversity.

(Cross-listed with BIOL). (4-0) Cr. 2. S. *Prereq:* One course in life sciences

Survey of the major groups of organisms and biological systems. Definition, measurements, and patterns of distribution of organisms. Sources of information about biodiversity. Does not satisfy biology major requirements. Half semester course.

ENV S 220. Global Sustainability.

(Cross-listed with ANTHR, GLOBE, M E, MAT E, SOC, T SC). (3-0) Cr. 3. F.S.

An introduction to the key global issues in sustainability. Focuses on interconnected roles of energy, materials, human resources, economics, and technology in building and maintaining sustainable systems. Applications discussed will include challenges in both the developed and developing world and will examine the role of technology in a resource-constrained world. Cannot be used for technical elective credit in any engineering department. Meets International Perspectives Requirement.

ENV S 250. Environmental Geography.

(Cross-listed with ENSCI). (3-0) Cr. 3. F.

The distribution, origins and functions of the earth's physical systems and the spatial relationship between human activity and the natural world.

ENV S 260. Soils and Environmental Quality.

(Cross-listed with AGRON). (3-0) Cr. 3. F.S.

Role of soils in environmental quality and natural resources management. Emphasis on soil erosion and conservation, water quality, and environmental planning. Saturday field trip.

ENV S 270. Foundations in Natural Resource Policy and History.

(Cross-listed with L A, NREM). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

The development of natural resource conservation philosophy and policy from the Colonial Era to the present. North American wildlife, forestry, and environmental policy; national parks and other protected lands; federal and state agencies. Relationship to cultural contexts, including urban reform and American planning movement. Discussion of common pool resources, public and private lands.

ENV S 293. Environmental Planning.

(Cross-listed with C R P). (3-0) Cr. 3. F.

Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water.

ENV S 320. Ecofeminism.

(Cross-listed with W S). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:*

W S 201 or 3 credits in Women's Studies at the 300 level or above

Women's relationships with the earth, non-human nature, and other humans.

The course explores the connections between society's treatment of women and nature; origins of ecofeminism and how it relates to the science of ecology, conventional and sustainable agriculture as well as how ecofeminism relates to other branches of feminist philosophy. Evaluation and critique of modern science, technology, political systems and SOLUTIONS will be included.

ENV S 324. Energy and the Environment.

(Cross-listed with ENSCI, GEOL, MTEOR). (3-0) Cr. 3. S.

Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, geothermal, biomass, hydroelectric, and solar energy. Biofuels. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, coal ash, mountaintop removal mining, oil drilling, hydraulic fracturing, groundwater contamination, nuclear waste disposal, and global climate change. Carbon sequestration and geoengineering solutions for reducing atmospheric CO₂ concentrations.

ENV S 334. Environmental Ethics.

(Cross-listed with PHIL). (3-0) Cr. 3. F. *Prereq:* 3 credits in philosophy or junior classification

Thorough study of some of the central moral issues arising in connection with human impact on the environment, e.g., human overpopulation, species extinction, forest and wilderness management, pollution. Several world views of the proper relationship between human beings and nature will be explored.

ENV S 342. World Food Issues: Past and Present.

(Cross-listed with AGRON, FS HN, T SC). (3-0) Cr. 3. F.S. *Prereq:* Junior classification

Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects.

Meets International Perspectives Requirement.

ENV S 342H. World Food Issues: Past and Present, Honors.

(Cross-listed with AGRON, T SC). (3-0) Cr. 3. F.S. *Prereq:* Junior classification

Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects.

Meets International Perspectives Requirement.

ENV S 345. Population and Society.

(Cross-listed with SOC). (3-0) Cr. 3. F. *Prereq:* SOC 134

Human population growth and structure; impact on food, environment, and resources; gender issues; trends of births, deaths, and migration; projecting future population; population policies and laws; comparison of the United States with other societies throughout the world.

Meets International Perspectives Requirement.

ENV S 355. Literature and the Environment.

(Cross-listed with ENGL). (3-0) Cr. 3. *Prereq: ENGL 250*

Study of literary texts that address the following topics, among others: the relationship between people and natural/urban environments, ecocriticism, and the importance of place in the literary imagination.

ENV S 380. Environmental and Resource Economics.

(Cross-listed with ECON). (3-0) Cr. 3. *Prereq: ECON 101*

Natural resource availability, use, conservation, and government policy, including energy issues. Environmental quality and pollution control policies.

ENV S 381. Environmental Systems I: Introduction to Environmental Systems.

(Cross-listed with BIOL, ENSCI, MICRO). Cr. 3-4. F. *Prereq: 12 credits of natural science including biology and chemistry*

Introduction to the structure and function of natural environmental systems.

Emphasis on the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

ENV S 382. Environmental Sociology.

(Cross-listed with SOC). (3-0) Cr. 3. F.S. *Prereq: Soc 134 or 3 credits of ENV S*

Environment-society relations; social construction of nature and the environment; social and environmental impacts of resource extraction, production, and consumption; environmental inequality; environmental mobilization and movements; U.S. and international examples.

ENV S 383. Environmental Politics and Policies.

(Cross-listed with POL S). (3-0) Cr. 3. F. *Prereq: sophomore classification*

Major ideologies relation to conservation and ecology. Processes, participants, and institutions involved in state, national, and global environmental policymaking. Case studies of environmental controversies and proposals for policy reform.

ENV S 384. Religion and Ecology.

(Cross-listed with RELIG). (3-0) Cr. 3.

Introduction to concepts of religion and ecology as they appear in different religious traditions, from both a historical and contemporary perspective. Special attention to religious response to contemporary environmental issues.

Meets International Perspectives Requirement.

ENV S 390. Internship in Environmental Studies.

Cr. arr. Repeatable. F.S.SS. *Prereq: Approval of the Environmental Studies Coordinator*

Practical experience with nature centers, government agencies, schools, private conservation groups, and other organizations. Offered on a satisfactory-fail basis only.

ENV S 404. Global Change.

(Cross-listed with AGRON, ENSCI, MTEOR). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Also offered online Alt. F, even-numbered years.

ENV S 407. Watershed Management.

(Cross-listed with ENSCI, NREM). (3-3) Cr. 4. S. *Prereq: A course in general biology*

Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

ENV S 417. Urban and Peri-urban Watershed Assessment.

(Cross-listed with L A). (2-3) Cr. 3. *Prereq: Junior classification and 6 credits of natural science*

Assessment and reduction of impacts in urban and peri-urban watershed areas. Course prepares students to work with various analysis methods for vegetation, topography, stormwater and stream condition as well as work with data from other disciplines. Emphasis on communicating with the public. Introductory GIS and GPS technologies are utilized. Learning is largely field-based.

ENV S 424. Sustainable and Environmental Horticulture Systems.

(Cross-listed with HORT). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Inquiry into ethical issues and environmental consequences of horticultural cropping systems, production practices and managed landscapes. Emphasis on systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

ENV S 442. The Policy and Politics of Coastal Areas.

(Cross-listed with POL S). (3-0) Cr. 3. SS.

Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, trade-offs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

ENV S 450. Issues in Sustainable Agriculture.

(Cross-listed with AGRON). (3-0) Cr. 3. F.

Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices.

Meets International Perspectives Requirement.

ENV S 460. Controversies in Natural Resource Management.

(Cross-listed with NREM). (3-0) Cr. 3. F.S. *Prereq: NREM 120, and A ECL 312 or NREM 301, and Junior classification*

Analysis of controversial natural resource issues using a case approach that considers uncertainty and adequacy of information and scientific understanding. Ecological, social, political, economic, and ethical implications of issues will be analyzed.

ENV S 461I. Introduction to GIS.

(Cross-listed with ENSCI, IA LL, L A). Cr. 4. SS.

Descriptive and predictive GIS modeling techniques, spatial statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management.

ENV S 472. U. S. Environmental History.

(Cross-listed with HIST). (3-0) Cr. 3. *Prereq: Sophomore classification*

Survey of the interactions of human communities with the North American environment. Focus on the period from presettlement to the present, with a particular concentration on natural resources, disease, settlement patterns, land use, and conservation policies.

ENV S 484. Sustainable Communities.

(Cross-listed with C R P). (3-0) Cr. 3. S. *Prereq: Junior classification*

The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

ENV S 490. Independent Study.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor and approval of Environmental Studies coordinator*

ENV S 490H. Independent Study: Honors.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor and approval of Environmental Studies coordinator.*

ENV S 491. Environmental Law and Planning.

(Cross-listed with C R P, L A). (3-0) Cr. 3. S. *Prereq: 6 credits in natural sciences*

Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

ENV S 496. Travel Course.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

Extended field trips to study environmental topics in varied locations. Location and duration of trips will vary. Trip expenses paid by students. Check with department for current offerings.

ENV S 496A. International Tour.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

Extended field trips to study environmental topics in varied locations. Location and duration of trips will vary. Trip expenses paid by students. Check with department for current offerings.

ENV S 496B. Domestic Tour.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

Extended field trips to study environmental topics in varied locations. Location and duration of trips will vary. Trip expenses paid by students. Check with department for current offerings.

Event Management (EVENT)

Courses primarily for undergraduates:

EVENT 271. Introduction to Event Management.

(2-2) Cr. 3. F.S.SS. *Prereq: HSP M 101*

Overview of the event management industries. Techniques and procedures required for producing successful and sustainable events.

EVENT 289. Contemporary Club Management.

(Cross-listed with HSP M). (2-0) Cr. 2. F.S. *Prereq: HSP M 101*

Organization and management of private clubs including city, country, and other recreational and social clubs. Field trip may be required.

EVENT 320. Attractions and Amusement Park Administration.

(Cross-listed with HSP M). (3-0) Cr. 3. S. *Prereq: HSP M 101 or permission of instructor*

An examination of current issues in the attractions and amusement park industry will be conducted. Emphasis will be placed on development and design along with the functional departments of modern amusement parks and themed attractions.

EVENT 333. Entertainment Venue Management.

(3-0) Cr. 3. F.S. *Prereq: EVENT 271 or equivalent*

Organization and management of various types of entertainment venues including clubs, theaters, auditoriums, and arenas.

EVENT 371. Conference and Meeting Planning.

(2-2) Cr. 3. F.S. *Prereq: EVENT 271*

Application of event management principles to conference and meeting planning, trade shows, and conventions focusing on budget development, resource allocation, promotion, hospitality, and professional development.

EVENT 373. Wedding Planning and Management.

(3-0) Cr. 3. F.S. *Prereq: EVENT 371 and Event Management major*

Overview of wedding event industry. Focus on wedding planning processes and implementation, design, and business planning and development.

EVENT 471. Special Events Coordination.

(2-2) Cr. 3. F.S. *Prereq: EVENT 371; permission of instructor.*

Advanced application event management. Provide leadership and communicate direction for production of an event including developing budgets, publicity, advertising, fund raising, choreography, staging, lighting, and food.

EVENT 490. Independent Study.

Cr. arr. Repeatable. *Prereq: Sections B-D: Program approval; Section H: Full membership in Honors Program*
Independent study.

EVENT 490B. Independent Study: Conferences.

Cr. arr. Repeatable. *Prereq: Program approval*
Independent study.

EVENT 490C. Independent Study: Special Events.

Cr. arr. Repeatable. *Prereq: Program approval.*
Independent study.

EVENT 490D. Independent Study: Event Management.

Cr. arr. Repeatable. *Prereq: Sections B-D: Program approval; Section H: Full membership in Honors Program*
Independent study.

Family Financial Planning (FFP)

Courses primarily for graduate students, open to qualified undergraduates:

FFP 520. Financial Theory and Research I.

(3-0) Cr. 3. F.S.SS.

Theories of family functioning, macroeconomic theory related to family resource allocation decisions, the family as an economic unit, and the interaction of the economy and families. (on-line course offering via Distance Education).

FFP 525. Financial Theory and Research II.

(3-0) Cr. 3. F.S.SS.

Microeconomic theory as it relates to family resource allocation decisions, theories of household behavior, the lifecycle hypothesis, behavioral economics, behavioral finance, theories of behavioral change, and psychological theories of family well-being. Focus on empirical research investigating household financial decision-making. (on-line course offering via Distance Education).

FFP 530. Fundamentals of Family Financial Planning.

(3-0) Cr. 3. F.S.SS.

The nature and functioning of financial systems, including currencies, markets, monetary and fiscal policy, and supply/demand for land, labor, and capital. Focus is on the impact of global financial interdependence on individuals and families in the U.S. Current and emerging issues, as well as current research and theory relative to financial systems. (on-line course offering via Distance Education).

FFP 535. Financial Counseling.

(3-0) Cr. 3. F.S.SS.

Theory and research regarding the interactive process between the client and the practitioner, including communication techniques, motivation and esteem building, the counseling environment, ethics, and methods of data intake, verification, and analysis. Other topics include legal issues, compensation, uses of technology to identify resources, information management, and current or emerging issues. (on-line course offering via Distance Education).

FFP 540. Estate Planning for Families.

(3-0) Cr. 3. F.S.SS.

Fundamentals of the estate planning process, including estate settlement, estate and gift taxes, property ownership and transfer, and powers of appointment. Tools and techniques used in implementing an effective estate plan, ethical considerations used in providing estate planning services, and new and emerging issues in the field. Case studies provide experience in developing estate plans suitable for varied family forms. (on-line course offering via Distance Education).

FFP 541. Housing and Real Estate in Family Financial Planning.

(Cross-listed with HD FS). (3-0) Cr. 3. Alt. SS., offered even-numbered years.

The role of housing and real estate in the family financial planning process, including taxation, mortgages, financial calculations, legal concerns, and ethical issues related to home ownership and real estate investments. Emphasis on emerging issues in the context of housing and real estate. (on-line course offering via Distance Education).

FFP 545. Retirement Planning, Employee Benefits, and the Family.

(3-0) Cr. 3. F.S.SS.

Study of micro and macro considerations for retirement planning. Survey of various types of retirement plans, ethical considerations in providing retirement planning services, assessing and forecasting financial needs in retirement, and integration of retirement plans with government benefits. (on-line course offering via Distance Education).

FFP 550. Military Personal Financial Readiness.

(3-0) Cr. 3. F.SS.

Overview of the topics relevant to the financial planning process that address the unique needs of military service members and their families. (on-line course offering via Distance Education).

FFP 555. Insurance Planning for Families.

(3-0) Cr. 3. F.S.SS.

In-depth study of risk management concepts, tools, and strategies for individuals and families, including life insurance; property and casualty insurance; liability insurance; accident, disability, health, and long-term care insurance; and government-subsidized programs. Current and emerging issues and ethical considerations relative to risk management. Case studies provide experience in selecting insurance products suitable for individuals and family, study of investment options for clients including common stocks, fixed income securities, convertible securities, and related choices. Relationships between investment options and employee/employer benefit plan choices. Current and emerging issues and ethics are included. (on-line course offering via Distance Education).

FFP 565. Personal Income Taxation.

(3-0) Cr. 3. F.S.SS.

In-depth information on income tax practices and procedures including tax regulations, tax return preparation, the tax audit processes, the appeals process, preparation for an administrative or judicial forum, and ethical considerations of taxation. New and emerging issues related to taxation. Family/individual case studies provide practice in applying and analyzing tax information and recommending appropriate tax strategies. (on-line course offering via Distance Education).

FFP 570. Professional Practices in Financial Planning.

(3-0) Cr. 3. F.S.SS.

Challenges of managing financial planning practices including, but not limited to: business valuation, personnel, marketing, client services, ethics and technological applications. Relying both on a theoretical as well as an applied approach, students analyze case studies that provide relevant, practical exposure to practice management issues, with a strong emphasis on current research findings. (on-line course offering via Distance Education).

FFP 583. Investing for the Family's Future.

(Cross-listed with HD FS). (3-0) Cr. 3. F. *Prereq: HD FS 483*

Evaluation of investment markets for the household. Analysis of how families choose where to put their savings. Emphasis is on using the family's overall financial and economic goals to help inform investment choices. (on-line course offering via Distance Education).

FFP 591. Practicum.

Cr. 3-6. F.S.SS.

Supervised experience in family financial planning.

FFP 595. Financial Planning - Case Studies.

(3-0) Cr. 3. F.S.SS. *Prereq: FFP 530, FFP 540, FFP 545, FFP 555, FFP 565, FFP 583*

Professional issues in financial planning, including ethical considerations, regulation and certification requirements, communication skills, and professional responsibility. Students are expected to utilize skills obtained in other courses and work experiences in the completion of personal finance case studies, the development of a targeted investment policy, and other related financial planning assignments. (on-line course offering via Distance Education).

Family and Consumer Sciences Education and Studies (FCEDS)

Courses primarily for undergraduates:

FCEDS 206. Professional Roles in Family and Consumer Sciences.

(1-1) Cr. 2. F. Prereq: HD FS 103 or concurrent enrollment in HD FS 103
Influencing factors that have contributed to the development and mission of Family and Consumer Sciences. Program goals, objectives and professional ethics. Introduction to various roles in professional settings, e.g., community agencies, secondary schools, business and industry, and Cooperative Extension. Includes 12 hours of a practicum experience outside of the regular class schedule.

FCEDS 306. Educational Principles for Family and Consumer Sciences.

(3-2) Cr. 4. F. Prereq: 15 credits in family and consumer sciences subject matter
Instructional methods and strategies of teaching and learning applied to family and consumer sciences content, including family financial literacy; reading strategies. Instructional methods appropriate for formal and non-formal educational settings. Specific strategies for diverse audiences. Includes 12 hour arranged practicum. May be used for family life certification.

FCEDS 413. Planning and Assessment for Family and Consumer Sciences and Family Life Education.

(3-2) Cr. 4. S. Prereq: FCEDS 306
Development of curriculum and assessment tools for family and consumer sciences programs for school settings. Accommodating exceptional learners. Includes 12 hours of Career and Technical Student Organization Competitive Event Assessment. May be used for family life certification.

FCEDS 417. Supervised Teaching in Family and Consumer Sciences.

Cr. 3-8. Repeatable. F.S. Prereq: FCEDS 413; 24 credits in family and consumer sciences subject matter; cumulative grade point of 2.50; full admission to teacher education
Supervised teaching experience in secondary schools. Examination of ways to implement actions that reflect a professional philosophy of family and consumer sciences for teaching middle and high school level students. Reservation required.

FCEDS 417A. Supervised Teaching in Family and Consumer Sciences: Vocational family and consumer sciences..

Cr. 3-8. Repeatable. F.S. Prereq: FCEDS 413, 24 credits in family and consumer sciences subject matter, cumulative grade point of 2.50, full admission to teacher education
Supervised teaching experience in secondary schools. Examination of ways to implement actions that reflect a professional philosophy of family and consumer sciences for teaching middle and high school level students. Reservation required.

FCEDS 417B. Supervised Teaching in Family and Consumer Sciences: Family and consumer sciences..

Cr. 3-8. Repeatable. F.S. Prereq: FCEDS 413, 24 credits in family and consumer sciences subject matter, cumulative grade point of 2.50, full admission to teacher education
Supervised teaching experience in secondary schools. Examination of ways to implement actions that reflect a professional philosophy of family and consumer sciences for teaching middle and high school level students. Reservation required.

FCEDS 418. Career and Technical Programs in Family and Consumer Sciences.

(Dual-listed with FCEDS 518). (3-0) Cr. 3. S. Prereq: FCEDS 206; 400 hours employment in a family and consumer sciences related field.
Philosophy of career and technical education. Historical development of family and consumer sciences. Planning and implementing programs in family and consumer sciences including FCCLA. Impact of selected legislation on family and consumer sciences programs. May be used toward Multioccupations Endorsement.

FCEDS 480. Pre-Student Teaching Experience in Family and Consumer Sciences Education.

(0-2) Cr. 1. Repeatable. F.S. Prereq: Admission to teacher education.
Laboratory experience in foods, textiles and human development in family and consumer sciences secondary programs. At least 2 hour blocks of time needed for field experience. Observation of family and consumer sciences laboratories in diverse classrooms. Planning, implementing, managing and assessing laboratory lessons in family and consumer sciences. Offered on a satisfactory-fail basis only.

FCEDS 480A. Pre-Student Teaching Experience in FCS Education: Practicum in FCS Labs (24 hours).

(0-2) Cr. 1. Repeatable. F.S. Prereq: Admission to teacher education
Laboratory experience in foods, textiles and human development in family and consumer sciences secondary programs. At least 2 hour blocks of time needed for field experience. Observation of family and consumer sciences laboratories in diverse classrooms. Planning, implementing, managing and assessing laboratory lessons in family and consumer sciences. Offered on a satisfactory-fail basis only.

FCEDS 480B. Pre-Student Teaching Experience in FCS Education: Practicum in Diverse Settings (24 hours).

(0-2) Cr. 1. Repeatable. F.S. Prereq: Admission to teacher education.
Laboratory experience in foods, textiles and human development in family and consumer sciences secondary programs. At least 2 hour blocks of time needed for field experience. Observation of family and consumer sciences laboratories in diverse classrooms. Planning, implementing, managing and assessing laboratory lessons in family and consumer sciences. Offered on a satisfactory-fail basis only.

FCEDS 490. Independent Study.

Cr. arr. F.S.SS.

FCEDS 490A. Independent Study: Adult Education.

Cr. arr. F.S.SS.

FCEDS 490C. Independent Study: Curriculum.

Cr. arr. F.S.SS.

FCEDS 490D. Independent Study: Evaluation.

Cr. arr. F.S.SS.

FCEDS 490E. Independent Study: Cooperative Extension.

Cr. arr. F.S.SS.

FCEDS 490G. Independent Study: General.

Cr. arr. F.S.SS.

FCEDS 490H. Independent Study: Honors.

Cr. arr. F.S.SS.

FCEDS 490I. Independent Study: International.

Cr. arr. F.S.SS.

FCEDS 490K. Independent Study: Occupational Education.

Cr. arr. F.S.SS.

FCEDS 490N. Independent Study: Leadership and Human Relations.

Cr. arr. F.S.SS.

FCEDS 490P. Independent Study: Special Needs/Mainstreaming.

Cr. arr. F.S.SS.

FCEDS 490R. Independent Study: Vocational Education.

Cr. arr. F.S.SS.

FCEDS 490S. Independent Study: Technology and Distance Education.

Cr. arr. F.S.SS.

FCEDS 491. Supervised Experiences in a Professional Setting.

Cr. 3-8. Repeatable. F.S.SS. Prereq: HD FS 418B; 24 credits in family and consumer sciences; reservation required
Supervised professional experience in an approved setting such as Cooperative Extension, business, community, human service, or government agency. Offered on a satisfactory-fail basis only.

FCEDS 491A. Supervised Experiences in a Professional Setting: Communications.

Cr. 3-8. Repeatable, maximum of 8 credits. F.S.SS. Prereq: HD FS 418B; 24 credits in family and consumer sciences; reservation required
Supervised professional experience in an approved setting such as Cooperative Extension, business, community, human service, or government agency. Offered on a satisfactory-fail basis only.

FCEDS 491B. Supervised Experiences in a Professional Setting: Professional Studies.

Cr. 3-8. Repeatable, maximum of 8 credits. F.S.SS. Prereq: HD FS 418B; 24 credits in family and consumer sciences; reservation required
Supervised professional experience in an approved setting such as Cooperative Extension, business, community, human service, or government agency. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

FCEDS 500. Short Course: Current Family and Consumer Sciences Offerings.

Cr. 1-3. Repeatable. F.S.SS. Prereq: 6 credits in family and consumer sciences or education

FCEDS 500A. Short Course: Adult Education.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 500B. Short Course: Supervision and Administration.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 500C. Short Course: Curriculum.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 500D. Short Course: Evaluation.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 500E. Short Course: Teacher Education.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 500F. Short Course: Occupational, Career and Technical Education.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 500G. Short Course: General.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 500H. Short Course: Research Methodology.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 500I. Short Course: International Education.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 500J. Short Course: Middle Level Education.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 500K. Short Course: Textile Selection and Apparel Construction Methods.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 504. Intellectual Foundations of Family and Consumer Sciences Leadership.

(3-0) Cr. 3. F. *Prereq: Graduate classification*

Exposure to a variety of selected readings that provide an intellectual foundation and framework for the family and consumer sciences profession. Connects the historical and philosophical structure of the profession with perspectives leading to innovative professional action.

FCEDS 507. Program Development and Assessment in Family and Consumer Sciences.

(3-0) Cr. 3. S. *Prereq: Professional experience in family and consumer sciences or related area*

Application of principles of program development and assessment to formal and non-formal educational settings, e.g., secondary school family and consumer sciences programs, training positions in business, Cooperative Extension, human services agencies. Planning and constructing test items and other assessments of school and non-school learning.

FCEDS 508. Models for Teaching Family and Consumer Sciences.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: 6 credits in family and consumer sciences*

Selecting and applying teaching strategies and instructional materials based on theories of learning and human development that reflect a professional philosophy of family and consumer sciences. Application to formal and non-formal educational settings with diverse audiences.

FCEDS 511. Research Methods.

(3-0) Cr. 3. F. *Prereq: Graduate classification*

An overview of diverse research approaches focusing on methods for collecting and analyzing quantitative and qualitative data. Critique of research reports and development of research proposals.

FCEDS 515. Assessment in Family and Consumer Sciences.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: Introductory statistical and program development skills*

Role of assessment in family and consumer sciences education programs. Planning and constructing test items and other assessments of school and nonschool learning.

FCEDS 518. Career and Technical Programs in Family and Consumer Sciences.

(Dual-listed with FCEDS 418). (3-0) Cr. 3. S. *Prereq: FCEDS 206; 400 hours employment in a family and consumer sciences related field.*

Philosophy of career and technical education. Historical development of family and consumer sciences. Planning and implementing programs in family and consumer sciences including FCCLA. Impact of selected legislation on family and consumer sciences programs. May be used toward Multioccupations Endorsement.

FCEDS 521. International Perspectives of Family and Consumer Sciences.

(3-0) Cr. 3. Alt. SS., offered even-numbered years. *Prereq: 6 credits in family and consumer sciences*

Examination of family and consumer sciences from an international perspective; focus on the roles and responsibilities of women in development. Application and adaptation of content to working with families in other countries and cultures. Student participation in cultural activities and critique of international research articles.

Meets International Perspectives Requirement.

FCEDS 590. Special Topics.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590A. Special Topics: Adult Education.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590B. Special Topics: Administration.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590C. Special Topics: Curriculum.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590D. Special Topics: Evaluation.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590E. Special Topics: Teacher Education.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590F. Special Topics: Occupational, Career and Technical Education.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590G. Special Topics: General.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590H. Special Topics: Research Methodology.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590I. Special Topics: International Education.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590J. Special Topics: Educational Gerontology.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590K. Special Topics: Leadership and Human Relations.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590L. Special Topics: Special Needs.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590M. Special Topics: Family Life Education.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590N. Special Topics: Human Sexuality.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590O. Special Topics: Technology.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590P. Special Topics: Supervision.

Cr. arr. Repeatable. *Prereq: 6 credits in family and consumer sciences or education*

FCEDS 590Q. Special Topics: Family/Individual Health.

Cr. arr. Repeatable. Prereq: 6 credits in family and consumer sciences or education

FCEDS 590R. Special Topics: Consumer Education.

Cr. arr. Repeatable. Prereq: 6 credits in family and consumer sciences or education

FCEDS 590S. Special Topics: Distance Education.

Cr. arr. Repeatable. Prereq: 6 credits in family and consumer sciences or education

FCEDS 590T. Special Topics: Professional Communications.

Cr. arr. Repeatable. Prereq: 6 credits in family and consumer sciences or education

FCEDS 593. Workshop.

Cr. 1-3. Repeatable. F.S.SS. Prereq: 6 credits in family and consumer sciences or education

Concentrated group study of new developments in family and consumer sciences education. Sections offered will vary from year to year.

FCEDS 599. Creative Component.

Cr. arr. Prereq: 9 graduate credits in Family and Consumer Sciences Education

Courses for graduate students:**FCEDS 610. Seminar.**

Cr. 1. Repeatable. F.S.SS. Prereq: Graduate classification

Exploration of trends and issues in the profession. Offered on a satisfactory-fail basis only.

FCEDS 611. Program Evaluation in Family and Consumer Sciences.

(3-0) Cr. 3. Alt. SS., offered even-numbered years. Prereq: FCEDS 511, FCEDS 515

Application of program evaluation approaches and models to family and consumer sciences programs. Standards for program evaluation.

FCEDS 620. Theories of Administration in Family and Consumer Sciences.

(3-0) Cr. 3. Alt. SS., offered even-numbered years. Prereq: Professional Experience

Review of administrative theory; application to family and consumer sciences programs with emphasis on higher education. Administrative leadership roles and their interrelationships. Consideration of current issues.

FCEDS 690. Family and Consumer Sciences Education and Studies Advanced Topics.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690A. Advanced Topics: Adult Education.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690B. Advanced Topics: Administration.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690C. Advanced Topics: Curriculum.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690D. Advanced Topics: Evaluation.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690E. Advanced Topics: Teacher Education.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690F. Advanced Topics: Occupational, Career and Technical Education.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690G. Advanced Topics: General.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690I. Advanced Topics: International Education.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690J. Advanced Topics: Educational Gerontology.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690K. Advanced Topics: Leadership and Human Relations.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690L. Advanced Topics: Special Needs.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690M. Advanced Topics: Family Life Education.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690N. Advanced Topics: Human Sexuality.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690O. Advanced Topics: Technology.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690P. Advanced Topics: Supervision.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690Q. Advanced Topics: Family/Individual Health.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690R. Advanced Topics: Consumer Education.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690S. Advanced Topics: Distance Education.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690T. Advanced Topics: Professional Education.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 690U. Advanced Topics: Research Methodology.

Cr. arr. Prereq: Enrollment in doctoral program, permission of instructor; and approval of D.O.G.E

Topics for the independent study will be in any of the following areas:.

FCEDS 699. Research.

Cr. arr. Repeatable.

Finance (FIN)

Courses primarily for undergraduates:

FIN 301. Principles of Finance.

(3-0) Cr. 3. F.S.SS. *Prereq: ACCT 284, ECON 101, STAT 226*

Introduction to financial management with emphasis on corporate financing and investment decision making, time value of money, asset valuation, capital budgeting decision methods, cash budgeting, and financial markets.

FIN 310. Corporate Finance.

(3-0) Cr. 3. F.S.SS. *Prereq: FIN 301*

Theory used in a firm's investment and financing decisions. Analysis of environment in which financial decisions are made; applications of analytical techniques to financial management problems.

FIN 320. Investments.

(3-0) Cr. 3. F.S.SS. *Prereq: FIN 301*

Introduction to securities and markets from the viewpoint of the individual investor. Emphasis on mechanics of trading, measurement of return and risk, behavior of security prices, valuation of stocks and bonds, mutual funds, portfolio selection techniques, and performance evaluation.

FIN 327. Fixed Income Securities.

(3-0) Cr. 3. *Prereq: FIN 301*

Valuation of fixed income securities, including pricing conventions, term structure of interest rates, default, duration, and hedging of interest rate risk with derivatives. Analysis of bond market sectors, including treasury, agency, corporate, sovereign, municipal, and residential mortgage bonds.

FIN 330. Financial Markets and Institutions.

(3-0) Cr. 3. F.S. *Prereq: FIN 301*

Introduction to the structure and operations of the United States financial system and its markets and institutions. Emphasis on developing an integrated understanding of markets and financial service providers including global linkages.

FIN 361. Personal Risk Management and Insurance.

(3-0) Cr. 3. F.S. *Prereq: ECON 101*

Risk concepts and the use of insurance by individuals and families. Emphasis on the insurance mechanism and methods of dealing with income, property, and liability risks.

FIN 371. Real Estate Principles.

(3-0) Cr. 3. SS. *Prereq: ECON 101*

Legal, economic, social and financial aspects of real estate, including property rights, contracts, mortgage instruments, tax factors, brokerage, valuation, risk and return analysis, financing techniques, and investments.

FIN 415. Business Financing Decisions.

(3-0) Cr. 3. *Prereq: FIN 301 and STAT 326*

In depth study of the firm's external financing decision. Emphasis on the development of cash flow statements, projected financing needs and the selection of the appropriate financing instrument. Focus on case studies and application of developed techniques on actual field project.

FIN 424. Financial Futures and Options.

(3-0) Cr. 3. *Prereq: FIN 320 and STAT 326*

Advanced study of pricing and using derivatives - instruments deriving value from fundamental items such as commodities, currency exchange rates, market indices, equities and bonds. Addresses basic building blocks of derivatives (i.e., forwards, futures, options and swaps) and relevant current topics and issues.

FIN 425. Security Analysis and Portfolio Management.

(3-0) Cr. 3. F.S. *Prereq: FIN 320, STAT 326 and permission of instructor*

Advanced study of security analysis, security selection techniques and portfolio management. Emphasis on the applications of methods learned via the selection and evaluation of a portfolio of actual securities purchased in securities markets in the U.S. or abroad. Tracking and periodic reporting of the portfolio's performance relative to standard benchmarks is also required.

FIN 428. Advanced Fixed Income Analysis and Portfolio Management.

(Dual-listed with FIN 528). (3-0) Cr. 3. *Prereq: FIN 327, FIN 320, STAT 326 and permission of the instructor*

Advanced analysis of fixed income markets and securities, including valuation and trading of treasury securities, corporate bonds, mortgage backed securities. Analysis of structured financial securities, including CDO, CMBS, and ABS. Analysis of active and passive investment strategies for managing fixed income portfolios. Students are required to manage a fixed income portfolio for an institutional investor. A top-down approach to portfolio management is assumed, with active bets taken on market direction, duration, yield curve, and credit spreads.

FIN 435. Venture Capital, Private Equity, and Mergers and Acquisitions.

(3-0) Cr. 3. S. *Prereq: FIN 310, FIN 320, STAT 326, and permission of instructor*
An advanced investments class that focuses on alternative investments. Topics include techniques for valuing public and private firms, venture capital finance, investment banking, private equity finance, leveraged buyouts, hedge funds, the structure and financing of mergers and acquisitions, and divestitures.

FIN 445. Bank Management Decisions.

(3-0) Cr. 3. F.S. *Prereq: STAT 326 and FIN 330*

Analysis of operations of depository financial institutions from management viewpoint. Emphasis on evaluating performance, policy formation, asset and liability management, the role of capital, and the operating environment.

FIN 462. Corporate Risk Management and Insurance.

(3-0) Cr. 3. F. *Prereq: FIN 301 and STAT 326*

Analysis of an organization's approaches to the management of price, credit, and pure risk. Emphasis on the consideration and selection of risk control and financing treatments and the decision making framework underlying the alternatives selected. Covers commercial insurance, self-insurance, and alternative financing arrangements.

FIN 472. Real Estate Finance.

(3-0) Cr. 3. *Prereq: FIN 301 and STAT 326*

Introduction to the techniques of assessing the value of real estate and real estate financing instruments.

FIN 480. International Finance.

(3-0) Cr. 3. F.S. *Prereq: FIN 301 and STAT 326*

Advanced study of currency market equilibrium, use and analysis of currency derivatives, hedging currency risk, and additional topics, which could include multinational capital budgeting, taxation, raising capital internationally, international portfolio diversification, international capital market equilibrium, political and country risk, financing international trade, multinational corporate treasury management, and current issues.

FIN 490. Independent Study.

Cr. 1-3. Repeatable. *Prereq: FIN 301, STAT 326 and permission of instructor*

FIN 499. Finance Internship.

(3-0) Cr. 1-3. F.S.SS. *Prereq: GPA 2.5; permission of internship coordinator; STAT 326; FIN 499A: FIN 330; FIN 499B: FIN 361; FIN 499C: FIN 301 plus 3 additional credits in finance; FIN 499D: FIN 320; FIN 499E: FIN 310*

Supervised experience in a private sector banking, insurance, real estate, investments or corporate organization or in a governmental agency that regulates such organizations. Offered on a satisfactory-fail basis only.

FIN 499A. Finance Internship:Banking.

(3-0) Cr. 1-3. F.S.SS. *Prereq: GPA 2.5; permission of internship coordinator; STAT 326.*

Supervised experience in a private sector banking, insurance, real estate, investments or corporate organization or in a governmental agency that regulates such organizations. Offered on a satisfactory-fail basis only.

FIN 499B. Insurance.

(3-0) Cr. 1-3. F.S.SS. *Prereq: GPA 2.5; permission of internship coordinator; FIN 361 and STAT 326*

Supervised experience in a private sector insurance organization or in a governmental agency that regulates such organizations. Offered on a satisfactory-fail basis only.

FIN 499C. Real Estate.

(3-0) Cr. 1-3. F.S.SS. *Prereq: GPA 2.5; permission of internship coordinator; FIN 301 plus 3 additional credits in finance and STAT 326;*

Supervised experience in a private sector real estate organization or in a governmental agency that regulates such organizations. Offered on a satisfactory-fail basis only.

FIN 499D. Investments.

(3-0) Cr. 1-3. F.S.SS. *Prereq: GPA 2.5; permission of internship coordinator; FIN 320 and STAT 326*

Supervised experience in a private sector investment organization or in a governmental agency that regulates such organizations. Offered on a satisfactory-fail basis only.

FIN 499E. Corporate.

(3-0) Cr. 1-3. F.S.SS. *Prereq: GPA 2.5; permission of internship coordinator; FIN 310 and STAT 326*

Supervised experience in a private sector corporate organization or in a governmental agency that regulates such organizations. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

FIN 501. Financial Valuation and Corporate Financial Decisions.

(3-0) Cr. 3. *Prereq: Enrollment in MBA program or departmental permission.* Shareholder wealth maximization as the goal of the firm within a social responsibility context, financial Math, valuation of securities, the global financial market place as the test of value, estimation of cost of capital, global capital investment decisions, capital structure policy, working capital management.

FIN 510. Advanced Corporate Finance.

(3-0) Cr. 3. *Prereq: FIN 501*
Examines corporate financial decisions, including theory and associated empirical evidence. Topics include agency conflicts, corporate governance, executive compensation, becoming publicly traded, raising capital through public and private offerings, capital structure, financial distress and bankruptcy, leasing, dividend policy, corporate control, restructuring, and risk management.

FIN 515. Case Studies in Financial Decision Making.

(3-0) Cr. 3. *Prereq: FIN 501*
This course focuses on case studies to develop an integrated set of financial decisions. Topic areas include fixed asset, working capital, capital structure, dividend and merger/acquisition decisions. The objective of the course is to examine different firm settings and establish a framework within which to apply financial tools.

FIN 520. Investments.

(3-0) Cr. 3. *Prereq: FIN 501*
Analysis of risk and return for individual securities and portfolios of securities. Topics include the market environment, mechanics of trading, measurement of return and risk, valuation of stocks and bonds, mutual funds, optimal asset allocation, market efficiency, portfolio performance evaluation, and risk management.

FIN 528. Advanced Fixed Income Analysis and Portfolio Management.

(Dual-listed with FIN 428). (3-0) Cr. 3. *Prereq: FIN 327, FIN 320, STAT 326 and permission of the instructor*
Advanced analysis of fixed income markets and securities, including valuation and trading of treasury securities, corporate bonds, mortgage backed securities. Analysis of structured financial securities, including CDO, CMBS, and ABS. Analysis of active and passive investment strategies for managing fixed income portfolios. Students are required to manage a fixed income portfolio for an institutional investor. A top-down approach to portfolio management is assumed, with active bets taken on market direction, duration, yield curve, and credit spreads.

FIN 530. Financial Analysis and Valuation.

(3-0) Cr. 3. *Prereq: FIN 501*
Valuation of public and private firms through analysis of financial statements and other information. Study of drivers of value creation, industry analysis, patterns of growth, models for forecasting and analyzing firm cash flows, estimating and adjusting cost of capital, alternative methods of cash flow valuation, the calculation and use of valuation multiples, and valuing mergers and acquisitions.

FIN 534. Financial Derivatives.

(3-0) Cr. 3. F. *Prereq: Graduate classification*
An applied course in derivative markets. Topics covered include futures and options markets, option pricing, swaps, use and rating of insurance products, and alternative forms of reinsurance. Emphasis will be placed on agricultural commodity markets, but energy, interest, currency and stock index contracts will also be covered.

FIN 535. Venture Capital, Private Equity, and Mergers and Acquisitions.

(3-0) Cr. 3. *Prereq: FIN 501*
Advanced investments class focusing on alternative investments. Topics include the nature and scope of investment banking, techniques for valuing public and private firms, venture capital finance, private equity finance, leveraged buyouts, hedge funds, the structure and financing of mergers and acquisitions, and divestitures.

FIN 550. Financial Econometrics.

(3-0) Cr. 3. *Prereq: FIN 501, ECON 571*
Analysis, modeling, and forecasting of time series data, volatility modeling and forecasting, maximum likelihood estimation, robust standard error computation, specification testing, estimation under alternative distributional assumptions, and Monte Carlo simulation. Applications include tests of asset pricing models, analysis of asset volatility, corporate event studies, and value at risk analysis.

FIN 564. Advanced Derivatives and Risk Management.

(3-0) Cr. 3. *Prereq: FIN 501, FIN 534*
Risk management tools and how they are applied within financial institutions and the corporate enterprise. Focus on measuring exposure to stock market risk, interest rate risk, currency risk, and credit risk and how these exposures may be managed. Topics include bank risk management regulations, volatility modeling, value at risk analysis, extreme value theory, credit default swaps, and portfolio simulation.

FIN 572. Real Estate Finance.

(3-0) Cr. 3. *Prereq: MBA Core*
Survey of techniques for assessing the value of real estate assets. Introduction to real estate financing instruments, their use and appropriateness.

FIN 590. Special Topics.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*
For students wishing to do individual research in a particular area of finance.

Food Science and Human Nutrition (FS HN)

Courses primarily for undergraduates:

FS HN 101. Food and the Consumer.

(3-0) Cr. 3. F.S. *Prereq: High school biology and chemistry or 3 credits each of biology and chemistry*

The food system from point of harvest to the consumption of the food by the consumer. Properties of food constituents. Protection of food against deterioration and microbial contamination. Introduction of foods into the marketplace. Processes for making various foods. Government regulations. Use of food additives. Current and controversial topics. Electronic communication from web emphasized for class reports, notes and assignments.

FS HN 102. Nutrition for Sport Performance.

(1-0) Cr. 1. F.S.

Analysis of how the body uses nutrients for energy and how to select a balanced diet to meet specific athletic performance needs. Lecture and activities specific to students' interest.

FS HN 104. Introduction to Professional Skills in Culinary Science.

(0-6) Cr. 1. S.

Introduction to culinary science. Students will develop fundamental culinary skills by arranged on-campus work experience (100 hours). Sessions with instructor arranged.

FS HN 110. Professional and Educational Preparation.

(1-0) Cr. 1. F.S.

Introduction to professional and educational development within the food science and human nutrition disciplines. Focus is on university and career acclimation, enhancement of communication skills, and portfolio development. Offered on a satisfactory-fail basis only.

FS HN 111. Fundamentals of Food Preparation.

(2-0) Cr. 2. F.S. *Prereq: FS HN 101 or FS HN 167; high school chemistry or CHEM 160; concurrent enrollment in FSHN 115.*

Principles involved in preparation of food products of standard quality. Influence of composition and techniques on properties of food products.

FS HN 112. Orientation to Learning and Productive Team Membership.

(Cross-listed with AER E, CON E, HORT, NREM). (2-0) Cr. 2. F.

Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

FS HN 114. Developing Responsible Learners and Effective Leaders.

(Cross-listed with CON E, HORT, NREM). (2-0) Cr. 2. S. *Prereq: Hort 112 or NREM 112*

Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

FS HN 115. Food Preparation Laboratory.

(0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in FS HN 111 or FS HN 214*

Practice standard methods of food preparation with emphasis on quality, nutrient retention, and safety.

FS HN 167. Introduction to Human Nutrition.

(3-0) Cr. 3. F.S.SS. *Prereq: High school biology or 3 credits of biology*

Understanding and implementing present day knowledge of nutrition. The role of nutrition in the health and well being of the individual and family.

FS HN 203. Contemporary Issues in Food Science and Human Nutrition.

(1-0) Cr. 1. F.S.

Introduction to published research and discussion of current issues in food science and human nutrition. Emphasis on sources of credible information, ethics, communication and portfolio development.

FS HN 214. Scientific Study of Food.

(3-0) Cr. 3. F.S. *Prereq: FS HN 167 or FS HN 265; CHEM 231 or CHEM 331; plus concurrent enrollment in FS HN 115 or 215*

Composition and structure of foods. Principles of preparation of standard quality food products. Behavior and interactions of food constituents.

FS HN 215. Advanced Food Preparation Laboratory.

(0-6) Cr. 2. F.S. *Prereq: Credit or enrollment in FS HN 214*

Practice standard methods of food preparation with emphasis on quality, nutrient retention, and safety. Development of culinary skills and advanced food preparation.

FS HN 242. Societal Impacts on Food Systems.

(3-0) Cr. 3. S.

Description of food systems from farming practices to global marketing. Exploration of the impacts of food system choices on personal health, the environment and global society.

FS HN 262. Special Topics in Health Professions.

(1-0) Cr. 1. F.

Careers and controversies in nutritional science. Discussion of current topics in health professions involving nutrition, such as "low-carb" diets, supplements for athletic performance, "food and mood," interviews with health professionals on how they use nutrition concepts in practice.

FS HN 264. Fundamentals of Nutritional Biochemistry and Metabolism.

(3-0) Cr. 3. F. *Prereq: FS HN 167; CHEM 163, CHEM 163L; BIOL 211*

Digestion, absorption, metabolism, and biochemical functions of nutrients. Biochemical aspects of nutrient deficiencies.

FS HN 265. Nutrition for Active and Healthy Lifestyles.

(3-0) Cr. 3. S. *Prereq: FS HN 167, plus credit or enrollment in BBMB 301 or credit in FS HN 264*

Fundamentals of nutrient metabolism and nutrient requirements. Role of macronutrient metabolism in physical performance and disease prevention. Effect of manipulation of macronutrient metabolism on physical performance and disease prevention. Applications of nutrient metabolism principles to dietary recommendations and planning.

FS HN 308. Dairy Products: Current Issues and Controversies.

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

Course will address milk chemistry, microbiology, handling, processing, regulations, organic production, and nutrition; dispel myths about dairy foods; improve critical thinking and communication skills. Students will participate in structured controversies and debate.

FS HN 311. Food Chemistry.

(3-0) Cr. 3. F. *Prereq: CHEM 231 and CHEM 231L or CHEM 331 and CHEM 331L; credit or enrollment in BBMB 301*

The structure, properties, and chemistry of food constituents and animal and plant commodities.

FS HN 311L. Food Chemistry Laboratory.

(0-3) Cr. 1. F. *Prereq: Credit or concurrent enrollment in FSHN 311.*

The laboratory practices of structure, properties, and chemistry of food constituents.

FS HN 314. Foundations of Culinary Science.

(1-0) Cr. 1. S. *Prereq: FSHN 104 or concurrent enrollment in FSHN 104.*

Introduction to the roles culinary scientists hold within industry including product development, research, and quality assurance. Discussions focused on professional and educational development, enhancement of communication skills, ethics and emerging issues and trends in culinary science.

FS HN 340. Foundations of Dietetic Practice.

(1-0) Cr. 1. F. *Prereq: DIET or PDEX classification*

Introduction to the profession of dietetics and responsibilities associated with dietetic professional practice. Emphasis on development of a pre-professional portfolio, career options in dietetics and preparation for a dietetic internship. Leadership and professional career development for the dietitian is addressed through self reflection, creation of materials for post-baccalaureate programs and job shadowing experience. Professional issues related to dietetic practice include Code of Ethics, legal credentialing and standards of professional practice, leadership and future trends in the profession. Offered on a satisfactory-fail basis only.

FS HN 342. World Food Issues: Past and Present.

(Cross-listed with AGRON, ENV S, T SC). (3-0) Cr. 3. F.S. *Prereq: Junior classification*

Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects.

Meets International Perspectives Requirement.

FS HN 342H. World Food Issues: Past and Present (Honors).

(3-0) Cr. 3. F.S. *Prereq: Junior classification*

Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects.

Meets International Perspectives Requirement.

FS HN 351. Introduction to Food Engineering Concepts.

(3-0) Cr. 3. S. *Prereq: A course in calculus and physics (PHYS 111 or PHYS 115)*

Methodology for solving problems in food processing and introduction to food engineering concepts including food properties, material and energy balances, sources of energy, thermodynamics, fluid flow, heat transfer, and mass transfer. Field trip.

FS HN 360. Advanced Human Nutrition and Metabolism.

(3-0) Cr. 3. F. *Prereq: FS HN 265, 3 credits in biochemistry; 3 credits in physiology recommended*

Physiological and biochemical basis for nutrient needs; assessment of nutrient deficiency and toxicity; examination of nutrient functions and regulation of metabolism; nutrient-gene interactions.

FS HN 361. Nutrition and Health Assessment.

(1-3) Cr. 2. S. *Prereq: FS HN 265; 3 credits in statistics; 3 credits in physiology recommended*

The assessment of nutritional status in healthy individuals. Laboratory experiences in food composition and assessment of dietary intake, body composition, and biochemical indices of nutritional status.

FS HN 362. Nutrition in Growth and Development.

(3-0) Cr. 3. S. *Prereq: FS HN 360; credit or enrollment in a course in physiology*
Nutrient needs throughout the life cycle. Interrelationships of genes, gene expression and nutrients with physiological outcomes during human development and aging.

FS HN 364. Nutrition and Prevention of Chronic Disease.

(3-0) Cr. 3. F. *Prereq: BIOL 256, BIOL 256L or BIOL 306*

Overview of nutrients, their functions, metabolism, food sources and optimal choices for the promotion of health and wellness. Nutrition strategies for the prevention of chronic disease, including cancer, diabetes and obesity, as they apply to individuals or the wider population will be discussed.

FS HN 365. Obesity and Weight Management.

(3-0) Cr. 3. S. *Prereq: BIOL 256 and BIOL 256L, or BIOL 306*

Multifactorial aspects of obesity, maintenance of healthy weight, and the relationship of weight status and chronic disease prevention. Traditional and novel nutrition and exercise theories as well as current popular diet and exercise trends will be discussed.

FS HN 366. Communicating Nutrition Messages.

(3-0) Cr. 3. S. *Prereq: FS HN 264 or FS HN 265*

Theory and application of adult learning as it relates to the role of nutrition in health promotion and disease prevention. Discussion of nutrition education and interventions relative to the social-ecological model. Factors to consider in developing the nutrition education/intervention practicum experience using the social-ecological model. Focus on communication strategies for providing nutrition messages to diverse community audiences using various forms of media and outreach (print, radio, TV, newspaper, consumer publications, websites, community venues). Development of nutrition messages using various forms of media for a target population.

FS HN 367. Medical Terminology for Health Professionals.

(1-0) Cr. 1. S.

An independent course focused on medical terminology, abbreviations, and simple clinical mathematical calculations.

FS HN 403. Food Laws, Regulations, and the Regulatory Process.

(2-0) Cr. 2. S.SS. *Prereq: 3 credits in food science coursework at 200 level or above*

Review of federal legislative and regulatory processes and documents related to food and food ingredients. Discussion of federal food safety programs, food distribution programs, related programs, and key agencies. Exploration of analogous State of Iowa processes, programs, and agencies.

FS HN 405. Food Quality Assurance.

(2-2) Cr. 3. S. *Prereq: FS HN 214 or FS HN 311; STAT 101 or STAT 104*

Basis of food quality control/assurance programs and establishment of decision-making processes using official (government and industry) instrumental, chemical, and sensory procedures. Statistical process and quality control procedures and their applications to various food systems. Development of hazard analysis procedures, specifications, grades, and standards.

FS HN 406. Sensory Evaluation of Food.

(Dual-listed with FS HN 506). (2-3) Cr. 3. F. *Prereq: FS HN 214 or FS HN 311 or AN S 360; 3 credits in statistics*

Sensory test methods and procedures used to evaluate the flavor, color and texture of foods. Relationships between sensory and instrumental measurements of color and texture. Acceptance and preference testing.

FS HN 407. Microbiological Safety of Foods of Animal Origins.

(Dual-listed with FS HN 507). (Cross-listed with MICRO). (3-0) Cr. 3. S. *Prereq: MICRO 420*

Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

FS HN 408. Dairy Products Evaluation.

(0-3) Cr. 1. F. *Prereq: Permission of instructor*

Experience in identifying quality defects in dairy products including milk, cottage cheese, cheddar cheese, strawberry yogurt, butter, and vanilla ice cream. Intensive training for the National Collegiate Dairy Products Evaluation competition and for dairy product evaluation in the food industry.

FS HN 410. Food Analysis.

(2-3) Cr. 3. S. *Prereq: FS HN 214 or FS HN 311 or CHEM 211*

An introduction to the theory and application of physical and chemical methods for determining the constituents of food. Modern separation and instrumental analysis. Use of food composition data bases.

FS HN 411. Food Ingredient Interactions and Formulations.

(1-3) Cr. 2. F.S. *Prereq: FSHN 214 or FS HN 311 and FS HN 115, FS HN 215 or FS HN 311L.*

Application of food science principles to ingredient substitutions in food products. Laboratory procedures for standard formulations and instrumental evaluation, with emphasis on problem-solving and critical thinking.

FS HN 412. Food Product Development.

(Dual-listed with FS HN 512). (1-6) Cr. 3. S. *Prereq: FS HN 311 or FS HN 411, FSHN 471*

Principles of developing consumer packaged food products. Application of skills gained in food chemistry, formulation, microbiology, and processing. Some pilot plant experiences. Electronic communication from web emphasized for class reports, notes and assignments.

FS HN 419. Foodborne Hazards.

(Cross-listed with MICRO, TOX). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: MICRO 201 or MICRO 302, a course in biochemistry*

Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Only one of FS HN 419 and FS HN 519 may count toward graduation.

FS HN 420. Food Microbiology.

(Cross-listed with MICRO, TOX). (3-0) Cr. 3. F. *Prereq: MICRO 201 or MICRO 302*

Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications.

FS HN 421. Food Microbiology Laboratory.

(Cross-listed with MICRO). (0-6) Cr. 3. F. *Prereq: MICRO 201 or MICRO 302; MICRO 201L or MICRO 302L. Credit or enrollment in FS HN/MICRO 420*

Standard techniques used for the microbiological examination of foods. Independent and group projects on student-generated questions in food microbiology. Emphasis on oral and written communication and group interaction.

FS HN 440. Bioprocessing and Bioproducts.

(Dual-listed with FS HN 540). (Cross-listed with C E). (3-0) Cr. 3. F. *Prereq: C E 326 or equivalent, MATH 160 or MATH 165, CHEM 167 or higher, BIOL 173 or BIOL 211 or higher, senior or graduate classification*

Sustainability, cleaner production. Taxonomy, kinetics, metabolism, microbial cultivation, aerobic and anaerobic fermentation. Antibiotics, food supplements, fermented foods, vitamin production. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

FS HN 442. Issues in Food and Society.

(2-0) Cr. 2. F. *Prereq: FS HN 242, FS HN 342*

In-depth discussion, synthesis, and analysis of domestic and international food issues including: food systems from farm to fork, poverty and world hunger, overnutrition, population, agriculture and the environment, ethics, biotechnology, and policy.

FS HN 461. Medical Nutrition and Disease I.

(4-0) Cr. 4. F. *Prereq: FS HN 360, FS HN 361, FS HN 367; plus BIOL 256 and 256L or BIOL 306 or BIOL 335*

(Dual-listed with NutrS 561) Pathophysiology of selected chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state.

FS HN 463. Community Nutrition.

(3-0) Cr. 3. F. *Prereq: FS HN 265 or FS HN 360; FS HN 366 recommended*

Dual-listed with NutrS 563. Survey of current public health nutrition problems among nutritionally vulnerable individuals and groups. Discussion of the multidimensional nature of those problems and of community programs addressing them. Grant writing as a means for funding community nutrition program development. Significant emphasis on written and oral communication at the lay and professional level. Field trip. Meets U.S. Diversity Requirement

FS HN 464. Medical Nutrition and Disease II.

(3-0) Cr. 3. S. *Prereq: FS HN 360, FS HN 461; plus BIOL 256 and BIOL 256L or BIOL 306 or BIOL 335*

(Dual-listed with NutrS 564) Pathophysiology of selected acute and chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state.

FS HN 466. Nutrition Counseling and Education Methods.

(Dual-listed with FS HN 566). (2-2) Cr. 3. F.S. *Prereq: FS HN 361, FS HN 362* Application of counseling and learning theories with individuals and groups in community and clinical settings. Includes discussion and experience in building rapport, assessment, diagnosis, intervention, monitoring, evaluation, and documentation.

FS HN 467. Molecular Basis of Nutrition in Disease Prevention.

(3-0) Cr. 3. S. *Prereq: FS HN 360 or equivalent*

Understanding the molecular basis for the role of diet in the development and prevention of common diseases such as diabetes, cancer, and vascular diseases. Translating this understanding into practical approaches for improving the health of individuals and populations.

FS HN 471. Food Processing I.

(Dual-listed with FS HN 571). (2-3) Cr. 3. F. *Prereq: FS HN 351 or A E 451 or CH E 357; MICRO 201 or MICRO 302; CHEM 163 or CHEM 177.*

Principles and applications of food processing by application of heat (blanching, pasteurization, canning, extrusion, evaporation and distillation, extrusion and dehydration) and by removal of heat (refrigeration and freezing). Emphasis on solving problems in laboratory and recitation sessions.

FS HN 472. Food Processing II.

(Dual-listed with FS HN 572). (2-3) Cr. 3. S. *Prereq: FS HN 351 or A E 451 or CH E 357.*

Principles and applications of food processing by biological (fermentation, enzymes) and nontraditional (high pressure, irradiation, pulsed electric field) preservation methods. Includes packaging, waste water treatment, and sanitation. Emphasis on solving problems in laboratory and recitation sessions.

FS HN 480. Professional Communication in Food Science and Human Nutrition.

(1-0) Cr. 1. F.S. *Prereq: FS HN 203, senior classification in the department* Presentation of current topics using written and oral communication to a lay audience. Emphasis on communication skills for the profession.

FS HN 489. Issues in Food Safety.

(Cross-listed with AN S, HSP M, VDPAM). (1-0) Cr. 1. S. *Prereq: Credit or enrollment in FS HN 101 or FS HN 272 or HSP M 233; FS HN 419 or FS HN 420; FS HN 403*

Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

FS HN 490. Independent Study.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of instructor*

Independent work in food science, nutrition, or dietetics. A maximum of 6 credits of FS HN 490 may be used toward graduation.

FS HN 490A. Independent Study: Dietetics.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of instructor*

Independent work in food science, nutrition, or dietetics. A maximum of 6 credits of FS HN 490 may be used toward graduation.

FS HN 490B. Independent Study: Food Science.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of instructor*

Independent work in food science, nutrition, or dietetics. A maximum of 6 credits of FS HN 490 may be used toward graduation.

FS HN 490C. Independent Study: Nutrition.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of instructor*

Independent work in food science, nutrition, or dietetics. A maximum of 6 credits of FS HN 490 may be used toward graduation.

FS HN 490D. Independent Study: International Experience.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of instructor*

Independent work in food science, nutrition, or dietetics. A maximum of 6 credits of FS HN 490 may be used toward graduation.

FS HN 490E. Independent Study: Entrepreneurship.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of instructor*

Independent work in food science, nutrition, or dietetics. A maximum of 6 credits of FS HN 490 may be used toward graduation.

FS HN 490H. Independent Study: Honors.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of instructor*

Independent work in food science, nutrition, or dietetics. A maximum of 6 credits of FS HN 490 may be used toward graduation.

FS HN 491. Supervised Work Experience.

Cr. 1-4. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Advance approval of instructor and adviser*

Supervised off-campus work experience relevant to the academic major. Offered on a satisfactory-fail basis only. A maximum of 4 credits of FS HN 491 may be used toward graduation.

FS HN 491A. Supervised Work Experience: Dietetics.

Cr. 1-4. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Advance approval of instructor and adviser*

Supervised off-campus work experience relevant to the academic major. Offered on a satisfactory-fail basis only. A maximum of 4 credits of FS HN 491 may be used toward graduation.

FS HN 491B. Supervised Work Experience: Food Science.

Cr. 1-4. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Advance approval of instructor and adviser*

Supervised off-campus work experience relevant to the academic major. Offered on a satisfactory-fail basis only. A maximum of 4 credits of FS HN 491 may be used toward graduation.

FS HN 491C. Supervised Work Experience: Nutrition.

Cr. 1-4. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Advance approval of instructor and adviser*

Supervised off-campus work experience relevant to the academic major. Offered on a satisfactory-fail basis only. A maximum of 4 credits of FS HN 491 may be used toward graduation.

FS HN 491D. Supervised Work Experience: Culinary Science.

Cr. 1-4. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Advance approval of instructor and adviser*

Supervised off-campus work experience relevant to the academic major. Offered on a satisfactory-fail basis only. A maximum of 4 credits of FS HN 491 may be used toward graduation.

FS HN 492. Research Concepts in Human Nutrition.

(1-3) Cr. 2. F. Prereq: senior classification or permission of instructor; FS HN 360
Students will develop and implement research projects with faculty supervision, based on knowledge gained from nutrition, biology and chemistry courses. Students will prepare a research proposal, conduct research and report results. Students will gain appreciation for independent research and experience creative and innovative aspects of nutrition research.

FS HN 493. Food Preparation Workshop.

(1-3) Cr. 1-3.
Selected topics in food preparation including scientific principles, culture and culinary techniques. Variable format may include laboratory, recitation, and lecture. Offered on a satisfactory-fail basis only.

FS HN 495. Practicum.

(1-3) Cr. 2. F.S. Prereq: Senior classification in Nutritional Science-Nutrition and Wellness option or permission of instructor; FS HN 366; credit or enrollment in FS HN 463.

Service-learning in community activities. Students will develop, implement and assess a project that engages groups in learning and practicing concepts related to nutrition and wellness.

FS HN 496. Food Science and Human Nutrition Travel Course.

(Dual-listed with FS HN 596). Cr. 1-4. Repeatable. F.S.SS. Prereq: Permission of instructor

(One credit per week traveled and 1 credit for pre-departure class, if offered.) Limited enrollment. Tour and study of food industry, culinary science, dietetic and nutritional agencies in different regions of the world. Pre-travel session arranged. Travel expenses paid by students.

FS HN 496A. Food Science and Human Nutrition Travel Course: International travel.

(Dual-listed with FS HN 596A). Cr. 1-4. Repeatable. F.S.SS. Prereq: Permission of instructor

(One credit per week traveled.) Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Pre-travel session arranged. Travel expenses paid by students. Meets International Perspectives Requirement.

FS HN 496B. Food Science and Human Nutrition Travel Course: Domestic travel.

(Dual-listed with FS HN 596B). Cr. 1-4. Repeatable. F.S.SS. Prereq: Permission of instructor

(One credit per week traveled.) Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Pre-travel session arranged. Travel expenses paid by students.

FS HN 498. Cooperative Education.

Cr. R. Repeatable, maximum of 2 times. F.S.SS. Prereq: Permission of department chair.

Required for students completing professional work periods in a cooperative education program. Students must register prior to commencing each work period. Offered on a satisfactory-fail basis only.

FS HN 499. Undergraduate Research.

Cr. 1-6. Repeatable, maximum of 6 credits. F.S.SS. Prereq: Permission of staff member with whom student proposes to work
Research under staff guidance. A maximum of 6 credits of FS HN 499 may be used toward graduation.

Courses primarily for graduate students, open to qualified undergraduates:**FS HN 505. Short Course in Food Science.**

Cr. arr. F.S.SS. Prereq: Permission of instructor

FS HN 506. Sensory Evaluation of Food.

(Dual-listed with FS HN 406). (2-3) Cr. 3. F. Prereq: FS HN 214 or FS HN 311 or AN S 360; 3 credits in statistics

Sensory test methods and procedures used to evaluate the flavor, color and texture of foods. Relationships between sensory and instrumental measurements of color and texture. Acceptance and preference testing.

FS HN 507. Microbiological Safety of Foods of Animal Origins.

(Dual-listed with FS HN 407). (Cross-listed with MICRO). (3-0) Cr. 3. S. Prereq: MICRO 420

Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

FS HN 511. Principles of Food Science-Chemistry.

(2-0) Cr. 2. S. Prereq: 3 credits in organic chemistry

Key principles and applications in the chemistry of food. This course is designed for graduate students with no previous food chemistry background.

FS HN 512. Food Product Development.

(Dual-listed with FS HN 412). (1-6) Cr. 3. S. Prereq: FS HN 311 or FS HN 411, FSHN 471

Principles of developing consumer packaged food products. Application of skills gained in food chemistry, formulation, microbiology, and processing. Some pilot plant experiences. Electronic communication from web emphasized for class reports, notes and assignments.

FS HN 513. Principles of Food Science-Processing.

(2-0) Cr. 2. S. Prereq: 3 credits each in physics and mathematics.

Key principles and applications in the processing of food. This course is designed for graduate students with no previous food processing background.

FS HN 514. Principles of Food Science-Microbiology.

(2-0) Cr. 2-1. S. Prereq: 3 credits each in microbiology and organic chemistry

Key principles and applications in the microbiology of food. This course is designed for graduate students with no previous food microbiology background.

FS HN 519. Food Toxicology.

(Cross-listed with NUTRS, TOX). (3-0) Cr. 3. Alt. F., offered even-numbered years. Prereq: A course in biochemistry

Basic principles of toxicology. Toxicants in the food supply: modes of action, toxicant defense systems, toxicant and nutrient interactions, risk assessment. Only one of FS HN 419 and FS HN 519 may count toward graduation.

FS HN 521. Microbiology of Food.

(2-0) Cr. 2. F.S.SS. Prereq: A course in microbiology with laboratory; enrollment in GP-IDEA Food Safety and Defense Graduate Certificate or permission of instructor.

This course deals with the identification, enumeration, and characterization of bacteria, yeasts, and mold associated with foods and food processing. Effects of physical and chemical agents on micro-organisms will be studied. Microbiological problems in food spoilage, food preservation, food fermentation, and food-borne disease will be discussed. Offered online only.

FS HN 522. Advanced Food Microbiology and Biotechnology.

(2-0) Cr. 2. Alt. SS., offered odd-numbered years. Prereq: Food microbiology, a course in biochemistry; enrollment in GP-IDEA Food Safety and Defense Graduate Certificate or permission of instructor.

This course will cover basic principles in biotechnology and applied food microbiology, including current topics of interest in food biotechnology. Students will be introduced to recombinant DNA techniques and how they are applied to genetically modify microorganisms, the use of nucleic acids as tools of rapid detection of microorganisms in foods, basic enzyme immobilization and downstream processing techniques, and regulatory aspects of food biotechnology. Offered online only.

FS HN 523. A Multidisciplinary Overview of Food Safety and Security.

(2-0) Cr. 2. F.S.SS. Prereq: A course in biology or chemistry; enrollment in GP-IDEA Food Safety and Defense Graduate Certificate or permission of instructor.

Multidisciplinary food safety and security perspectives provided by numerous subject matter experts. Topics include food safety policy, ag bioterrorism, border security, animal ID, food defense and site security, risk analysis, crisis communication, epidemiology, HACCP, and more. Offered online only.

FS HN 524. Food Microbiology.

(3-0) Cr. 3. F. Prereq: A course in microbiology with laboratory; enrollment in GP-IDEA Food Safety and Defense Graduate Certificate or permission of instructor.

Food Microbiology looks at the nature, physiology, and interactions of microorganisms in foods. The course is an introduction to food-borne diseases, the effect of food processing systems on the microflora of foods, principles of food preservation, food spoilage, and foods produced by microorganisms. Additionally, the course looks at food plant sanitation and criteria for establishing microbial standards for food products. Offered online only.

FS HN 525. Principles of HACCP.

(2-0) Cr. 2. F.S. Prereq: Undergraduate biology and chemistry courses; enrollment in GP-IDEA Food Safety and Defense Certificate or permission of instructor.

A comprehensive study of the Hazard Analysis and Critical Control Point System and its application in the food industry. Offered online only.

FS HN 526. Ethnic Foods: Food Safety, Food Protection and Defense.

(2-0) Cr. 2. SS. Prereq: Graduate standing; enrollment in GP-IDEA Food Safety and Defense Graduate Certificate or permission of instructor.

Understanding of the various factors that impact safety of ethnic and imported ethnic foods; knowledge about the handling, preparation, processing and storage of ethnic and imported foods and food products; science-based characterization of representative ethnic foods. Offered online only.

FS HN 527. Microbiology of Fermented Foods.

(2-0) Cr. 2. SS. *Prereq: Food microbiology; enrollment in GP-IDEA Food Safety and Defense Graduate Certificate or permission of instructor.*

Microbiology of fermented foods covers the physiology, biochemistry, and genetics of microorganisms important in food fermentations. The course looks at how microorganisms are used in fermentations and the effects of processing and manufacturing conditions on production of fermented foods. Offered online only.

FS HN 528. Food Protection and Defense-Essential Concepts.

(2-0) Cr. 2. F.S.SS. *Prereq: Enrollment in GP-IDEA Food Safety and Defense Graduate Certificate or permission of instructor.*

This course will provide students with an understanding of the principles required in a food defense program for a food manufacturing, warehousing or distribution center. The topics covered include: defining threats and aggressors; the Bioterrorism Act; food defense teams; vulnerability assessments; security programs; recall and traceability basics; security inspections; crisis management; emergency preparedness; and workplace violence. Offered online only.

FS HN 529. Foodborne Toxicants.

(Cross-listed with TOX). (2-0) Cr. 2. F. *Prereq: A course in biochemistry; enrollment in GP-IDEA Food Safety and Defense Graduate Certificate or permission of instructor.*

Mechanisms of action, metabolism, sources, remediation/detoxification, risk assessment of major foodborne toxicants of current interest, design of HAACP plans for use in food industries targeting foodborne toxicants, discussion of toxicants from a food defense perspective. Offered online only.

FS HN 540. Bioprocessing and Bioproducts.

(Dual-listed with FS HN 440). (Cross-listed with C E). (3-0) Cr. 3. F. *Prereq: C E 326 or equivalent, MATH 160 or MATH 165, CHEM 167 or higher, BIOL 173 or BIOL 211 or higher, senior or graduate classification*

Sustainability, cleaner production. Taxonomy, kinetics, metabolism, microbial cultivation, aerobic and anaerobic fermentation. Antibiotics, food supplements, fermented foods, vitamin production. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

FS HN 542. Introduction to Molecular Biology Techniques.

(Cross-listed with B M S, EEOB, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

FS HN 542A. Introduction to Molecular Biology Techniques: DNA Techniques.

(Cross-listed with B M S, BBMB, EEOB, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

FS HN 542B. Introduction to Molecular Biology Techniques: Protein.

(Cross-listed with B M S, BBMB, EEOB, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.SS. *Prereq: Graduate classification*

Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

FS HN 542C. Introduction to Molecular Biology Techniques: Cell Techniques.

(Cross-listed with B M S, BBMB, EEOB, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

FS HN 542D. Introduction to Molecular Biology Techniques: Plant Transformation.

(Cross-listed with B M S, EEOB, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

FS HN 542E. Introduction to Molecular Biology Techniques: Proteomics.

(Cross-listed with B M S, BBMB, EEOB, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

FS HN 542F. Introduction to Molecular Biology Techniques: Metabolomics.

(Cross-listed with B M S, BBMB, EEOB, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

FS HN 542G. Introduction to Molecular Biology Techniques: Genomic.

(Cross-listed with B M S, BBMB, EEOB, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

FS HN 546. Classroom Strategies for Nutrition Education.

(2-2) Cr. 3. S. *Prereq: HD FS 340 or HD FS 343 or HD FS 344 or KIN 312 or KIN 375 or H S 275 or H S 375 or FCEDS 306*

Overview of education theories used in nutrition education. Discussion and skill building exercises to integrate various models and strategies into a variety of pre-K through 12 classroom settings. Discussion of picky eating, role modeling, family meals, and primary prevention efforts relative to eating disorders including body image and cultural criticism. Distance only.

FS HN 554. Dietetic Internship I.

(0-22) Cr. 5. S.SS.

For students enrolled in the Dietetic Internship program only. Supervised practice experience in operational management, medical nutrition therapy and community nutrition. Experiences and activities designed to meet accreditation standards.

FS HN 555. Dietetic Internship II.

(0-18) Cr. 4. F.S. *Prereq: Concurrent enrollment or successful completion of FS HN 554*

For students enrolled in the Dietetic Internship program only. Supervised practice experience in operational management, medical nutrition therapy and community nutrition. Experiences and activities designed to meet accreditation standards.

FS HN 556. Dietetic Internship III.

(0-22) Cr. 5. F.SS. *Prereq: Concurrent enrollment or successful completion of FS HN 554 and FS HN 555*

For students enrolled in the Dietetic Internship program only. Supervised practice experience in operational management, medical nutrition therapy and community nutrition. Experiences and activities designed to meet accreditation standards.

FS HN 566. Nutrition Counseling and Education Methods.

(Dual-listed with FS HN 466). (Cross-listed with DIET). (2-2) Cr. 3. F.S. *Prereq: FS HN 361 and FS HN 362*

Application of counseling and learning theories with individuals and groups in community and clinical settings. Includes discussion and experience in building rapport, assessment, diagnosis, intervention, monitoring, evaluation, and documentation. Literature review of specific counseling and learning theories.

FS HN 571. Food Processing I.

(Dual-listed with FS HN 471). (2-3) Cr. 3. F. *Prereq: FS HN 351 or A E 451 or CH E 357; MICRO 201 or MICRO 302; CHEM 163 or CHEM 177.*

Principles and applications of food processing by application of heat (blanching, pasteurization, canning, extrusion, evaporation and distillation, extrusion and dehydration) and by removal of heat (refrigeration and freezing). Emphasis on solving problems in laboratory and recitation sessions.

FS HN 572. Food Processing II.

(Dual-listed with FS HN 472). (2-3) Cr. 3. S. *Prereq: FS HN 351 or A E 451 or CH E 357.*

Principles and applications of food processing by biological (fermentation, enzymes) and nontraditional (high pressure, irradiation, pulsed electric field) preservation methods. Includes packaging, waste water treatment, and sanitation. Emphasis on solving problems in laboratory and recitation sessions.

FS HN 575. Processed Foods.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: FS HN 214 or FS HN 311; a course in nutrition*

This course will examine effect of industrial and domestic food processing on the nutrient content of food and risk of developing chronic disease.

FS HN 580. Orientation to Food Science and Nutrition Research.

(1-0) Cr. 1. F.

Orientation to and discussion of research interests in food science and nutrition. Discussion of policy and ethical issues in the conduct of research. Intended for entering students in FS HN and related disciplines. Offered on a satisfactory-fail basis only.

FS HN 581. Seminar.

(1-0) Cr. 1. S.

Discussion and practice of oral presentation of scientific data in a professional setting. Discussion of issues related to data presentation. Offered on a satisfactory-fail basis only.

FS HN 590. Special Topics.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

FS HN 590A. Special Topics: Nutrition.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

FS HN 590B. Special Topics: Food Science.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

FS HN 590C. Special Topics: Teaching.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

FS HN 596. Food Science and Human Nutrition Travel Course.

Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor* (One credit per week traveled.) Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Pre-travel session arranged. Travel expenses paid by students.

FS HN 596A. Food Science and Human Nutrition Travel Course: International travel.

(Dual-listed with FS HN 496A). Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

(One credit per week traveled.) Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Pre-travel session arranged. Travel expenses paid by students. Meets International Perspectives Requirement.

FS HN 596B. Food Science and Human Nutrition Travel Course: Domestic travel.

(Dual-listed with FS HN 496B). Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

(One credit per week traveled.) Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Pre-travel session arranged. Travel expenses paid by students.

FS HN 599. Creative Component.

Cr. arr.

Nonthesis option only.

Courses for graduate students:**FS HN 606. Instrumental Measurement of Food Quality.**

(2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: FS HN 311 or FS HN 411 or FS HN 502 or BBMB 404*

Principles of instrumental measurements of color, aroma, flavor, texture, and rheology. Techniques and instrumentation for measuring the quality of foods; relationship of these methods to food color, taste, flavor, texture, and rheological quality. Application of methods to various foods and biorenewable materials.

FS HN 610. Food & Bioprocessing Enzymology.

(Cross-listed with BRT). (2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq: FS HN 311 or FS HN 411 or FS HN 502 or BBMB 404*

Properties and applications of industrial enzymes important in food, feed, and bioprocessing, including biofuels and bioproducts. Characterization of enzyme catalytic mechanisms, kinetics, isolation, mutagenesis, and operating conditions, including evaluation of substrates, products, immobilization, enzyme inhibitors, pH, pressure, and temperature.

FS HN 612. Lipid Chemistry and Applications.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: FS HN 311 or FS HN 411 or FS HN 502 or BBMB 404*

Structure and analysis of lipids; glyceride structure; crystal form and texture; autoxidation and chemical modification; extraction, refining and processing; applications of fats and oils in food, biofuel and biobased products.

FS HN 613. Food Proteins.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: FS HN 311 or FS HN 411 or FS HN 502 or BBMB 404*

Properties of proteins found in milk, eggs, meat, legumes, and cereal grains. Effect of processing on food proteins.

FS HN 614. Carbohydrates: Structures, Properties, and Applications.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: FS HN 311 or FS HN 411 or FS HN 502 or BBMB 404*

Study of chemical structures and physical properties of carbohydrates, applications of carbohydrates in foods and as biomaterial, and changes they undergo during processing and storage.

FS HN 626. Advanced Food Microbiology.

(Cross-listed with MICRO, TOX). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: FS HN 420 or FS HN 421 or FS HN 504*

Topics of current interest in food microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

FS HN 627. Rapid Methods in Food Microbiology.

(Cross-listed with MICRO, TOX). (2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: FS HN 420 or FS HN 421 or FS HN 504*

Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests (phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

FS HN 681. Seminar.

(1-0) Cr. 1. F.S.SS.

Presentation of thesis or dissertation research. May be taken once for M.S. program and twice for the Ph.D. program.

FS HN 682. Seminar Reflection.

Cr. R. Repeatable.

Active listening and critical thinking activities related to research seminars in food science and human nutrition. Required each semester for all FSHN graduate students except when presenting thesis or dissertation research seminar. Electronic documentation.

FS HN 690. Special Problems.

Cr. arr. Repeatable. F.S.SS. *Prereq: FS HN 502 or FS HN 503 or FS HN 504 or FS HN 553 or FS HN 554*

FS HN 695. Grant Proposal Writing.

(Cross-listed with NUTRS). (1-0) Cr. 1. F. *Prereq: 3 credits of graduate course work in food science and/or nutrition*

Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Formation of grant writing teams in food science and/or nutrition. Offered on a satisfactory-fail basis only.

FS HN 699. Research in Food Science and Technology.

Cr. arr. Repeatable. F.S.SS.

Offered on a satisfactory-fail basis only.

Forestry (FOR)

Courses primarily for undergraduates:

FOR 201. Forest Biology.

(2-0) Cr. 2. F. *Prereq:* Concurrent enrollment in FOR 202, FOR 203, FOR 204, FOR 205, and FOR 206

Discussion of ecological concepts, individual tree structure and growth, variation and diversity in tree populations. Physical environment of trees and forests, ecological processes in forest communities, and introduction to different regional forest communities.

FOR 202. Wood Utilization.

(2-0) Cr. 2. F. *Prereq:* Concurrent enrollment in FOR 201, FOR 203, FOR 204, FOR 205, and FOR 206

Processing of sustainable materials including wood into products and general properties and proper use of these products.

FOR 203. Resource Measurements/Evaluation.

(2-0) Cr. 2. F. *Prereq:* Concurrent enrollment in FOR 201, FOR 202, FOR 204, FOR 205, and FOR 206; MATH 140

Survey techniques involved in quantification, valuation, and evaluation of tree and stand growth and other variables in the forest environment (e.g., recreational use, wildlife habitat value, biomass, and solid wood).

FOR 204. Forest Ecosystem Decision-Making.

(2-0) Cr. 2. F. *Prereq:* Concurrent enrollment in FOR 201, FOR 202, FOR 203, FOR 205, and FOR 206

Methods of decision-making related to forest ecosystems including communications, teams and conflict resolution. Current issues relating to public, private, and urban forests; quantification of processes, services, and goods produced by the forest and expected by the public such as wildlife, water, range, recreation, wilderness, biodiversity, as well as wood and fiber products.

FOR 205. Integrated Forestry Laboratory.

(0-8) Cr. 3. F. *Prereq:* Concurrent enrollment in FOR 201, FOR 202, FOR 203, FOR 204, and FOR 206

Field and laboratory exercises integrating the evaluation and management of forest goods, services, and the processing of wood products.

FOR 206. Fall Forestry Camp.

Cr. 4. F. *Prereq:* Concurrent enrollment in FOR 201, FOR 202, FOR 203, FOR 204, and FOR 205

Three-week field camp to address topics and issues covered in 201, 202, 203, 204, and 205.

FOR 280. Wood Properties and Identification.

(3-3) Cr. 4. S.

Properties of wood and how they relate to its successful use. Comparative anatomical characteristics, scientific nomenclature, and hand lens identification of commercially important North American woods.

FOR 283. Pesticide Application Certification.

(Cross-listed with AGRON, ENT, HORT). (2-0) Cr. 2. S.

Core background and specialty topics in agricultural, and horticultural pesticide applicator certification. Students can select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

FOR 290. Special Problems.

Cr. 1-4. Repeatable. *Prereq:* Freshman or Sophomore classification, permission of instructor

FOR 290A. Special Problems: Leadership in Forestry Teams (LIFT) Learning Community.

Cr. 1-4. Repeatable. *Prereq:* Freshman or Sophomore classification, permission of instructor

FOR 290B. Special Problems: Forest Ecosystem Management.

Cr. 1-4. Repeatable. *Prereq:* Freshman or Sophomore classification, permission of instructor

FOR 290C. Special Problems: Natural Resource Conservation.

Cr. 1-4. Repeatable. *Prereq:* Freshman or Sophomore classification, permission of instructor

FOR 290D. Special Problems: Urban and Community Forestry.

Cr. 1-4. Repeatable. *Prereq:* Freshman or Sophomore classification, permission of instructor

FOR 290E. Special Problems: Wood Science and Technology.

Cr. 1-4. Repeatable. *Prereq:* Freshman or Sophomore classification, permission of instructor

FOR 302. Silviculture.

(2-3) Cr. 3. S. *Prereq:* FOR 201

Manipulation of forest vegetation based on ecological principles for the production of goods and services.

FOR 356. Dendrology.

(Cross-listed with BIOL). (2-4) Cr. 4. F. *Prereq:* BIOL 211

Identification and ecology of North American woody plant species. Importance of woody plants in timber production and wildlife habitat. Natural disturbances, human impacts, management and restoration concerns for major North American forest regions will be addressed.

FOR 358. Forest Herbaceous Layer: Ecology and Identification..

(Cross-listed with NREM). (0.5-1) Cr. 1. S. *Prereq:* BIOL 212

Survey of the major plant families, general, and representative species of the forest herbaceous layer. Functional ecology and restoration.

FOR 416. Forest Insects and Diseases.

(Cross-listed with PL P). (3-0) Cr. 3. F. *Prereq:* 8 credits in biological sciences, including BIOL 211 or equivalent.

Nature of insects and pathogens of forest and shade trees; their role in the dynamics of natural and managed forest ecosystems; and the management of indigenous and exotic pests.

FOR 416L. Forest Insects and Diseases Laboratory.

(Cross-listed with PL P). (0-3) Cr. 1. F. *Prereq:* 8 credits in biological sciences, including BIOL 211 or equivalent. Credit or enrollment in PL P 416.

Laboratory experience working with insect and fungal pests of trees.

FOR 442. Dynamics of Forest Stands.

(2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* FOR 301, FOR 302, STAT 101 or their equivalents

Change in forest species composition and structure at the stand and landscape scales resulting from site quality, tree growth, competition, succession, and disturbance. Methods for assessing tree growth and reconstructing past stand development. Applications to forest and savanna management.

FOR 451. Forest Resource Economics and Quantitative Methods.

(3-3) Cr. 4. S. *Prereq:* FOR 203, MATH 150

Application of economic principles to forest resource management considering both market and non-market goods and services. Methods of identifying and specifying problems in the management and use of forest resources. Application of mathematical and statistical models to the solution of managerial problems.

FOR 452. Ecosystem Management.

(Dual-listed with FOR 552). (Cross-listed with NREM). (2-3) Cr. 3. S. *Prereq:* Senior classification, and NREM 120 or its equivalent

Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints.

FOR 454. Forestry Practicum.

(1-4) Cr. 3. S. *Prereq:* 20 credits in student's major at 300 level or above

Integrated decision-making related to the conservation, management, and preservation of private and public forests, wildlands, urban/community forests, and/or the production and utilization of wood products. Student teams work with a client and develop management plans that incorporate ecological, social, economic, ethical, and institutional/political factors. Effective teamwork, written/oral/visual communication, and problem-solving stressed. Multiple trips to project site and client.

FOR 475. Urban Forestry.

(Cross-listed with HORT). (2-3) Cr. 3. F. *Prereq:* Junior or senior classification, 3 credits in biology

Discussion of establishment and management of woody perennials in community-owned urban greenspaces, consideration of urban site and soil characteristics, plant physiology, plant culture, urban forest valuation, inventory methods, species selection, and urban forest maintenance (health care and pest management).

FOR 480. Wood Anatomy and Fiber Analysis.

(2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* FOR 280 or permission of instructor

Microscopic anatomy and ultrastructure of wood and other industrial lignocellulosic materials. Microscopy techniques for fiber analysis. Comparison of fiber properties.

FOR 481. Conversion of Lignocellulosic Materials.

(2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* FOR 280 or equivalent

Chemical properties of lignocellulosic materials. Wood chemistry. Various conversion processes. Pulp and paper technology. Biobased products. Other fiber products. Cellulose derivatives. Term paper and/or student project required for graduate level.

FOR 483. Wood Deterioration and Preservation.

(Cross-listed with PL P). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* FOR 280

Deterioration of wood in use by biological and physical agents. Wood preservation and fire retardant treatments. Environmental impact of wood treating.

FOR 485. Wood and Natural Fiber Composites.

(2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* FOR 280 or TSM 240

Consolidation behavior of wood and other lignocellulosic materials. Principles of adhesion. Manufacturing processes for wood and lignocellulose composites such as plywood, oriented strand products, laminated lumber, particleboard, medium density fiberboard, and bast fiber products. Extrusion processing of natural fiber/plastic composites.

FOR 486. Drying Processes for Wood and Other Lignocellulosic Materials.

(2-3) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* FOR 280 or TSM 240

Principles of moisture relations in hygroscopic materials; adsorption, desorption, equilibrium moisture content. Transport processes in natural materials such as wood. Drying processes for wood and other lignocellulosic materials. Influence of moisture on dimensional stability and durability of wood and lignocellulosic composites.

FOR 487. Physical Properties of Wood.

(3-3) Cr. 4. Alt. S., offered even-numbered years. *Prereq:* FOR 280

Mechanical, thermal, electrical, and acoustical properties of wood. Lumber grading and stress rating, nondestructive evaluation of wood and wood composite products.

Courses primarily for graduate students, open to qualified undergraduates:**FOR 552. Ecosystem Management.**

(Dual-listed with FOR 452). (Cross-listed with NREM). (2-3) Cr. 3. S. *Prereq:* Senior classification, and NREM 120 or its equivalent

Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints.

FOR 599. Creative Component.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 599A. Creative Component: Forest Biology.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 599B. Creative Component: Forest Biometry.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 599C. Creative Component: Forest and Recreation Economics.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 599D. Creative Component: Forest Management and Administration.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 599E. Creative Component: Wood Science.

Cr. 1-12. Repeatable, maximum of 12 credits.

Courses for graduate students:**FOR 696. Research Seminar.**

(Cross-listed with AGRON, BBMB, GDCB, HORT, PLBIO). Cr. 1. Repeatable. F.S. Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

FOR 699. Research.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699A. Research: Forest Biology - Wood Science.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699B. Research: Forest Biometry.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699C. Research: Forest Economics.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699D. Research: Forest Management and Administration.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699E. Research: Wood Science.

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699F. Research: Plant Physiology.

Cr. 1-12. Repeatable, maximum of 12 credits.

French (FRNCH)

Courses primarily for undergraduates:

FRNCH 101. Elementary French I.

(4-0) Cr. 4. F.SS.

Beginning level development of reading, writing, listening comprehension, and speaking in French, within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

FRNCH 102. Elementary French II.

(4-0) Cr. 4. S.SS. *Prereq:* FRNCH 101

Beginning level development of reading, writing, listening comprehension, and speaking in French, within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Meets International Perspectives Requirement.

FRNCH 201. Intermediate French I.

(4-0) Cr. 4. F. *Prereq:* FRNCH 102

Intermediate level development of reading, writing, listening comprehension, and speaking in French within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Meets International Perspectives Requirement.

FRNCH 202. Intermediate French II.

(4-0) Cr. 4. S. *Prereq:* FRNCH 201

Intermediate level development of reading, writing, listening comprehension, and speaking in French within the context of French culture. Credit by examination in the Department of World Languages and Cultures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the Department is normally not available.

Meets International Perspectives Requirement.

FRNCH 301. French Writing and Grammar.

(3-0) Cr. 3. F. *Prereq:* FRNCH 202

Emphasis on developing functional language skills in reading and writing. Selective review of grammar within the context of cultural and literary prose. Meets International Perspectives Requirement.

FRNCH 302. Reading and Writing French.

(3-0) Cr. 3. S. *Prereq:* FRNCH 301

Readings in French prose, theater and poetry. Introduction to close reading and analysis. Development of reading and writing skills for upper-level courses.

FRNCH 304. French for Business and Professions.

(3-0) Cr. 3. *Prereq:* FRNCH 301

Communication in business and professional contexts in French-speaking countries. Cultural contexts of business and professional practice. Emphasis on working across French-American cultures. Preparation for internships.

Meets International Perspectives Requirement.

FRNCH 305. French Conversation.

(3-0) Cr. 3. *Prereq:* FRNCH 202

Intensive conversational or listening practice emphasizing contemporary French or Francophone civilization. Native or near-native speakers are not eligible to enroll.

FRNCH 320. France Today.

(3-0) Cr. 3. *Prereq:* FRNCH 202

Selected topics dealing with contemporary French society and culture. Introduction to materials, resources, and forms of communication available on the Internet, and in other electronic and print media. Meets International Perspectives Requirement.

FRNCH 326. Studies in French or Francophone Film.

(3-0) Cr. 3. Repeatable. *Prereq:* FRNCH 302 or concurrent enrollment in FRNCH 302

In-depth study of a selected filmmaker, genre, or movement. Emphasis on analytical interpretation and relationship between film and French or Francophone culture, history, and society.

FRNCH 340. Studies in French or Francophone Literature.

(3-0) Cr. 3. Repeatable. *Prereq:* FRNCH 302 or concurrent enrollment in FRNCH 302

In-depth study of a selected topic, genre, movement or writer in French or Francophone literature, civilization or culture. Emphasis on close readings and discussion.

FRNCH 370. French Studies in English.

(3-0) Cr. 3. Repeatable.

Topics vary according to faculty interest. Author, genre, or period study in French or Francophone history, literature, or culture. Readings, discussions, and papers in English.

Meets International Perspectives Requirement.

FRNCH 370F. French studies in English: French Topics on Women and Gender Studies.

(Cross-listed with W S). (3-0) Cr. 3. Repeatable.

Topics vary according to faculty interest. Readings, discussions, and papers in English.

Meets International Perspectives Requirement.

FRNCH 378. French Film Studies in English.

(2-2) Cr. 3. Repeatable.

Analysis and interpretation of film in twentieth-century French society. Topics vary according to faculty interest. Film directors, genres, movements (e.g. The New Wave), historical survey, aesthetics, and cinematography. Readings, discussions and papers in English.

Meets International Perspectives Requirement.

FRNCH 476. French Civilization Seminar in English.

(3-0) Cr. 3. S.

Advanced seminar in French civilization. Topics vary according to faculty interest. Readings, discussions, and paper in English.

FRNCH 490. Independent Study.

Cr. 1-6. Repeatable, maximum of 9 credits. *Prereq:* Permission of French staff and department chair

Designed to meet the needs of students who wish to focus on areas other than those in which courses are offered. No more than 9 credits in Frnch 490 may be counted toward graduation.

FRNCH 499. Internship in French.

Cr. 1-3. Repeatable, maximum of 3 credits. F.S.SS. *Prereq:* 9 credits of French at the 300 level; permission of advisor and WLC Internship Coordinator. Work experience using French language skills in the public or private sector, combined with academic work under faculty supervision

Credits may be applied only to LCP major. Offered on a satisfactory-fail basis only. No more than 3 credits of Frnch 499 may be applied to the major.

Courses primarily for graduate students, open to qualified undergraduates:

FRNCH 590. Special Topics in French.

Cr. 2-4. Repeatable. *Prereq:* Permission of instructor; 6 credits of 400 level French

FRNCH 590A. Special Topics in French: Literature or Literary Criticism.

Cr. 2-4. Repeatable. *Prereq:* Permission of instructor; 6 credits of 400 level French

FRNCH 590B. Special Topics in French: Linguistics.

Cr. 2-4. Repeatable. *Prereq:* Permission of instructor; 6 credits of 400 level French

FRNCH 590C. Special Topics in French: Language Pedagogy.

Cr. 2-4. Repeatable. *Prereq:* Permission of instructor; 6 credits of 400 level French

FRNCH 590D. Special Topics in French: Civilization.

Cr. 2-4. Repeatable. *Prereq:* Permission of instructor; 6 credits of 400 level French

Genetics (GEN)

Courses primarily for undergraduates:

GEN 110. Genetics Orientation.

(1-0) Cr. 1. F.

This course is intended for first year students and others new to the genetics major. Discussion of university policies and resources, requirements of the major, career opportunities, and other topics related to the first year experience.

GEN 298. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; sophomore classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

GEN 313. Principles of Genetics.

(Cross-listed with BIOL). (3-0) Cr. 3. F.S.SS. *Prereq: BIOL 211, BIOL 211L, BIOL 212, and BIOL 212L*

Introduction to the principles of transmission and molecular genetics of plants, animals, and bacteria. Recombination, structure and replication of DNA, gene expression, cloning, quantitative and population genetics. Students may receive graduation credit for no more than one of the following: Gen 260, Gen 313 and 313L, Gen 320, Biol 313 and 313L, and Agron 320.

GEN 313L. Genetics Laboratory.

(Cross-listed with BIOL). (0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in BIOL 313 Laboratory to accompany 313.* Students may receive graduation credit for no more than one of the following: Biol 313 and 313L, Gen 260, Gen 313, Gen 320, and Agron 320.

GEN 320. Genetics, Agriculture and Biotechnology.

(Cross-listed with AGRON). (3-0) Cr. 3. F.S. *Prereq: BIOL 212*

Transmission genetics with an emphasis on applications in agriculture, the structure and expression of the gene, how genes behave in populations and how recombinant DNA technology can be used to improve agriculture. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320 and Biol 313 and 313L.

GEN 340. Human Genetics.

(3-0) Cr. 3. F.S.SS. *Prereq: BIOL 313 or GEN 313*

Fundamental concepts and current issues of human genetics. Human chromosome analysis, pedigree analysis, gene mapping, the human genome project, sex determination, genetics of the immune system, genetics of cancer, gene therapy, the genetic basis of human diversity, eugenics.

GEN 349. The Genome Perspective in Biology.

(Cross-listed with BIOL, MICRO, V PTH). (2-0) Cr. 2. S. *Prereq: GEN 313 or GEN 320*

Analysis of genome, RNA, and protein data using computer technology to answer biological questions on topics ranging from microbial diversity to human health. An introduction for students in the life sciences to the fields of genomics, bioinformatics and systems.

GEN 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; junior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

GEN 409. Molecular Genetics.

(3-0) Cr. 3. F. *Prereq: BIOL 313*

The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes.

GEN 410. Analytical Genetics.

(3-0) Cr. 3. S. *Prereq: GEN 409*

The principles and practice of genetic analysis. Mendelian genetic analysis, mutational, transgenic, and genomic analysis of gene function, linkage and gene mapping, chromosomal aberrations, aneuploidy and polyploidy, extrachromosomal inheritance, analysis of genetic pathways.

GEN 444. Introduction to Bioinformatics.

(Cross-listed with BCB, BCBIO, BIOL, COM S, CPR E). (4-0) Cr. 4. F. *Prereq: MATH 165 or STAT 401 or equivalent*

Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics, systems biology.

GEN 462. Evolutionary Genetics.

(Cross-listed with BIOL). (3-0) Cr. 3. F. *Prereq: BIOL 315*

The genetic basis of evolutionary processes in higher organisms. The role of genetic variation in adaptation, natural selection, adaptive processes, and the influence of random processes on evolutionary change.

GEN 490. Independent Study.

Cr. 1-5. Repeatable, maximum of 9 credits. *Prereq: GEN 313, junior or senior classification, permission of instructor*

Independent study in any area of genetics. Students may use no more than 9 credits of university-wide 490 or 499 credits (including Gen 490) toward the total of 120 credits required for graduation.

GEN 491. Undergraduate Seminar.

(1-0) Cr. 1. F.S. *Prereq: GEN 409*

Communication within the discipline based on comprehension, discussion, presentation, and critical evaluation of original research literature; survey of career paths within the genetics disciplines and approaches to obtaining positions; exposure to research publication and grantsmanship processes; ethical issues in genetics research; outcomes assessment activities.

GEN 492. Laboratory Teaching Experience.

Cr. 1-2. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: GEN 313, junior or senior classification, permission of instructor*

For students registering to be undergraduate laboratory assistants. Offered on a satisfactory-fail basis only. No more than 2 credits of GEN 490U or GEN 492 may be applied toward the Genetics advanced course requirement.

GEN 495. Special Topics in Genetics.

(1-0) Cr. 1-3. Repeatable, maximum of 3 credits. F.S. *Prereq: GEN 313; permission of instructor*

Content varies from year to year. Students may use no more than 9 credits of university-wide 490-499 credits toward the total of 120 credits required for graduation.

GEN 496. Attendance and Critique of Genetics Seminars.

Cr. 1. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: GEN 313, junior or senior classification, permission of instructor*

Attendance and critique of departmental seminars in BBMB, GDCB, or EEOB. Offered on a satisfactory-fail basis only. Students may use no more than 9 credits of university-wide 490 - 499 credits toward the total of 120 credits required for graduation.

GEN 498. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

GEN 499. Genetics research.

Cr. 1-5. Repeatable, maximum of 9 credits. *Prereq: GEN 313, junior or senior classification, permission of instructor*

Independent research in any area of genetics. Students may use no more than 9 credits of university-wide 490 or 499 credits (including Gen 490R) toward the total of 120 credits required for graduation.

GEN 499H. Genetics research for Honors.

Cr. 1-5. Repeatable. F.S.SS. *Prereq: GEN 313, junior or senior classification, permission of instructor*

Independent research in any area of genetics; for Honors students only. Students may use no more than 9 credits of university-wide 490 or 499 credits (including Gen 490H) toward the total of 120 credits required for graduation.

Genetics, Development and Cell Biology (GDCB)

Courses primarily for graduate students, open to qualified undergraduates:

GDCB 505. Entrepreneurship in Science and Technology.

(3-0) Cr. 3. Alt. F., offered even-numbered years.

High level success at modern science requires entrepreneurship both in and outside the laboratory. Scientists are in a unique position to not only think, but to thrive, "outside of the box" and take unorthodox approaches to research that lead to positive paradigm shifts in our lives. Exploration of many facets of science, technology, industry and commerce, with frequent guest lectures from entrepreneurs.

GDCB 510. Transmission Genetics.

(3-0) Cr. 3. F. *Prereq: GEN 410 or graduate standing*

In-depth investigations of modern research practices of transmission genetics. Designed for students interested in genetic research. Topics include: Mendelian genetic analysis, analysis of genetic pathways, mutational analysis of gene function, chromosomal mechanics, genetic mapping, epigenetic inheritance, human genetic analysis.

GDCB 511. Molecular Genetics.

(Cross-listed with MCDB). (3-0) Cr. 3. S. *Prereq: BIOL 313 and BBMB 405*

The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes.

GDCB 513. Plant Metabolism.

(Cross-listed with PLBIO). (2-0) Cr. 2. Alt. F., offered even-numbered years.

Prereq: BIOL 330, PHYS 111, CHEM 331; one semester of biochemistry recommended

Photosynthesis, respiration, and other aspects of plant metabolism.

GDCB 528. Advances in Molecular Cell Biology.

(Cross-listed with MCDB). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: Courses in general cell biology and biochemistry

Cell biological processes including cell signaling, cell division, intracellular trafficking, biogenesis of organelles, cell adhesion and motility.

GDCB 533. Advances in Developmental Biology.

(Cross-listed with MCDB). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: BIOL 314 or Biol 423*

Fundamental principles in multicellular development. Emphasis on cellular and molecular regulation of developmental processes, and experimental approaches as illustrated in the current literature.

GDCB 536. Statistical Genetics.

(Cross-listed with STAT). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: STAT 401, STAT 447; GEN 320 or BIOL 313

Statistical models and methods for genetics covering models of population processes: selection, mutation, migration, population structure, and linkage disequilibrium, and inference techniques: genetic mapping, linkage analysis, and quantitative trait analysis. Applications include genetic map construction, gene mapping, genome-wide association studies (GWAS), inference about population structure, phylogenetic tree construction, and forensic and paternity identification.

GDCB 542. Introduction to Molecular Biology Techniques.

(Cross-listed with B M S, EEOB, FS HN, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

GDCB 542A. Introduction to Molecular Biology Techniques: DNA Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

GDCB 542B. Introduction to Molecular Biology Techniques: Protein.

(Cross-listed with B M S, BBMB, EEOB, FS HN, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.SS. *Prereq: Graduate classification*
Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

GDCB 542C. Introduction to Molecular Biology Techniques: Cell Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

GDCB 542D. Introduction to Molecular Biology Techniques: Plant Transformation.

(Cross-listed with B M S, BBMB, EEOB, FS HN, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

GDCB 542E. Introduction to Molecular Biology Techniques: Proteomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

GDCB 542F. Introduction to Molecular Biology Techniques: Metabolomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

GDCB 542G. Introduction to Molecular Biology Techniques: Genomic.

(Cross-listed with B M S, BBMB, EEOB, FS HN, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

GDCB 544. Introduction to Bioinformatics.

(Cross-listed with BCB, COM S, CPR E). (4-0) Cr. 4. F. *Prereq: MATH 165 or STAT 401 or equivalent*

Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative, functional genomics, and systems biology.

GDCB 545. Plant Molecular, Cell and Developmental Biology.

(Cross-listed with MCDB, PLBIO). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: Biol 313, BIOL 314, BIOL 330 or BBMB 405*

Plant nuclear and organelle genomes; regulation of gene expression; hormone signaling; organization, function, and development of plant cells and subcellular structures; regulation of plant growth and development.

GDCB 556. Cellular, Molecular and Developmental Neuroscience.

(Cross-listed with B M S, NEURO). (3-0) Cr. 3. F. *Prereq: BIOL 335 or BIOL 436; physics recommended*

Fundamental principles of neuroscience including cellular and molecular neuroscience, nervous system development, sensory, motor and regulatory systems.

GDCB 557. Advanced Neuroscience Techniques.

(Cross-listed with NEURO). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: Neuro 556 or equivalent course

Research methods and techniques; lectures, laboratory exercises and/or demonstrations representing individual faculty specialties.

GDCB 568. Bioinformatics II (Advanced Genome Informatics).

(Cross-listed with BCB, COM S, STAT). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, BIOL 315, STAT 430, credit or enrollment in GEN 411*

Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

GDCB 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology).

(Cross-listed with BCB, COM S, CPR E, STAT). (3-0) Cr. 3. S. *Prereq: BCB 567, BIOL 315, COM S 311 and either 208 or 228, GEN 411, STAT 430*

Algorithmic and statistical approaches in computational functional genomics and systems biology. Elements of experiment design. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Multi-scale, multi-granularity models. Ontology-driven, network based, and probabilistic approaches to information integration.

GDCB 590. Special Topics.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

Courses for graduate students:

GDCB 661. Current Topics in Neuroscience.

(Cross-listed with BBMB, NEURO). (2-0) Cr. 2-3. Repeatable. Alt. S., offered even-numbered years. *Prereq: NEURO 556 (or comparable course) or permission of instructor*

Topics may include molecular and cellular neuroscience, neurodevelopment, neuroplasticity, neurodegenerative diseases, cognitive neuroscience, sensory biology, neural integration, membrane biophysics, neuroethology, techniques in neurobiology and behavior.

GDCB 690. Seminar in GDCB.

Cr. 1. Repeatable.

Research seminars by faculty, invited speakers, and graduate students. Offered on a satisfactory-fail basis only.

GDCB 691. Faculty Seminar.

Cr. 1. Repeatable.

Faculty research series.

GDCB 696. Research Seminar.

(Cross-listed with AGRON, BBMB, FOR, HORT, PLBIO). Cr. 1. Repeatable. F.S. Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

GDCB 698. Seminar in Molecular, Cellular, and Developmental Biology.

(Cross-listed with BBMB, MCDB, MICRO, V MPM). (2-0) Cr. 1-2. Repeatable. F.S. Student and faculty presentations.

GDCB 699. Research.

Cr. arr. Repeatable.

Research for thesis or dissertation. Offered on a satisfactory-fail basis only.

GDCB 699I. Research.

(Cross-listed with A ECL, ANTHR, EEOB, IA LL). Cr. 1-4. Repeatable.

Genetics- Interdisciplinary (GENET)

Courses primarily for graduate students, open to qualified undergraduates:

GENET 539. Ethics and Biological Sciences.

(2-0) Cr. 2. S.

Introduction to Bioethics through case study discussion and recent news events. Students will read and discuss contemporary issues in science ethics, including some of the following topics: ethics and responsible research practice, animal ethics and the use of animals in teaching and research, cloning, human reproductive and stem cell research, regulation of genetically modified crops and foods, plant biotechnology, gene patents. Students will be divided into groups to develop their own case study, to be presented in class at the end of the term. Offered on a satisfactory-fail basis only.

GENET 590. Special Topics.

Cr. arr. Repeatable. F.S.SS.

Contact individual faculty for special projects or topics. Graded.

GENET 591. Workshop in Genetics.

(1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor*

Current topics in genetics research. Lectures by off-campus experts. Students read background literature, attend preparatory seminars, attend all lectures, meet with lecturers.

Courses for graduate students:

GENET 690. Graduate Student Seminar in Genetics.

(1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor*

Research presentations by students to improve their ability to: orally present scientific work in a clear and meaningful way, critically evaluate oral presentations, and give and receive constructive criticism. Students may enroll in one seminar per school year.

GENET 691. Faculty Seminar in Genetics.

(1-0) Cr. 1. Repeatable. F. *Prereq: Permission of instructor*

Faculty research seminars that introduce students to the variety of genetics research projects on campus and provide an opportunity for students to become engaged in the scientific presentation to the point where they can think critically and ask meaningful questions.

GENET 692. Conceptual Foundations of Genetics.

(1-0) Cr. 1. F. *Prereq: Permission of instructor*

Landmark papers in the development of genetics concepts. Papers are presented and discussions led by students, guided and mentored by the instructors. Instructors provide a broad overview and history of the development of fundamental concepts in genetics.

GENET 697. Graduate Research Rotation.

Cr. arr. Repeatable. F.S.SS.

Graduate research projects performed under the supervision of selected faculty members in the graduate Genetics major.

GENET 699. Research.

Cr. arr. Repeatable. F.S.SS.

Research.

Geology (GEOL)

Courses primarily for undergraduates:

GEOL 100. The Earth.

(3-0) Cr. 3. F.S.SS.

How does the earth work, what is it made of, and how does it change through time? Plate tectonics, Earth materials, landforms, structures, climate, and natural resources. Emphasis on the observations and hypotheses used to interpret earth system processes. Students may also enroll in Geol 100L.

GEOL 100L. The Earth: Laboratory.

(0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in GEOL 100*

Students will gain understanding of how Earth processes affect their lives and how they affect the Earth, and of the complex nature of the Earth and its processes. They will gain a deep knowledge of the methods used to understand the time scales and rates of Earth processes also through an applied research experience on groundwater and surface water.

GEOL 101. Environmental Geology: Earth in Crisis.

(Cross-listed with ENV S). (3-0) Cr. 3. F.S.

An introduction to geologic processes and the consequences of human activity from local to global scales. Discussion of human population growth, resource depletion, pollution and waste disposal, global warming and ozone depletion, desertification, and geologic hazards such as earthquakes, landslides, flooding, and volcanism.

GEOL 102. History of the Earth.

(3-0) Cr. 3. S. *Prereq: GEOL 100 or GEOL 201*

The Earth's physical and biological evolution; concepts of global tectonics. Methods used to decipher earth history. Students majoring in geology must also enroll in Geol 102L.

GEOL 102L. History of the Earth: Laboratory.

(0-2) Cr. 1. S. *Prereq: Credit or enrollment in GEOL 102*

Introduction to the use of sedimentary rocks and fossils in reconstructing the Earth's history.

GEOL 105. Gems and Gemstones.

(2-0) Cr. 1. F.

Offered in second half of the semester. Introduction to gems and gemstones, physical and optical properties of gems and gemstones, explanation of where gems come from and how they are found, how to distinguish between synthetic and naturally occurring gems, how the value of gems are determined, and the history of famous gems.

GEOL 106. Earth and Space Science for Elementary Education Majors.

(Cross-listed with ASTRO). (2-0) Cr. 2. F.S. *Prereq: Major in elementary or early childhood education.*

Fundamental concepts of Earth and Space Science, including the solar system, weather and climate, water and soils, plate tectonics, and geologic hazards. Online course format.

GEOL 106L. Earth and Space Science for Elementary Education Majors: Laboratory.

(Cross-listed with ASTRO). (0-2) Cr. 1. F.S. *Prereq: Restricted to elementary and early childhood education majors; to be taken concurrently with GEOL 106/ASTRO 106*

Inquiry-based lab exploring fundamental concepts of Earth and Space Science, including the solar system, weather and climate, water and soils, plate tectonics, and geologic hazards. Must be taken concurrently with GEOL/ASTRO 106.

GEOL 108. Introduction to Oceanography.

(Cross-listed with ENV S). (3-0) Cr. 3. F.

Introduction to study of the oceans. Ocean exploration. Waves and currents. Shape, structure, and origin of the ocean basins. Sedimentary record of oceanic life. Composition of seawater and its significance for life. Ocean circulation and its influence on climate. Life of the oceans, including coral reefs. Use and misuse of ocean resources. Anthropogenic impacts on the oceanic environment.

GEOL 109. Exploring Iowa Geology.

(1-0) Cr. 1. Repeatable, maximum of 2 times. F.

Introduction to Iowa geology through classroom lectures and up to four Saturday field trips to selected Iowa geological attractions. Students will learn basic geologic concepts such as geologic time, erosion and sedimentation, stratigraphy, glacial geology, and karst topography using Iowa examples.

GEOL 111. Geological Disasters.

(Cross-listed with ENV S). (1-0) Cr. 1. F.S.SS.

Introduction to the catastrophic geologic processes that disrupt ecosystems and human activity. Includes a discussion on the role of plate tectonics, the hydrologic cycle, and humans as the driving forces behind selected case studies on volcanic eruptions, earthquakes, tsunamis, landslides, and floods. Summer - online only.

GEOL 112. Geoscience Orientation.

(Cross-listed with MTEOR). (1-0) Cr. 1. F.

Orientation course for students enrolled in the Earth, Wind and Fire Learning Community. Provides an introduction to Iowa State University and meteorology, geology, and Earth science programs for students enrolled in the department's learning community. Activities include academic and social activities, talks and presentations on academic success, resume writing, and study abroad, as well as research talks by faculty members.

GEOL 160. Water Resources of the World.

(Cross-listed with AGRON, ENV S, MTEOR). (3-0) Cr. 3. S.

Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in society and the environment.

GEOL 201. Geology for Engineers and Environmental Scientists.

(2-2) Cr. 3. F.

Introduction to Earth materials and processes with emphasis on engineering and environmental applications.

GEOL 290. Independent Study.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor*

GEOL 298. Cooperative Education.

Cr. R. F.S.SS. *Prereq: GEOL 100 or GEOL 201, GEOL 100L, GEOL 102, GEOL 102L, and permission of the department cooperative education coordinator; sophomore classification*

Required of all cooperative education students. Students must register for this course prior to commencing the work period.

GEOL 302. Summer Field Studies.

Cr. 6. SS. *Prereq: GEOL 102, GEOL 356, GEOL 368*

Geologic mapping; structural, stratigraphic, sedimentologic, metamorphic, geomorphic, and environmental analyses. Study areas in the Bighorn Basin and Wind River Range and excursions to Yellowstone and Grand Teton National Parks. A 6-week summer field course required of all geology majors.

GEOL 306. Geology Field Course.

Cr. 1-2. Repeatable, maximum of 2 times. F.S. *Prereq: GEOL 100 or GEOL 201*

Weekly seminar introduces students to a selected geological region or theme that is visited on a required ten-day field excursion. Introduction to field-safety leadership.

GEOL 315. Mineralogy and Earth Materials.

(3-0) Cr. 3. F. *Prereq: GEOL 100 or GEOL 201, CHEM 177*

Introduction to mineral classification, elementary crystal chemistry, crystal growth and morphology, mineral stability, and mineral associations.

GEOL 315L. Laboratory in Mineralogy and Earth Materials.

(0-3) Cr. 1. F. *Prereq: GEOL 100 or GEOL 201*

Mineral identification methods, especially hand-specimen identification.

GEOL 316. Optical Mineralogy.

(1-2) Cr. 2. F. *Prereq: GEOL 100 or GEOL 201, CHEM 177, credit or enrollment in GEOL 315*

Laboratory problems in mineral-identification methods utilizing optical microscopic techniques.

GEOL 324. Energy and the Environment.

(Cross-listed with ENSCI, ENV S, MTEOR). (3-0) Cr. 3. S.

Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, geothermal, biomass, hydroelectric, and solar energy. Biofuels. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, coal ash, mountaintop removal mining, oil drilling, hydraulic fracturing, groundwater contamination, nuclear waste disposal, and global climate change. Carbon sequestration and geoenvironmental solutions for reducing atmospheric CO₂ concentrations.

GEOL 356. Structural Geology.

(3-6) Cr. 5. S. *Prereq: GEOL 100 or GEOL 201; PHYS 111*

Principles of stress and strain. Brittle and ductile behavior of rocks. Description, classification, and mechanics of formation of fractures, faults, folds, foliation, and lineation. Plate tectonics and regional geology. Laboratory includes application of geometrical techniques to solve structural problems; emphasizes map interpretation and use of stereonet and computer methods.

GEOL 365. Igneous and Metamorphic Petrology.(2-3) Cr. 3. S. *Prereq:* GEOL 315, GEOL 315L, GEOL 316

Nature and origin of igneous and metamorphic rocks. Emphasis on important rock-forming environments and processes and their influence on rock characteristics. Laboratory includes thin section study of rock textures and mineralogy and the interpretation of these features.

GEOL 368. Sedimentary Geology.(3-3) Cr. 4. F. *Prereq:* GEOL 102

Exploration of the interplay between weathering, sedimentation, sea-level change, tectonics, and life through time that creates sedimentary rocks and stratigraphic packages. Understanding of the historical development of sedimentary geology through the development of petrography, paleontology, deep earth sampling, geophysical technologies, and geochemistry. Field and laboratory problem sets illuminate lecture material.

GEOL 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq:* GEOL 100 or GEOL 201, GEOL 100L, GEOL 102, GEOL 102L, and permission of the department cooperative education coordinator; junior classification

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

GEOL 402. Watershed Hydrology.

(Dual-listed with GEOL 502). (Cross-listed with ENSCI, MTEOR, NREM). (3-3) Cr. 4. F. *Prereq:* Four courses in physical or biological sciences or engineering; junior standing

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

GEOL 409. Field Methods in Hydrogeology.

(Dual-listed with GEOL 509). (Cross-listed with ENSCI). (0-4) Cr. 3. Alt. SS., offered even-numbered years. *Prereq:* GEOL/ENSCI 402 or GEOL/ENSCI 411 or C E 473

Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, and electronic instrumentation for data collection. Field trips to investigate water resource, water quality, and remediation projects.

GEOL 411. Hydrogeology.

(Dual-listed with GEOL 511). (Cross-listed with ENSCI). (3-2) Cr. 4. F. *Prereq:* Four courses in biological or physical sciences

Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations.

GEOL 414. Applied Groundwater Flow Modeling.

(Dual-listed with GEOL 514). (Cross-listed with ENSCI). (2-2) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* GEOL 411 or C E 473; MATH 165 or MATH 181

Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course.

GEOL 415. Paleoclimatology.

(Dual-listed with GEOL 515). (Cross-listed with ENSCI). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* Four courses in biological or physical science

Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~1 million years).

GEOL 416. Hydrologic Modeling and Analysis.

(Dual-listed with GEOL 516). (Cross-listed with ENSCI, MTEOR). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* Four courses in Earth science, meteorology, or engineering; junior standing

Study of the basic principles of hydrologic modeling, including rainfall-runoff analysis, lumped and distributed modeling, conceptual and physical models, parameter estimation and sensitivity analysis, input and validation data, uncertainty analysis, and the use of models in surface water hydrology. A range of common models are applied to study hydrologic topics such as flood forecasting and land use change impacts. Previous experience with Matlab or other programming language is needed.

GEOL 419. Environmental Geochemistry.

(Dual-listed with GEOL 519). (Cross-listed with ENSCI). (2-2) Cr. 3. F. *Prereq:* GEOL 402 or GEOL 411 or equivalent

Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling.

GEOL 420. Mineral Resources.

(Dual-listed with GEOL 520). (2-3) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* GEOL 365

Geology and geochemistry of non-metallic and metallic ore deposits. Major processes that concentrate metals in the Earth. Geochemical conditions of ore formation using stable-isotope and fluid-inclusion studies. Laboratory emphasizes the study of metallic ores.

GEOL 426. Stable Isotopes in the Environment.

(Dual-listed with GEOL 526). (Cross-listed with ENSCI). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* Four courses in biological or physical science

Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance.

GEOL 434. Contaminant Hydrogeology.

(Dual-listed with GEOL 534). (Cross-listed with ENSCI). (3-0) Cr. 3. S. *Prereq:* GEOL 411 or equivalent; GEOL 511 or equivalent for 500 level course

Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies.

GEOL 451. Applied and Environmental Geophysics.

(Dual-listed with GEOL 551). (Cross-listed with ENSCI). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* GEOL 100 or GEOL 201, college algebra and trigonometry

Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic - and resistivity-imaging systems and radar.

GEOL 452. GIS for Geoscientists.

(Dual-listed with GEOL 552). (Cross-listed with AGRON, ENSCI). (2-2) Cr. 3. F. *Prereq:* GEOL 100, GEOL 201 or equivalent

Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

GEOL 457. Seismic Methods in Geology, Engineering, and Petroleum Exploration.

(Dual-listed with GEOL 557). (2-2) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* GEOL 100 or GEOL 201, college algebra and trigonometry

Physics of elastic-wave propagation. Seismic surveys in environmental imaging, engineering, and petroleum exploration. Reflection and refraction techniques. Data collection, processing, and geological interpretation. Field work with state-of-the-art equipment.

GEOL 474. Glacial and Quaternary Geology.

(Dual-listed with GEOL 574). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: GEOL 100 or GEOL 201 or equivalent experience*

The study of glaciers and glacial processes. Discussion of glaciology, glacial sediment transport, glacial landforms, and Quaternary history. Laboratory emphasizes topographic map interpretation and the Quaternary landscapes of Iowa.

GEOL 479. Surficial Processes.

(Dual-listed with GEOL 579). (Cross-listed with ENSCI). (2-2) Cr. 3. F. *Prereq: GEOL 100 or GEOL 201 or equivalent experience*

The study of physical processes that shape Earth's surface. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory includes topographic map interpretation and local field trips.

GEOL 488. GIS for Geoscientists II.

(Dual-listed with GEOL 588). (Cross-listed with AGRON, ENSCI). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: GIS course, such as GEOL 452, CRP 451, CRP 452, NREM 345, NREM 446, AE 408 or equivalent*

GIS course with focus on the spatial analysis and modeling of raster data and triangulated irregular network (TIN) data. Uses ArcGIS and various extensions, such as Spatial Analyst, 3D Analyst, and ArcScene. Includes practical exercises during lectures, lab exercises, homework assignments, and (for GEOL 588) a class project.

GEOL 490. Independent Study.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq: 6 credits in geology and permission of instructor*

No more than 9 credits of Geol 490 may be counted toward graduation.

GEOL 495. Undergraduate Seminar.

Cr. 1. F.S. *Prereq: Junior or senior classification*

Weekly seminar on topics of current research interest.

GEOL 498. Cooperative Education.

Cr. R. F.S.S. *Prereq: Geol 100 or GEOL 201, GEOL 100L, GEOL 102, GEOL 102L, and permission of the department cooperative education coordinator; senior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduates:**GEOL 502. Watershed Hydrology.**

(Dual-listed with GEOL 402). (Cross-listed with ENSCI, MTEOR, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

GEOL 506. Geology Field Course.

Cr. 1-2. Repeatable, maximum of 2 times. F.S. *Prereq: Graduate classification*

Weekly seminar introduces students to a selected geological region or theme that is visited on a required ten-day field excursion. Graduate students are expected to assist in field teaching and safety leadership.

GEOL 507. Midwestern Geology Field Trip.

Cr. 1. Repeatable, maximum of 4 times. F. *Prereq: GEOL 365*

On-site inspection of various ore deposits, mining operations, and terrains dominated by igneous or metamorphic rocks. Offered on a satisfactory-fail basis only.

GEOL 509. Field Methods in Hydrogeology.

(Dual-listed with GEOL 409). (Cross-listed with ENSCI). (0-4) Cr. 3. Alt. SS., offered even-numbered years. *Prereq: GEOL/ENSCI 402 or GEOL/ENSCI 411 or C E 473*

Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, and electronic instrumentation for data collection. Field trips to investigate water resource, water quality, and remediation projects.

GEOL 511. Hydrogeology.

(Dual-listed with GEOL 411). (Cross-listed with ENSCI). (3-2) Cr. 4. F. *Prereq: Four courses in biological or physical sciences*

Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations.

GEOL 514. Applied Groundwater Flow Modeling.

(Dual-listed with GEOL 414). (Cross-listed with ENSCI). (2-2) Cr. 3. Alt. S., offered even-numbered years. *Prereq: GEOL 411 or C E 473; MATH 165 or MATH 181*

Introduction to the principles of modeling groundwater flow systems. Finite-difference and analytic-element methods, spreadsheet models, boundary conditions, calibration, sensitivity analysis, parameter estimation, particle tracking, and post-audit analysis. Application of MODFLOW to regional flow-system analysis. Computer laboratory emphasizes assigned problems that illustrate topics discussed in the course.

GEOL 515. Paleoclimatology.

(Dual-listed with GEOL 415). (Cross-listed with ENSCI). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Four courses in biological or physical science*

Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~ 1 million years).

GEOL 516. Hydrologic Modeling and Analysis.

(Dual-listed with GEOL 416). (Cross-listed with ENSCI, MTEOR). (2-3) Cr. 3.

Alt. S., offered odd-numbered years. *Prereq: Four courses in earth science, meteorology, or engineering; junior standing*

Study of the basic principles of hydrologic modeling, including rainfall-runoff analysis, lumped and distributed modeling, conceptual and physical models, parameter estimation and sensitivity analysis, input and validation data, uncertainty analysis, and the use of models in surface water hydrology. A range of common models are applied to study hydrologic topics such as flood forecasting and land use change impacts. Previous experience with Matlab or other programming language is needed.

GEOL 519. Environmental Geochemistry.

(Dual-listed with GEOL 419). (Cross-listed with ENSCI). (2-2) Cr. 3. F. *Prereq: GEOL 402 or GEOL 411 or equivalent*

Geochemistry of natural waters and water-rock interactions. Acid-base equilibria, carbonate chemistry and buffer systems, mineral dissolution and precipitation, sorption, ion exchange, and redox reactions. Introduction to thermodynamics and kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling.

GEOL 520. Mineral Resources.

(Dual-listed with GEOL 420). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: GEOL 365

Geology and geochemistry of non-metallic and metallic ore deposits. Major processes that concentrate metals in the Earth. Geochemical conditions of ore formation using stable-isotope and fluid-inclusion studies. Laboratory emphasizes the study of metallic ores.

GEOL 526. Stable Isotopes in the Environment.

(Dual-listed with GEOL 426). (Cross-listed with ENSCI). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: Four courses in biological or physical science*

Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance.

GEOL 534. Contaminant Hydrogeology.

(Dual-listed with GEOL 434). (Cross-listed with ENSCI). (3-0) Cr. 3. S. *Prereq: GEOL 411 or equivalent; GEOL 511 or equivalent for 500 level course*

Theory and practical considerations of fate and transport of solutes through porous geologic materials. Organic and inorganic contaminants in industrial and agricultural settings. Subsurface microbiology and biodegradation of aromatic and chlorinated hydrocarbons. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Soil and groundwater monitoring and remediation strategies.

GEOL 551. Applied and Environmental Geophysics.

(Dual-listed with GEOL 451). (Cross-listed with ENSCI). (2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: GEOL 100 or GEOL 201, college algebra and trigonometry*

Seismic, gravity, magnetic, resistivity, electromagnetic, and ground-penetrating radar techniques for shallow subsurface investigations and imaging. Data interpretation methods. Lab emphasizes computer interpretation packages. Field work with seismic - and resistivity-imaging systems and radar.

GEOL 552. GIS for Geoscientists.

(Dual-listed with GEOL 452). (Cross-listed with AGRON, ENSCI). (2-2) Cr. 3. F. Prereq: *GEOL 100, GEOL 201 or equivalent*
Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

GEOL 555. Environmental Soil Mineralogy.

(Cross-listed with AGRON). (3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: *AGRON 473, CHEM 178. Recommend: GEOL 311*
Structure and behavior of clay minerals, humic substances and biochar in soil environments, with emphasis on reactions and environmental implications.

GEOL 555L. Soil Clay Mineralogy Laboratory.

(Cross-listed with AGRON). (0-3) Cr. 1. Alt. S., offered odd-numbered years. Prereq: *Credit or enrollment in AGRON 555*
Application of X-ray diffraction, thermal analysis, infrared spectroscopy, and chemical analyses to identification and behavior of clay minerals in soils.

GEOL 557. Seismic Methods in Geology, Engineering, and Petroleum Exploration.

(Dual-listed with GEOL 457). (2-2) Cr. 3. Alt. S., offered even-numbered years. Prereq: *GEOL 100 or GEOL 201, college algebra and trigonometry*
Physics of elastic-wave propagation. Seismic surveys in environmental imaging, engineering, and petroleum exploration. Reflection and refraction techniques. Data collection, processing, and geological interpretation. Field work with state-of-the-art equipment.

GEOL 558. Introduction to the 3D Visualization of Scientific Data.

(Cross-listed with COM S, HCI). (2-2) Cr. 3. Alt. S., offered odd-numbered years. Prereq: *Graduate-student standing in the mathematical or natural sciences*
Introduction to visualizing scientific information with 3D computer graphics and their foundation in human perception. Overview of different visualization techniques and examples of 3D visualization projects from different disciplines (natural sciences, medicine, and engineering). Class project in interactive 3D visualization using the OpenDX, VTK or a similar system.

GEOL 574. Glacial and Quaternary Geology.

(Dual-listed with GEOL 474). (2-2) Cr. 3. Alt. S., offered odd-numbered years. Prereq: *GEOL 100 or GEOL 201 or equivalent experience*
The study of glaciers and glacial processes. Discussion of glaciology, glacial sediment transport, glacial landforms, and Quaternary history. Laboratory emphasizes topographic map interpretation and the Quaternary landscapes of Iowa.

GEOL 579. Surficial Processes.

(Dual-listed with GEOL 479). (Cross-listed with ENSCI). (2-2) Cr. 3. F. Prereq: *GEOL 100 or GEOL 201 or equivalent experience*
The study of physical processes that shape Earth's surface. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory includes topographic map interpretation and local field trips.

GEOL 588. GIS for Geoscientists II.

(Dual-listed with GEOL 488). (Cross-listed with AGRON, ENSCI). (2-2) Cr. 3. Alt. S., offered odd-numbered years. Prereq: *GIS course, such as GEOL 452, CRP 451, CRP 452, NREM 345, NREM 446, AE 408 or equivalent*
GIS course with focus on the spatial analysis and modeling of raster data and triangulated irregular network (TIN) data. Uses ArcGIS and various extensions, such as Spatial Analyst, 3D Analyst, and ArcScene. Includes practical exercises during lectures, lab exercises, homework assignments, and (for GEOL 588) a class project.

GEOL 590. Special Topics.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590A. Special Topics: Surficial Processes.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590B. Special Topics: Stratigraphy.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590C. Special Topics: Sedimentation.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590D. Special Topics: Paleontology.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590E. Special Topics: Petrology.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590F. Special Topics: Structural Geology.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590G. Special Topics: Geochemistry.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590H. Special Topics: Hydrogeology.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590I. Special Topics: Earth Science.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590J. Special Topics: Mineral Resources.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590K. Special Topics: Geophysics.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590L. Special Topics: Mineralogy.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590M. Special Topics: Tectonics.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590N. Special Topics: Paleocology and Paleoclimatology.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590O. Special Topics: Isotope Geochemistry.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590P. Special Topics: Computational Methods and GIS.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590R. Special Topics: Surface Hydrology.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 590S. Special Topics: Oceanography.

Cr. 1-3. Repeatable. Prereq: *Permission of instructor*

GEOL 595. Graduate Seminar.

(Cross-listed with MTEOR). Cr. 1. Repeatable. F.S. Prereq: *Senior or graduate classification*

Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Offered on a satisfactory-fail basis only.

GEOL 595A. Graduate Seminar: Presentation Required.

(Cross-listed with MTEOR). (1-0) Cr. 1. Repeatable. F.S. Prereq: *Senior or graduate classification*

Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Offered on a satisfactory-fail basis only.

GEOL 595B. Graduate Seminar: Attendance Only.

(Cross-listed with MTEOR). Cr. R. Repeatable. F.S. Prereq: *Senior or graduate classification*

Attendance only. Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Offered on a satisfactory-fail basis only.

GEOL 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:**GEOL 610. Advanced Seminar.**

Cr. 1-3. Repeatable. F.S. Prereq: *Graduate standing and permission of instructor*

GEOL 610A. Advanced Seminar: Earth Materials.

Cr. 1-3. Repeatable. F.S. Prereq: *Graduate standing and permission of instructor*

GEOL 610B. Advanced Seminar: Economic Geology.

Cr. 1-3. Repeatable. F.S. Prereq: *Graduate standing and permission of instructor*

GEOL 610C. Advanced Seminar: Environmental Geochemistry.

Cr. 1-3. Repeatable. F.S. Prereq: *Graduate standing and permission of instructor*

GEOL 610D. Advanced Seminar: Geophysics.

Cr. 1-3. Repeatable. F.S. Prereq: *Graduate standing and permission of instructor*

GEOL 610E. Advanced Seminar: Geotectonics.

Cr. 1-3. Repeatable. F.S. Prereq: *Graduate standing and permission of instructor*

GEOL 610F. Advanced Seminar: Hydrogeology.

Cr. 1-3. Repeatable. F.S. Prereq: *Graduate standing and permission of instructor*

GEOL 610G. Advanced Seminar: Surficial Processes.

Cr. 1-3. Repeatable. F.S. Prereq: *Graduate standing and permission of instructor*

GEOL 610H. Advanced Seminar: Sedimentation and Stratigraphy.

Cr. 1-3. Repeatable. F.S. Prereq: *Graduate standing and permission of instructor*

GEOL 610I. Advanced Seminar: Paleocology and Paleoclimatology.

Cr. 1-3. Repeatable. F.S. *Prereq: Graduate standing and permission of instructor*

GEOL 610J. Advanced Seminar: Isotope Geochemistry.

Cr. 1-3. Repeatable. F.S. *Prereq: Graduate standing and permission of instructor*

GEOL 610K. Advanced Seminar: Computational Methods and GIS.

Cr. 1-3. Repeatable. F.S. *Prereq: Graduate standing and permission of instructor*

GEOL 699. Research.

Cr. arr. Repeatable.

GEOL 699A. Research: Surficial Processes.

Cr. arr. Repeatable.

GEOL 699B. Research: Stratigraphy.

Cr. arr. Repeatable.

GEOL 699C. Research: Sedimentation.

Cr. arr. Repeatable.

GEOL 699D. Research: Paleontology.

Cr. arr. Repeatable.

GEOL 699E. Research: Petrology.

Cr. arr. Repeatable.

GEOL 699F. Research: Structural Geology.

Cr. arr. Repeatable.

GEOL 699G. Research: Geochemistry.

Cr. arr. Repeatable.

GEOL 699H. Research: Hydrogeology.

Cr. arr. Repeatable.

GEOL 699I. Research: Earth Science.

Cr. arr. Repeatable.

GEOL 699J. Research: Mineral Resources.

Cr. arr. Repeatable.

GEOL 699K. Research: Geophysics.

Cr. arr. Repeatable.

GEOL 699L. Research: Mineralogy.

Cr. arr. Repeatable.

GEOL 699M. Research: Tectonics.

Cr. arr. Repeatable.

GEOL 699N. Research: Paleocology and Paleoclimatology.

Cr. arr. Repeatable.

GEOL 699O. Research: Isotope Geochemistry.

Cr. arr. Repeatable.

GEOL 699P. Research: Computational Methods and GIS.

Cr. arr. Repeatable.

GEOL 699R. Research: Surface Hydrology.

Cr. arr. Repeatable.

German (GER)

Courses primarily for undergraduates:

GER 101. Elementary German I.

(4-0) Cr. 4. F. SS.

Introduction to German language within the context of German culture; practice in the basic skills.

GER 102. Elementary German II.

(4-0) Cr. 4. S. SS. Prereq: GER 101

Continuation of German 101.

Meets International Perspectives Requirement.

GER 201. Intermediate German I.

(4-0) Cr. 4. F. Prereq: GER 102

Review of grammar, selected readings, further practice in oral and written communication.

Meets International Perspectives Requirement.

GER 202. Intermediate German II.

(4-0) Cr. 4. S. Prereq: GER 201

Continuation of German 201. One section will emphasize the use of German in professional contexts.

Meets International Perspectives Requirement.

GER 301. Reading: Problems of the Early Twentieth Century.

(3-0) Cr. 3. F. Prereq: GER 202

Emphasis on the development of reading skills through a variety of text types with a focus on German Culture from circa 1900 to 1933.

Meets International Perspectives Requirement.

GER 302. Composition.

(3-0) Cr. 3. S. Prereq: GER 202

Emphasis on writing skills, with further development of grammar and reading skills using a variety of current and historical materials.

Meets International Perspectives Requirement.

GER 304. German for Business and Professions.

(3-0) Cr. 3. F. Prereq: GER 202

Communication in business and professional contexts in German-speaking countries. Development of effective communication strategies and project management in the workplace. Cultural contexts of business and professional practice. Preparation for internships.

Meets International Perspectives Requirement.

GER 305. Conversation: The City in Contemporary Europe.

(3-0) Cr. 3. S. Prereq: GER 202 minimum, GER 301 recommended

Intensive conversational and listening practice in German with an emphasis on a major German-speaking city.

Meets International Perspectives Requirement.

GER 320. Germany Today.

(3-0) Cr. 3. S. Prereq: GER 301 or GER 304

Selected topics dealing with contemporary German society and culture.

Introduction to materials, resources, and forms of communication available on the Internet, and in other electronic and print media.

Meets International Perspectives Requirement.

GER 330. German Literature and Culture.

(3-0) Cr. 3. Repeatable. F. Prereq: GER 301 or permission of instructor

Selected readings in German literature from Classicism to present. Emphasis on techniques of reading and analysis of literary texts. No more than six credits of Ger 330 may be counted toward the major.

Meets International Perspectives Requirement.

GER 370. German Studies in English.

(3-0) Cr. 3-4. Repeatable, maximum of 6 credits. Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level

Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Three credits: English, open to all students. Four credits: Required for German concentration credit, supplementary readings and compositions in German.

Meets International Perspectives Requirement.

GER 370G. German Studies in English: German topics on women or feminism.

(Cross-listed with W S). (3-0) Cr. 3-4. Repeatable, maximum of 6 credits. Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level

Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Three credits: English, open to all students. Four credits: Required for German concentration credit, supplementary readings and compositions in German.

Meets International Perspectives Requirement.

GER 371. The Holocaust in Text, Image, and Memory.

(3-0) Cr. 3-4. Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level

Examination of such topics as the origins and expressions of Anti-Semitism in central Europe, the political events and structures of the Holocaust, the reality of ghettos and concentration camps, the impact of technological modernization on the Final Solution, and resistance to the Nazis. Materials will include non-fictional texts, literature, art, and music. Three credits: English, open to all students.

Four credits: required for German major credit, supplementary readings and compositions in German. Four credits: required for German concentration credit, supplementary readings and compositions in German.

Meets International Perspectives Requirement.

GER 375. Grimms' Tales.

(3-0) Cr. 3-4. Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level

Introduction to Germanic antiquities, mythology, and heroic legends; Herder's concept of Naturpoesie. Emphasis on the Grimm tales: theoretical approaches to the tales from the late 19th and early 20th centuries; perversions of these traditional tales by the National Socialists (Nazis). Readings in contemporary Grimm scholarship. Taught in English. Three credits: English, open to all students. Four credits: required for German concentration credit, supplementary readings and compositions in German.

Meets International Perspectives Requirement.

GER 378. German Film and Media Studies.

(3-0) Cr. 3-4. S. Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level

Analysis and interpretation of film or media in German society. Study of media production and reception within multicultural and global contexts. Thematic emphases based on faculty and student interest including: 1) film directors, genres, movements (e.g. New German Cinema), aesthetics, and cinematography or 2) media studies (e.g. television, mass press, popular culture). Three credits: English, open to all students. Four credits: required for German concentration credit, supplementary readings and compositions in German.

Meets International Perspectives Requirement.

GER 395. Study Abroad.

Cr. 1-10. Prereq: 2 years university-level German

Supervised instruction in language and culture of Germany; formal class instruction at level appropriate to student's training, augmented by practical living experience.

Meets International Perspectives Requirement.

GER 476. Topics in German Cultural Studies.

(3-0) Cr. 3-4. S. Prereq: Sophomore classification. For fourth credit, six credits in German at the 300-level courses instructed in German

Key topics and themes in German history and culture up to the modern era. Three credits: Taught in English, open to all students. Four credits: Required for German concentration credit, supplementary readings and compositions in German.

Meets International Perspectives Requirement.

GER 490. Independent Study.

Cr. 1-6. Repeatable, maximum of 9 credits. Prereq: 6 credits in German and permission of department chair

Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Ger 490 may be counted toward graduation.

GER 499. Internship in German.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. Prereq: 9 credits of German at the 300 level; permission of advisor and the World Languages and Cultures Internship coordinator

Work experience using German language skills in the public or private sector, combined with academic work under faculty supervision. Available only to majors and minors. Offered on a satisfactory-fail basis only. Ger 499 may be repeated to a maximum of 6 credits. No more than 3 credits of Ger 499 may be applied to the major.

Courses primarily for graduate students, open to qualified undergraduates:

GER 590. Special Topics in German.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level German*

GER 590A. Special Topics in German: Literature or Literary Criticism.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level German*

GER 590B. Special Topics in German: Linguistics.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level German*

GER 590C. Special Topics in German: Language Pedagogy.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level German*

GER 590D. Special Topics in German: Civilization.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level German*

Gerontology (GERON)

Courses primarily for undergraduates:

GERON 234. Adult Development and Aging.

(Cross-listed with HD FS). (3-0) Cr. 3. S. Prereq: HD FS 102

Introductory exploration of the health, individual and social factors associated with adult development including young adulthood, middle age and older adulthood. Information is presented from a life-span developmental framework.

GERON 373. Death as a Part of Living.

(Cross-listed with HD FS). (3-0) Cr. 3. F.S.Alt. SS., offered even-numbered years. Prereq: HD FS 102

Consideration of death in the life span of the individual and the family with opportunity for exploration of personal and societal attitudes.

GERON 377. Aging and the Family.

(Cross-listed with HD FS). (3-0) Cr. 3. F.Alt. SS., offered odd-numbered years. Prereq: HD FS 102

Interchanges of the aged and their families. Emphasis on role changes, social interaction, and independence as influenced by health, finances, life styles, and community development.

Meets U.S. Diversity Requirement

GERON 378. Retirement Planning and Employee Benefits.

(Cross-listed with ECON, HD FS). (3-0) Cr. 3. S. Prereq: 3 credits in Principles of Economics and 3 credits in Human Development and Family Studies

Economic well-being in the context of demographic change, the present and future of Social Security, family retirement needs analysis, investment strategies and characteristics of retirement plans, helping others to work towards financial security, family economic issues for retired persons. Overview of employee and retirement benefits.

Meets U.S. Diversity Requirement

GERON 414. Gerontechnology in Smart Home Environments.

(3-0) Cr. 3. F. Prereq: Com S 227 or (Com S 207 or Geron 377 or ArtGr 271) or equivalent.

An interdisciplinary course designed for students who are interested in assistive technology, pervasive computing, mobile computing and principles of universal and inclusive design for end users, in particular, the elderly population. Students will work in semester-long projects as interdisciplinary teams to apply knowledge obtained from lectures and mutual presentations. For graduate credit students are required to submit a research report and give an oral presentation.

GERON 463. Environments for the Aging.

(Dual-listed with GERON 563). (Cross-listed with HD FS). (3-0) Cr. 3. S. Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies or permission of instructor. Emphasis on independent living within residential settings including specialized shelter, supportive services and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities. (on-line course offering via Distance Education).

Meets U.S. Diversity Requirement

GERON 466. Gerontology Prepracticum Seminar.

(1-0) Cr. 1. F.S.SS. Prereq: 9 credits in core courses for the gerontology minor and approval of the gerontology undergraduate coordinator

Prepracticum training for students planning a gerontology practicum. Exploration of possible agencies for the practicum, in-depth study of a selected agency, and development of goals and objectives for the practicum.

GERON 467. Gerontology Practicum.

Cr. 3-6. Repeatable. F.S.SS. Prereq: GERON 466, advance reservation

Supervised field experience related to aging. Offered on a satisfactory-fail basis only.

GERON 490. Independent Study.

Cr. arr.

Consult program coordinator for procedure.

Courses primarily for graduate students, open to qualified undergraduates:

GERON 501. Seminar.

Cr. arr. Repeatable. F.S.SS.

GERON 510. Survey of Gerontology.

Cr. 1-3. Repeatable. S.

Provides an overview of important gerontological issues.

GERON 514. Gerontechnology in Smart Home Environments.

(3-0) Cr. 3. F. Prereq: COM S 227 or (COM S 207 or GERON 377 or ARTGR 271) or equivalent.

An interdisciplinary course designed for students who are interested in assistive technology, pervasive computing, mobile computing and principles of universal and inclusive design for end users, in particular, the elderly population. Students will work in semester-long projects as interdisciplinary teams to apply knowledge obtained from lectures and mutual presentations. For graduate credit students are required to submit a research report and give an oral presentation.

GERON 520. Women and Aging.

(3-0) Cr. 3. SS.

Women and Aging is the study of theory, research and application of issues related to women and the aging experience. This course will examine gender differences in areas such as health, mental health, income security, crime, and public policy. Attention will be given to ways in which younger women can prepare to meet the challenges and opportunities awaiting them as they age.

GERON 521. Biological Principles of Aging.

(3-0) Cr. 3. SS.

Basic biological principles of aging. Course modules include an introduction to the aging process, body systems and normal aging, and environment and the biology of aging. In addition, disorders and diseases of aging, prevention and treatment and exercise and aging topics will be covered.

GERON 522. Long-Term Care.

(3-0) Cr. 3. F.

Administration principles involved in the planning, organizing and directing of long-term care agencies. Includes an in-depth exposure to federal and state standards and regulations governing long-term care.

GERON 523. Mental Health and Aging.

(3-0) Cr. 3. S.

Introduction to the range of issues involved in aging and mental health. From a systems framework the major emotional and psychiatric problems encountered in old age will be examined including mood, anxiety, adjustment and personality disorders, dementia, cognitive problems, substance abuse, and suicide. Barriers to treatment and cohort and cultural issues will be explored.

GERON 524. Cognitive Health.

(3-0) Cr. 3. SS.

Cognitive skills form the foundation for functioning in everyday life and these skills take on added importance in older adulthood. This course focuses on selected theoretical approaches and current research related to cognitive aging. We will review normative and non-normative cognitive changes, assessment techniques, and prevention/intervention efforts. Throughout the course we will keep the role of environment and life-span implications in the forefront of our discussion.

GERON 530. Perspectives in Gerontology.

(Cross-listed with HD FS). (3-0) Cr. 3. F.

Overview of current aging issues including theory and research, critical social and political issues in aging, the interdisciplinary focus of gerontology, career opportunities, and aging in the future. (on-line course offering via Distance Education).

GERON 534. Adult Development.

(Cross-listed with HD FS). (3-0) Cr. 3. S.

Exploration of the biological, psychological and social factors associated with aging. Although the focus is on the later years, information is presented from a life-span developmental framework. Empirical studies are reviewed and their strengths, limitations and implications for normative and optimal functioning are discussed. (on-line course offering via Distance Education).

GERON 540. Nutrition and Physical Activity in Aging.

(Cross-listed with DIET). (3-0) Cr. 3. Alt. F., offered even-numbered years.

WWW only. Basic physiologic changes during aging and their impacts in health and disease. The focus will be on successful aging with special emphasis on physical activity and nutrition. Practical application to community settings is addressed.

GERON 545. Economics, Public Policy, and Aging.

(Cross-listed with HD FS). (3-0) Cr. 3. F.

Policy development in the context of the economic status of the older adult population. Retirement planning and the retirement decisions; social security and public transfer programs; intra-family transfers to/from the aged; private pensions; financing medical care; prospects and issues for the future.

GERON 563. Environments for the Aging.

(Dual-listed with GERON 463). (Cross-listed with HD FS). (3-0) Cr. 3. S. *Prereq:* HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies or permission of instructor. Emphasis on independent living within residential settings including specialized shelter, supportive services and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities. (on-line course offering via Distance Education).
Meets U.S. Diversity Requirement

GERON 571. Design for All People.

(Cross-listed with ARCH, DSN S). (3-0) Cr. 3. S. *Prereq:* Graduate or Senior classification. Principles and procedures of universal design in response to the varying ability level of users. Assessment and analysis of existing buildings and sites with respect to standards and details of accessibility for all people, including visually impaired, mentally impaired, and mobility restricted users. Design is neither a prerequisite nor a required part of the course. Enrollment open to students majoring in related disciplines. Credit counts toward fulfillment of Studies in Architecture and Culture requirements.
Meets U.S. Diversity Requirement

GERON 577. Aging in the Family Setting.

(Cross-listed with HD FS). (3-0) Cr. 3. S. *Prereq:* 9 credits in social sciences or permission of instructor. Theories and research related to personal and family adjustments in later life affecting older persons and their intergenerational relationships. Related issues including demographics also are examined through the use of current literature. (on-line course offering via Distance Education) Spring 2016: on campus.

GERON 584. Program Evaluation and Research Methods in Gerontology.

(Cross-listed with HD FS). (3-0) Cr. 3. S. Overview of program evaluation, research methods, and grant writing in gerontology. Includes application of quantitative and qualitative methods in professional settings. (on-line course offering via Distance Education).

GERON 590. Special Topics.

Cr. arr. Repeatable.
Consult program coordinator for procedure.

GERON 591. Internship.

Cr. 1-9. Repeatable, maximum of 9 credits. F.S.SS.
Supervised experience in an area of gerontology.

GERON 594. Professional Seminar in Gerontology.

(Cross-listed with HD FS). (3-0) Cr. 3. SS. An integrative experience for gerontology students designed to be taken near the end of the degree program. By applying knowledge gained in earlier coursework, students will strengthen skills in ethical decision-making behavior, applying these skills in gerontology-related areas such as advocacy, professionalism, family and workplace issues. Students from a variety of professions will bring their unique perspectives to bear on topics of common interest. (on-line course offering via Distance Education).

Global Resource Systems (GLOBE)

Courses primarily for undergraduates:

GLOBE 110. Orientation.

(1-0) Cr. 1. F.

An introduction to Global Resource Systems (GRS) program. University and career acclimation, development of educational and professional skills, participation in GRS Learning Community.

GLOBE 201. Global Resource Systems.

(3-0) Cr. 3. S.

A comparative analysis of global resources and the various natural and human systems affecting those resources.

GLOBE 211. Issues in Global Resource Systems.

(1-0) Cr. 1. Repeatable, maximum of 3 credits. F.S. *Prereq: credit or enrollment in GLOBE 201*

Discussion of topics of current importance in global resource systems. Offered on a satisfactory-fail basis only. A maximum of 3 credits of 211 may be used towards degree requirements.

GLOBE 220. Global Sustainability.

(Cross-listed with ANTHR, ENV S, M E, MAT E, SOC, T SC). (3-0) Cr. 3. F.S.

An introduction to the key global issues in sustainability. Focuses on interconnected roles of energy, materials, human resources, economics, and technology in building and maintaining sustainable systems. Applications discussed will include challenges in both the developed and developing world and will examine the role of technology in a resource-constrained world. Cannot be used for technical elective credit in any engineering department. Meets International Perspectives Requirement.

GLOBE 221. Apprenticeship.

Cr. R. Repeatable. F.S.SS. *Prereq: Approval by the Global Resource Systems Faculty Coordinator*

Practical work experience in approved domestic or international settings such as with a company, research laboratory, governmental agency or non-governmental organization. Offered on a satisfactory-fail basis only.

GLOBE 290. Independent Study.

Cr. 1-2. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator*

Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for freshmen and sophomores.

GLOBE 290H. Independent Study, Honors.

Cr. 1-2. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator*

Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for freshmen and sophomores.

GLOBE 301. Resource Systems of Industrialized Nations.

(2-2) Cr. 3. S. *Prereq: GLOBE 201, ECON 101 or ECON 102*

In-depth analysis of the opportunities, constraints and consequences of the resource systems common in industrialized nations. Topics integrate natural resources with land tenure, societal structure, food security, agriculture, shelter, energy and wealth dynamics.

GLOBE 302. Resource Systems of Developing Nations.

(2-2) Cr. 3. F. *Prereq: GLOBE 201, ECON 101 or ECON 102*

In depth appraisal of resource systems common throughout the developing world. Topics integrate natural resources with land tenure, societal structure including gender issues, food security, agriculture, shelter, energy and wealth dynamics and effectiveness of global programs aimed at sustainable development.

GLOBE 320. Global Resource Systems Internship Preparation.

(1-0) Cr. 1. S. *Prereq: Permission of instructor.*

Students enrolled in this course intend to enroll in Globe 321 or 322 in the following term. Topics provide a pre-departure orientation, including logistical, academic, and personal requirements for completion of an experiential supervised work experience.

GLOBE 321. Internship - Global.

Cr. 3-6. Repeatable. F.S.SS. *Prereq: Junior or Senior and enrollment in Global Resource Systems major; permission of the instructor and approval by the Global Resource Systems Faculty Coordinator*

A supervised learning experience including an analysis of an international location's resource system via immersion in a foreign culture lasting at least five weeks. The experience should focus on the region consistent with the student's degree track. Course expenses paid by student. A maximum of 12 credits of GLOBE 321 and 322 may be used for degree requirements.

GLOBE 322. Internship - United States.

Cr. 3-6. Repeatable. F.S.SS. *Prereq: Junior or Senior and enrollment in Global Resource Systems major; permission of the instructor and approval by the Global Resource Systems Faculty Coordinator*

A supervised learning experience including an analysis of a domestic location's resource system via immersion in a different culture within the United States lasting at least five weeks. Designed for international students and for students who are not in a position to leave the United States. Course expenses paid by student. A maximum of 12 credits of Globe 321 and 322 may be used for degree requirements.

GLOBE 385. Economic Development.

(Cross-listed with ECON). (3-0) Cr. 3. *Prereq: ECON 101, ECON 102*

Current problems of developing countries, theories of economic development, agriculture, and economic development, measurement and prediction of economic performance of developing countries, alternative policies and reforms required for satisfying basic needs of Third World countries, interrelationships between industrialized countries and the developing countries, including foreign aid. Meets International Perspectives Requirement.

GLOBE 401. Senior Project.

Cr. 3. F.S.SS. *Prereq: Senior classification in Global Resource Systems*

Research project in collaboration with faculty that complements and furthers a student's experiences from Globe 321 and 322 while simultaneously bringing into focus entire four-year experience. Student will write a research report and make either an oral or poster presentation.

GLOBE 401H. Senior Project, Honors.

Cr. 3. F.S.SS. *Prereq: Senior classification in Global Resource Systems*

Research project in collaboration with faculty that complements and furthers a student's experiences from Globe 321 and 322 while simultaneously bringing into focus entire four-year experience. Student will write a research report and make either an oral or poster presentation.

GLOBE 402. Responses to Global Resource System Challenges.

(1-4) Cr. 3. S.

Capstone analysis of critical global resource challenges facing both developed and developing countries. Students will use research skills to investigate specific global resource issues and use communications skills to work as a team to integrate their research, develop an interdisciplinary perspective, and evaluate potential solutions to resource challenges.

GLOBE 441. International Animal Agriculture.

(Cross-listed with AN S). (3-0) Cr. 3. S. *Prereq: Two courses from AN S 223, AN S 225, AN S 226, AN S 229, AN S 235*

An overview of animal agriculture with emphasis on animal agriculture in developing countries. Historical, economic, environmental; and political considerations will be assessed and evaluated. Issues related to gender, resilience and sustainability for different production systems will be investigated. Meets International Perspectives Requirement.

GLOBE 446. International Issues and Challenges in Sustainable Development.

(Cross-listed with AGRON, INTST). Cr. 4. S. *Prereq: 3-credit biology course, Sophomore or higher classification, permission of Instructor*

Interdisciplinary study and analysis of agricultural, biophysical, environmental, sociological, economical, political, and historical factors affecting sustainable development of communities and countries from art and science perspectives. International field experience with foreign language training required. A program fee is charged to students for international study abroad. Meets International Perspectives Requirement.

GLOBE 490. Independent Study.

Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator*

Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for juniors and seniors. A maximum of 9 credits of all (university-wide) 490 courses may be used for degree requirements.

GLOBE 490A. Independent Study: General.

Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator*

Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for juniors and seniors. A maximum of 9 credits of all (university-wide) 490 courses may be used for degree requirements.

GLOBE 490E. Independent Study: Entrepreneurship.

Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator*

Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for juniors and seniors. A maximum of 9 credits of all (university-wide) 490 courses may be used for degree requirements.

GLOBE 490H. Independent Study: Honors.

Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator*

Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for juniors and seniors. A maximum of 9 credits of all (university-wide) 490 courses may be used for degree requirements.

GLOBE 490Z. Independent Study: Service Learning.

Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator*

Independent study on topics of special interest to the student. Comprehensive report required. Intended primarily for juniors and seniors. A maximum of 9 credits of all (university-wide) 490 courses may be used for degree requirements.

GLOBE 494. Service Learning.

Cr. arr. F.S.SS. *Prereq: Permission of instructor.*

Selected projects that result in outcomes benefiting a non-Iowa State University entity while instilling a professional ethics and accomplishing student learning goals. Course expenses paid by student.

GLOBE 494A. Service Learning: International.

Cr. arr. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Permission of instructor.*

Selected projects that result in outcomes benefiting a non-Iowa State University entity while instilling a professional ethics and accomplishing student learning goals. Course expenses paid by student.

GLOBE 494B. Service Learning: Domestic.

Cr. arr. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Permission of instructor.*

Selected projects that result in outcomes benefiting a non-Iowa State University entity while instilling a professional ethics and accomplishing student learning goals. Course expenses paid by student.

GLOBE 495. Global Resource Systems Study Abroad Course Preparation.

(1-0) Cr. 1. Repeatable. F.S. *Prereq: Permission of instructor*

Global resource systems topics will include the agricultural industries, climate, crops, culture, economics, food, geography, government, history, livestock, marketing, natural resources, public policies, soils, and preparation for travel to locations to be visited. Students enrolled in this course intend to register for Globe 496 or 497 the following term.

GLOBE 496. Global Resource Systems Study Abroad.

Cr. 2-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Extended field trips abroad to study global resource systems. Location and duration of trips will vary. Pre-trip sessions arranged through Globe 495. Trip expenses paid by student.

GLOBE 497. Deans Global Ag and Food Leadership Program.

Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

An integrated agricultural and food production and policy program that allows students to assess, analyze and evaluate complex, country-specific situations and to develop their skills, knowledge and abilities via team-oriented projects that involve complex issues such as development of effective foreign food aid and agricultural and food production systems, drivers of world hunger, sustainable resource management and efficacy of policy, and the role of the USA and the United Nations and other development agencies in these systems. International location and duration of program will vary. Pre-trip sessions arranged through Globe 495. Trip expenses paid by students. Meets International Perspectives Requirement.

GLOBE 499. Undergraduate Research.

Cr. arr. F.S. *Prereq: Permission of the instructor and approval by the Global Resource Systems Faculty Coordinator*

Research projects in collaboration with faculty.

Graduate Studies (GR ST)

Courses primarily for graduate students, open to qualified undergraduates:

GR ST 529. Preparing Publishable Thesis Chapters.

(3-0) Cr. 3. S. *Prereq: Instructor permission*

Reporting original research results within the norms for writing of a student's discipline. Emphasis on preparing thesis/dissertation chapters that will be both acceptable to the Graduate College and ready for submission to a refereed journal in the student's discipline. Focus on reporting student-generated data, norms for discourse within disciplines, and how thesis chapters differ from journal manuscripts.

GR ST 565. Responsible Conduct of Research in Science and Engineering.

(1-0) Cr. 1. F.S. *Prereq: Graduate classification*

Ethical and legal issues facing researchers in the sciences and engineering.

GR ST 566. Communications in Science.

(0.5-0) Cr. 0.5. Alt. S., offered odd-numbered years. *Prereq: graduate classification*

Reading and reviewing manuscripts; publishing papers; oral and poster presentations.

GR ST 567. Time Management and Mentoring.

(0.5-0) Cr. 0.5. Alt. F., offered even-numbered years. *Prereq: graduate classification*

Balancing life and career; mentoring; lab management.

GR ST 568. The Interview Process.

(0.5-0) Cr. 0.5. Alt. S., offered odd-numbered years. *Prereq: graduate classification*

Applying and interviewing for academia, industry and government.

GR ST 569. Grant Writing.

(1-0) Cr. 1. Alt. F., offered odd-numbered years. *Prereq: at least two prior years of graduate classification*

Writing a winning proposal.

GR ST 570. Teaching Practices.

(0.5-0) Cr. 0.5. Alt. S., offered even-numbered years. *Prereq: graduate classification*

Preparation of a teaching portfolio and course materials; lecturing, technology.

GR ST 585. Preparing Future Faculty Introductory Seminar.

Cr. 1. F. *Prereq: One year of graduate course work; admission into PFF program*

Introduction to faculty life issues such as hiring, tenure, teaching, and service at a variety of higher education institutions. Includes presentations from faculty at other institutions.

GR ST 586. Preparing Future Faculty Intermediate Seminar.

Cr. 1-3. S. *Prereq: Admission into PFF program; completion of 585 or permission of instructor*

Consideration of a wide range of faculty life issues. Includes topics such as higher education trends, diversity issues, learning styles, assessment, grant and proposal writing, and legal and ethical issues. Written components include job and teaching portfolios.

GR ST 587. Preparing Future Faculty Teaching Practicum.

Cr. 1-3. Repeatable. F.S. *Prereq: Permission of instructor, GR ST 585, credit for or concurrent enrollment in GR ST 586*

Students complete a stand-alone teaching assignment at Iowa State or another higher education institution. Written components include pedagogical documents.

GR ST 588. Preparing Future Faculty Special Topics.

Cr. 1-3. Repeatable. F.S. *Prereq: Permission of instructor, GR ST 585, credit for or concurrent enrollment in GR ST 586*

In-depth study of topic providing academic professional development.

Courses for graduate students:

GR ST 600. Examination Only.

Cr. R.

Reserved for graduate students the term they take the final oral examination. Students must have completed all required coursework and not be registered for another non-R Credit course.

GR ST 601. Required Enrollment.

Cr. R.

Reserved for graduate students who must be registered for a particular term, but are not required to take additional coursework.

GR ST 633. Summer Graduate Assistant.

Cr. R. SS.

Only for students not registered in other courses in the summer term.

GR ST 680. Doctoral Post Prelim (Continuous) Registration.

Cr. R. Repeatable.

Reserved for Ph.D. candidates only. See the Graduate College Handbook for specific requirements.

GR ST 697. Curricular Practical Training.

Cr. R. Repeatable. F.S.SS.

Professional work period.

Graphic Design (ARTGR)

Courses primarily for undergraduates:

ARTGR 270. Graphic Design Studio I.

(0-6) Cr. 3. F. *Prereq:* DSN S 102, DSN S 131 and enrollment in ARTGR 275; admission to the graphic design program through department review
Basic design concepts and color principles used for visual communication.

ARTGR 271. Graphic Design Studio II.

(0-6) Cr. 3. S. *Prereq:* ART 230, ARTGR 270, ARTGR 275 and enrollment in ARTGR 276

Principles of typographic composition, structure and hierarchy. Formal and conceptual principles of symbology.

ARTGR 272. Digital Photography for Graphic Design.

(0-6) Cr. 3. F.S. *Prereq:* Concurrent enrollment in ARTGR 270 OR ARTGR 271
This course will address the development of "seeing" as a medium design, expression, and visual communication including compositional dynamics, advanced digital image manipulation, software usage and support, digital camera operations along with scanning and other digital input devices, color management, digital format for presentation and printing with digital ready formats.

ARTGR 275. Graphic Technology I.

(0-4) Cr. 2. F. *Prereq:* concurrent enrollment in ARTGR 270
Basic 2-dimensional computer skills for graphic design.

ARTGR 276. Graphic Technology II.

(1-2) Cr. 2. S. *Prereq:* ARTGR 275 and concurrent enrollment in ARTGR 271
Basic 3-dimensional computer skills for graphic design.

ARTGR 281. Visual Communication and Branding.

(3-0) Cr. 3. F.

Introduction to basic principles of visual communication that contribute to the successful comprehension of intended visual messages; these include promotional messages, such as corporate branding and marketing campaigns, as well as informational messages, such as those used in computer interface design or in the clear presentation of diagrammatic data. Emphasis is placed on sensitivity to the diversity of the intended American or global audience, and to the cross-cultural differences that may affect the ways that visual messages are interpreted. Methods for creating brand experiences are explored as they apply to both small and large enterprises, ranging from personal brand to corporate brand identities.

ARTGR 370. Graphic Design Studio III.

(0-6) Cr. 3. F. *Prereq:* ARTGR 271, ARTGR 276, and credit or concurrent enrollment in ARTGR 387

Creation and design of images and symbols for communication. Application and integration of typography with images and symbols.

ARTGR 371. Graphic Design Studio IV.

(0-6) Cr. 3. S. *Prereq:* ARTGR 370 and ARTGR 387

Development and preparation of design concepts for application to the printing and electronic publishing process. Creative problem-solving skills, introduction to systems design.

ARTGR 372. Graphic Design Materials and Processes.

(3-0) Cr. 3. S. *Prereq:* Credit or concurrent enrollment in ARTGR 371

Lecture about the processes and materials involved in graphic design arts reproduction. Course covers pre-press, paper selection and specification, ink systems, type systems and fonts, output technology, printing presses and bindery operations.

ARTGR 377. Graphic Design Internship Seminar.

(1-0) Cr. 1. S. *Prereq:* Credit or concurrent enrollment in ARTGR 370 or ARTGR 371

Procedural and ethical concerns related to the graphic design internship. Personal goals, preparation of resume and plans for internship. Study and tours of areas of interest within the graphic design profession.

ARTGR 378. Critical Issues in Graphic Design.

(2-0) Cr. 2. *Prereq:* Credit or concurrent enrollment in ARTGR 370

Lecture, discussion and writing about the critical issues facing the communications field today and in the future.

ARTGR 387. Graphic Design History/Theory/ Criticism I.

(Dual-listed with ARTGR 587). (3-0) Cr. 3. F. *Prereq:* ART H 280, ART H 281 and DSN S 183

Late nineteenth century to the 1990s. This course will explore the cultural, social, political, industrial, and technological forces that have influenced the practice of graphic design in Britain, Europe, and the United States. Students will study the historical issues and problems facing designers, their clients, and their publics.

ARTGR 388. Graphic Design History/Theory/ Criticism II.

(Dual-listed with ARTGR 588). (3-0) Cr. 3. S. *Prereq:* ARTGR 387 or ART H 281 and DSN S 183

Critical issues that affect the contemporary practice of graphic design as it relates to the United States. Students will study a variety of issues that include, but are not exclusive to, new media, gender, class, design and the public sphere, design as social action, postmodern design theory, sustainability, and ethical practice. Meets U.S. Diversity Requirement

ARTGR 391. Graphic Design Field Study.

(0-1) Cr. 1. Repeatable, maximum of 2 credits. *Prereq:* Concurrent enrollment in 300 or 400 level graphic design studio course

Travel, study, and tours of areas of interest within the graphic design profession such as print production companies, design studios, and museums. Offered on a satisfactory-fail basis only.

ARTGR 470. Graphic Design Studio V.

(0-6) Cr. 3. F. *Prereq:* ARTGR 371

Advanced design systems as applied to corporate identity and environmental graphic design. Symbology as an integrated component of communication systems.

ARTGR 471. Graphic Design Capstone.

(0-10) Cr. 5. S. *Prereq:* ARTGR 470 or permission of instructor

Experience design and innovation in a multi-disciplinary design studio. Class will use unique research, design, evaluation, creativity, and innovation methodologies to solve human problems on special topics. Designed solutions will be in the form of products, artifacts, interfaces, information, and human environments.

ARTGR 472. Photography and Narrative Message.

(Dual-listed with ARTGR 572). (0-6) Cr. 3. *Prereq:* Enrollment in ARTGR 370, ARTGR 371, ARTGR 470, or ARTGR 471

Photography as a tool for creating conceptually-driven images and metaphors. Emphasis is on photography as an evocative storytelling device for a range of audiences and design applications. Compositional and technical aspects are explored to ensure successful interpretation of the photograph's intended message.

ARTGR 473. Multimedia Design.

(Dual-listed with ARTGR 573). (0-6) Cr. 3. *Prereq:* Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470, Graduate: graduate enrollment in College of Design

The design of visual, aural and textual communication for electronic media.

ARTGR 474. Exhibition Design.

(Dual-listed with ARTGR 574). (0-6) Cr. 3. *Prereq:* Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470, Graduate: graduate enrollment in College of Design

Visual communication applied to exhibition design focusing on educational or interactive museum exhibitions, trade show booth design, and modular unit design for traveling exhibitions. Translation of graphic information to a three-dimensional space.

ARTGR 475. Advanced Typography.

(Dual-listed with ARTGR 575). (0-6) Cr. 3. *Prereq:* Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470, Graduate: graduate classification in College of Design

Typographic theory exploring traditional and non-traditional forms, both historical and contemporary typographic achievements.

ARTGR 476. Graphic Design Methodology.

(Dual-listed with ARTGR 576). (0-6) Cr. 3. *Prereq:* Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371 or ARTGR 470, Graduate: graduate enrollment in College of Design

Analysis and application of scientific, systematic, and non-traditional problem-solving and problem-seeking techniques.

ARTGR 477. Graphic Design Practicum.

(0-6) Cr. 3. *Prereq:* Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470

Graphic design outreach and problem solving. Individual and group projects for non-profit clients selected by the instructor.

ARTGR 478. Design for E-Commerce/Graphic Applications.

(Dual-listed with ARTGR 578). (0-6) Cr. 3. *Prereq: Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470. Graduate: Graduate enrollment in College of Design*

The development of advanced and experimental web design for the applications of e-commerce, education and the communication of visual information.

ARTGR 479. Wayfinding Design.

(Dual-listed with ARTGR 579). (0-6) Cr. 3. *Prereq: Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470. Graduate: Graduate enrollment in College of Design*

Study of the navigational challenges of built environments and outdoor spaces, including site analysis, development of navigational plans, and design of wayfinding sign systems. Issues of function, accessibility, legibility, and fabrication are considered.

ARTGR 480. Graphic Design Internship.

(3-0) Cr. 3. SS. *Prereq: ARTGR 377, 12 credits in graphic design; permission of instructor, registration in advance of enrollment*

Graphic design experience in an off-campus professional environment.

ARTGR 481. Graphic Design Professional Practices.

(3-0) Cr. 3. S. *Prereq: Credit or concurrent enrollment in ARTGR 470*

Professional design management: ethics, setting up a new business, client/designer relationships, contractual options, billing practices, and effective operating procedures.

ARTGR 482. Professional Presentation.

(0-6) Cr. 3. S. *Prereq: ARTGR 470 and concurrent enrollment in ARTGR 471*

Exploration and development of the graphic design portfolio and resume in electronic, print, and photographic form.

ARTGR 484. Selected Studies in Graphic Design.

(Dual-listed with ARTGR 584). Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Graduate classification in the College of Design*

Special issues related to graphic design. Topics vary each time offered.

ARTGR 490. Independent Study.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*

Student must have completed related graphic design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTGR 490A. Independent Study: Theory, Criticism, and Methodology.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*

Student must have completed related graphic design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTGR 490B. Independent Study: Two-Dimensional Design.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*

Student must have completed related graphic design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTGR 490C. Independent Study: Three-Dimensional Design.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*

Student must have completed related graphic design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTGR 490H. Independent Study: Honors.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*

Student must have completed related graphic design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTGR 490I. Internship/Cooperative (in-depth experience other than ArtGr 480).

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*

Student must have completed related graphic design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTGR 491. Publication Design: Magazines.

(Dual-listed with ARTGR 591). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design*

The philosophy, concepts and structures of magazine design.

ARTGR 492. Publication Design: Books.

(Dual-listed with ARTGR 592). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design*

The philosophy, concepts and structures of book design.

ARTGR 493. Workshop.

Cr. 1-3. Repeatable. *Prereq: Evidence of satisfactory experience in area of specialization*

Intensive 2 to 4 week studio exploration. Topics vary each time offered.

ARTGR 494. Graphic Design in Europe Seminar.

(1-0) Cr. 1. *Prereq: Permission of instructor and planned enrollment in ARTGR 495.*

Cultural and historical aspects of art and design in Western Europe in preparation for study abroad. Area of study varies each time offered. Offered on a satisfactory-fail basis only.

ARTGR 495. Graphic Design in Europe.

(Dual-listed with ARTGR 595). Cr. 3. SS. *Prereq: ARTGR 494, permission of instructor*

International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities.

ARTGR 496. Graphic Design Field Study.

Cr. R. Repeatable. *Prereq: Concurrent enrollment in a graphic design studio and permission of instructor.*

Study and tours of museums, galleries, artist and/or designer studios and other areas of interest within art and design. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:**ARTGR 570. Advanced Studies in Visual Communication.**

(0-6) Cr. 3. F. *Prereq: Graduate classification in College of Design*

Theory and investigation of systems, structures, principles of visual organization, and typography for communication. Studio problems will be influenced by social, cultural, environmental, or technological factors.

ARTGR 571. Signs, Symbols, Images.

(0-6) Cr. 3. S. *Prereq: Graduate Classification in College of Design*

Investigation and application of signs, symbols and semiotic theory for communication. Studio problems influenced by social, cultural, environmental, or technological factors.

ARTGR 572. Photography and Narrative Message.

(Dual-listed with ARTGR 472). (0-6) Cr. 3. *Prereq: Enrollment in ARTGR 370, ARTGR 371, ARTGR 470, or ARTGR 471*

Photography as a tool for creating conceptually-driven images and metaphors. Emphasis is on photography as an evocative storytelling device for a range of audiences and design applications. Compositional and technical aspects are explored to ensure successful interpretation of the photograph's intended message.

ARTGR 573. Multimedia Design.

(Dual-listed with ARTGR 473). (0-6) Cr. 3. *Prereq: Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470, Graduate: graduate enrollment in College of Design*

The design of visual, aural and textual communication for electronic media.

ARTGR 574. Exhibition Design.

(Dual-listed with ARTGR 474). (0-6) Cr. 3. *Prereq: Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470, Graduate: graduate enrollment in College of Design*

Visual communication applied to exhibition design focusing on educational or interactive museum exhibitions, trade show booth design, and modular unit design for traveling exhibitions. Translation of graphic information to a three-dimensional space.

ARTGR 575. Advanced Typography.

(Dual-listed with ARTGR 475). (0-6) Cr. 3. *Prereq: Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470, Graduate: graduate classification in College of Design*

Typographic theory exploring traditional and non-traditional forms, both historical and contemporary typographic achievements.

ARTGR 576. Graphic Design Methodology.

(Dual-listed with ARTGR 476). (0-6) Cr. 3. *Prereq: Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371 or ARTGR 470, Graduate: graduate enrollment in College of Design*

Analysis and application of scientific, systematic, and non-traditional problem-solving and problem-seeking techniques.

ARTGR 578. Design for E-Commerce/Graphic Applications.

(Dual-listed with ARTGR 478). (0-6) Cr. 3. *Prereq: Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470. Graduate: Graduate enrollment in College of Design*

The development of advanced and experimental web design for the applications of e-commerce, education and the communication of visual information.

ARTGR 579. Wayfinding Design.

(Dual-listed with ARTGR 479). (0-6) Cr. 3. *Prereq: Undergraduate: Concurrent enrollment in ARTGR 370, ARTGR 371, or ARTGR 470. Graduate: Graduate enrollment in College of Design*

Study of the navigational challenges of built environments and outdoor spaces, including site analysis, development of navigational plans, and design of wayfinding sign systems. Issues of function, accessibility, legibility, and fabrication are considered.

ARTGR 584. Selected Studies in Graphic Design.

(Dual-listed with ARTGR 484). Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Graduate classification in the College of Design*
Special issues related to graphic design. Topics vary each time offered.

ARTGR 587. Graphic Design History/Theory/ Criticism I.

(Dual-listed with ARTGR 387). (3-0) Cr. 3. F. *Prereq: ART H 280, ART H 281 and DSN S 183*

Late nineteenth century to the 1990s. This course will explore the cultural, social, political, industrial, and technological forces that have influenced the practice of graphic design in Britain, Europe, and the United States. Students will study the historical issues and problems facing designers, their clients, and their publics.

ARTGR 588. Graphic Design History/Theory/ Criticism II.

(Dual-listed with ARTGR 388). (3-0) Cr. 3. S. *Prereq: ARTGR 387 or ART H 281 and DSN S 183*

Critical issues that affect the contemporary practice of graphic design as it relates to the United States. Students will study a variety of issues that include, but are not exclusive to, new media, gender, class, design and the public sphere, design as social action, postmodern design theory, sustainability, and ethical practice. Meets U.S. Diversity Requirement

ARTGR 589. Design and Ethics.

(Cross-listed with HCI). (3-0) Cr. 3. F.S. *Prereq: Graduate classification or permission of instructor.*

Issues in ethics and decision-making as they relate to technology, design, design research, HCI, and the design industry.

ARTGR 590. Special Topics.

Cr. arr. *Prereq: Bachelor's degree in graphic design, or evidence of satisfactory equivalency in specialized area*

Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTGR 590A. Special Topics: Theory, Criticism, and Methodology.

Cr. arr. *Prereq: Bachelor's degree in graphic design, or evidence of satisfactory equivalency in specialized area*

Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTGR 590B. Special Topics: Two-Dimensional Design.

Cr. arr. *Prereq: Bachelor's degree in graphic design, or evidence of satisfactory equivalency in specialized area*

Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTGR 590C. Special Topics: Three-Dimensional Design.

Cr. arr. *Prereq: Bachelor's degree in graphic design, or evidence of satisfactory equivalency in specialized area*

Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTGR 591. Publication Design: Magazines.

(Dual-listed with ARTGR 491). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design*

The philosophy, concepts and structures of magazine design.

ARTGR 592. Publication Design: Books.

(Dual-listed with ARTGR 492). (0-6) Cr. 3. *Prereq: Graduate enrollment in College of Design*

The philosophy, concepts and structures of book design.

ARTGR 593. Workshop.

Cr. 1-3. Repeatable. *Prereq: Graduate classification; evidence of satisfactory experience in area of specialization*

Intensive 2 to 4 week studio exploration. Topics vary each time offered.

ARTGR 595. Graphic Design in Europe.

(Dual-listed with ARTGR 495). Cr. 3. SS. *Prereq: ARTGR 494, permission of instructor*

International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities.

ARTGR 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:**ARTGR 611. Teaching in Higher Education and Design Practice.**

(3-0) Cr. 3. *Prereq: Graduate classification*
Introduction to teaching methods, curriculum design, project development, and business strategies for Design Education and Professional Practice.

ARTGR 672. Graphic Design and Human Interaction.

(0-6) Cr. 3. F.S. *Prereq: ARTGR 570, ARTGR 571, and graduate enrollment in College of Design or permission of instructor*

The theory and investigation of experience design as it applies to human interactions in contemporary society and culture. Studio problems may involve such areas as: exhibition design, electronic interface design, wayfinding, package design, and publication design.

ARTGR 672A. Usability.

(0-6) Cr. 3. *Prereq: ARTGR 570, ARTGR 571, and graduate enrollment in College of Design or permission of instructor*

The exploration and design of interface/interaction with products, systems, and technologies.

ARTGR 672B. Design for Behavioral Change..

(0-6) Cr. 3. *Prereq: ARTGR 570, ARTGR 571, and graduate enrollment in College of Design or permission of instructor*

The exploration and design of educational experiences and artifacts as they relate to the social, emotional, and behavioral aspects of society.

ARTGR 672C. Consumer Experience Design and Branding..

(0-6) Cr. 3. *Prereq: ARTGR 570, ARTGR 571, and graduate enrollment in College of Design or permission of instructor*

The theory and investigation of experience design as it applies to human interactions in contemporary society and culture. Studio problems may involve such areas as: exhibition design, electronic interface design, wayfinding, package design, and publication design.

ARTGR 690. Advanced Topics.

Cr. arr. Repeatable.

ARTGR 698. Current Issues in Graphic Design.

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: Graduate enrollment in College of Design or permission of instructor*

Selected issues in contemporary graphic design. Topics and readings vary each time offered.

ARTGR 699. Research-Thesis.

Cr. arr. Repeatable.

Greek (GREEK)

Courses primarily for undergraduates:

GREEK 101. Elementary Ancient Greek I.

(4-0) Cr. 4. F.

Grammar and vocabulary of ancient Greek, within the context of Greek culture; reading knowledge through texts adapted from classical authors.

GREEK 102. Elementary Ancient Greek II.

(4-0) Cr. 4. S. *Prereq: GREEK 101*

Grammar and vocabulary of ancient Greek, within the context of Greek culture; reading knowledge through texts adapted from classical and later authors. Meets International Perspectives Requirement.

GREEK 201. Intermediate Classical Greek.

Cr. arr. F. *Prereq: GREEK 102*

Emphasis on grammatical principles, composition and reading classical or Hellenistic texts.

Meets International Perspectives Requirement.

GREEK 332. Introduction to Classical Greek Literature.

Cr. arr. S. *Prereq: GREEK 201*

Readings in ancient Greek Literature with emphasis on critical analysis of style, structure or thought.

Meets International Perspectives Requirement.

GREEK 490. Independent Study.

Cr. 1-6. Repeatable, maximum of 9 credits. *Prereq: 6 credits in Greek and permission of department chair*

Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Greek 490 may be counted toward graduation.

Health Studies (H S)

Courses primarily for undergraduates:

H S 105. First Aid and Emergency Care.

(1-2) Cr. 2. F.S.SS.

Discussion and application of the basic techniques of utilizing bloodborne pathogen safety measures, administering first aid and cardiopulmonary resuscitation. ARC layperson certification available.

H S 110. Personal and Consumer Health.

(3-0) Cr. 3. F.S.

Physical, mental, emotional and social aspects of health as a basis for understanding and preventing health problems. False and misleading advertising and effects of cultists and faddists on consumer health. Study of legislation and agencies concerned with consumer protection and health insurance.

H S 215. Drug Education.

(3-0) Cr. 3. F.S. Prereq: PSYCH 101 or PSYCH 230

Discussion of use, abuse and addiction of mood modifying substances in contemporary society. Includes study of tobacco, alcohol, and other drugs.

H S 275. Health Education in the Elementary School.

(3-0) Cr. 3. F.S. Prereq: HD FS 102 or HD FS 226

The application of instructional strategies related to health education and physical education for teachers at the elementary level. Credit for both H S 275 and 375 may not be applied toward graduation.

H S 285. Pre-Internship in Kinesiology and Health.

(Cross-listed with KIN). Cr. 1-2. F.S.SS. Prereq: Kinesiology and Health major and permission of internship coordinator

Pre-internship experience with a health or fitness organization based on option. Offered on a satisfactory-fail basis only.

H S 305. Instructor's First Aid and Cardio-pulmonary Resuscitation.

(1-2) Cr. 2. F.S. Prereq: H S 105

Discussion and practice of skills needed to teach first aid and cardiopulmonary resuscitation. ARC certification available.

H S 310. Community and Public Health.

(3-0) Cr. 3. F.S. Prereq: H S 110

Introduction to community health problems, programs of prevention, environmental health agencies, and health services. Study of local, state, and national community health agencies, their purposes and functions.

H S 350. Human Diseases.

(3-0) Cr. 3. F.S.SS. Prereq: H S 110 and BIOL 255, BIOL 256

Discussion of disease process and ill-health in the twentieth century. Emphasis on epidemiology, prevention, treatment, and the understanding of the etiology of communicable and noncommunicable diseases.

H S 375. Teaching-Learning Process in Health Education.

(3-0) Cr. 3. F. Prereq: H S 105, H S 110, H S 215

Principles, methods, materials, and resources involved in the teaching of health. Includes organization and development of the health education curriculum (K-12). Credit for both H S 275 and 375 may not be applied toward graduation.

H S 380. Worksite Health Promotion.

(3-0) Cr. 3. F.S. Prereq: KIN 258, KIN 366

The design and implementation of worksite health promotion programs and the benefits these programs have for both employees and employers. Review of various health risk appraisals and planning theory-based incentive programs designed to promote positive lifestyles.

H S 385. Strategies for Professional School and Field Experience Opportunities.

(Cross-listed with KIN). Cr. R. F.S. Prereq: Junior classification; to be taken minimum of two semesters prior to graduation or field experience placement.

Search techniques and preparation of relevant material for work and/or professional school admission. Information specifically related to health care and kinesiology fields. Field experience process and procedures will be reviewed.

H S 390. Administration of the School Health Program.

(3-0) Cr. 3. F. Prereq: H S 310

History and legal basis of school health programs. Procedures for developing, organizing, administering, and evaluating a modern program of health services, healthful school living, and health instruction. Includes administration, community and school relationships.

H S 417. Supervised Teaching in Health Education in the Secondary School.

Cr. 12. F.S. Prereq: H S 375

Advance registration required.

H S 417A. Supervised Teaching in Health Education in the Secondary School: Initial Endorsement.

Cr. 14. F.S. Prereq: H S 375

Students must be fully admitted to Teacher Education and must apply for approval to enroll at the beginning of the semester prior to registering.

H S 417B. Supervised Teaching in Health Education in the Secondary School: Additional Endorsement.

Cr. arr. F.S. Prereq: H S 375

Students must be fully admitted to Teacher Education and must apply for approval to enroll at the beginning of the semester prior to registering.

H S 430. Community Health Program Development.

(3-0) Cr. 3. F. Prereq: H S 380

Techniques of needs assessment, program design, administration, and evaluation of community health education programs in various settings.

H S 464. Physical Activity Epidemiology.

(Dual-listed with H S 564). (3-0) Cr. 3. S. Prereq: KIN 358 or H S 350; STAT 101 or STAT 401

Understanding health benefits of physical activity on chronic disease prevention and health promotion throughout the life span, from clinical and public health perspectives. Discussion and application of real-life physical activity assessment, research, guidelines, and promotion in population levels.

H S 485. Directed Field Experience in Health Promotion.

Cr. 8-16. Prereq: All required health studies courses and permission of coordinator Advance registration required. Supervised experience in health promotion field. Offered on a satisfactory-fail basis only.

H S 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 6 credits. Prereq: 6 credits in health studies and permission of coordinator

Courses primarily for graduate students, open to qualified undergraduates:

H S 564. Physical Activity Epidemiology.

(Dual-listed with H S 464). (3-0) Cr. 3. S. Prereq: KIN 358 or H S 350; STAT 101 or STAT 401

Understanding health benefits of physical activity on chronic disease prevention and health promotion throughout the life span, from clinical and public health perspectives. Discussion and application of real-life physical activity assessment, research, guidelines, and promotion in population levels.

Higher Education (HG ED)

Courses primarily for graduate students, open to qualified undergraduates:

HG ED 504. Higher Education in the United States.

(3-0) Cr. 3. S. *Prereq: Graduate classification*

Historical development of higher education; diversity, functions, and philosophies of colleges and universities; federal and state roles; review of general, liberal, technical, graduate, and professional education.

HG ED 540. Foundations of Leadership: Learning, Ethics, Self and Interaction.

(2-0) Cr. 2. F. *Prereq: permission of instructor*

Serving as an introduction to developing practicing leaders, this course will create the foundation upon which enduring understanding of leadership will be built. Specifically explored will be learning as the foundation of human enterprise, everyday leadership, determination of common good, roots of individual's actions, sensitivity to others, merits of divergent ideas, questioning the status quo, ethics as personal responsibility and choosing to grow.

HG ED 541. Learning, Leadership, Ethics and Community.

(2-0) Cr. 2. S. *Prereq: permission of instructor*

Serving as the second semester in a program to develop practicing leaders, this course will build upon the foundation started first semester to help students embrace the enduring understandings of leadership. Specifically explored will be team learning and the effect on individuals, skills required for a team to move forward, importance of decisions based on the good of the community, reflection as a means of enhancing learning, and interconnectedness of the individual, the community, and the world.

HG ED 542. Learning, Leadership, Ethics, and Teams; Knowing, Doing and Being.

(2-0) Cr. 2. F. *Prereq: permission of instructor*

The overall purpose of this course is to expand the foundation started in Foundations of Leadership: Learning, Ethics, Self and Interactions and Learning, Leadership, Ethics and Community for developing practicing leadership. The focus will shift from a naive understanding of the concepts of self within a team and community to a more sophisticated understanding of knowing, being and doing leadership.

HG ED 543. Learning, Leadership, Ethics and Teams in Action.

(2-0) Cr. 2. S. *Prereq: permission of instructor*

The purpose of this last (in a series of four) course is to allow students to put their knowledge, skills, and abilities related to leadership, learning, Ethics and Teams into practice. In addition to planning and implementing a major service learning project, the focus will be on the next wave of the study of leadership - connecting leadership to the research about the brain and human learning.

HG ED 544. Foundations of Leadership & Learning.

(3-0) Cr. 3. F. *Prereq: graduate student classification*

First of two-course series to help leaders develop the knowledge and skills to engage the collective capacity of a group to think, learn, and achieve important purpose. The foundation for developing deep understanding about leadership, learning, and the relationships therein. Focus on application of recent knowledge about human learning in the professional practice of leadership. Relationship leadership model and relationship to other leadership models, theories, and concepts; current theories of human learning (including expert/novice and transfer of learning); and interrelationships with leadership practice; critical understanding of self; facilitating learning for others; metacognition as a habit of mind; fundamentals of group interaction theories; social interdependence, communication, trusting, trustworthy goals, decision-making, cohesion, controversy, team development; power, resources, and development of community.

HG ED 545. Connecting Leadership & Learning in Practice.

(3-0) Cr. 3. F. *Prereq: Graduate student classification and completion of HG Ed 544*

Second of a two-course series designed to help leaders develop the knowledge and skills to best engage the collective capacity of a group to think, learn and achieve important purpose. Builds on foundation course to support students in creating applications of the relationships between leadership and learning. Focus on developing the habits of mind and habits of practice to best use knowledge about human learning in the professional practice of leadership. Applications of relational leadership model; applications of group interaction theories; development and implementation of action plans to achieve measurable goals; application of current theories of human learning as they relate to leadership; exploration of the fundamentals of emotional intelligence and the impacts on leadership; developing critical habits of mind to practice leadership focused on learning.

HG ED 550. Teaching, Learning and Leadership.

(3-0) Cr. 3. F. *Prereq: Teacher licensure*

Current issues and practices in community college teaching and learning, and the roles and responsibilities of teachers as leaders.

HG ED 561. College Teaching.

(3-0) Cr. 3. *Prereq: 6 graduate credits*

Educational theories, methods and strategies for the improvement of college instruction. Assist potential college instructors in developing knowledge of protocol, assessment, and the scholarship and art of teaching. Emphasis on the unique challenge of college teaching in a changing student population environment.

HG ED 562. Curriculum Development in Colleges.

(3-0) Cr. 3. *Prereq: Graduate classification*

Modes of curriculum design, development, and change in colleges. Development of curricular leadership and evaluation strategies.

HG ED 568. Global Education Policy Analysis.

(3-0) Cr. 3. *Prereq: HG ED 504*

Assessment of global education policy issues in education. Analysis of policies, implementation strategies, and policy outcomes.

HG ED 570. Current Topics in Student Affairs.

Cr. 1-3. *Prereq: Graduate classification*

Current issues and new directions in student affairs practice. Topics developed to the specific needs of student affairs professionals. Primarily for off-campus.

HG ED 570D. Current Topics in Student Affairs: Residential Life.

Cr. 1-3. *Prereq: Graduate classification*

Current issues and new directions in student affairs practice. Topics developed to the specific needs of student affairs professionals. Primarily for off-campus.

HG ED 570G. Current Topics in Student Affairs: Student Affairs Institute.

Cr. 1-3. *Prereq: Graduate classification*

Current issues and new directions in student affairs practice. Topics developed to the specific needs of student affairs professionals. Primarily for off-campus.

HG ED 570H. Current Topics in Student Affairs: Student Diversity.

Cr. 1-3. *Prereq: Graduate classification*

Current issues and new directions in student affairs practice. Topics developed to the specific needs of student affairs professionals. Primarily for off-campus.

HG ED 573. Equity, Diversity, and Inclusion in Student Affairs.

(3-0) Cr. 3. F.S. *Prereq: Graduate Standing*

Explores theories of equity, diversity, and inclusion to build knowledge and skills related to multicultural competence in student affairs practice.

HG ED 574. Student Affairs Practice in Higher Education.

(3-0) Cr. 3. F. *Prereq: Graduate classification, admission to Higher Education Program*

An introduction to the field of student affairs practice with a consideration of student activities, counseling services, financial aid, admissions, student conduct, academic advising, and residential programs; includes community college programs.

HG ED 575. Organization and Administration of Student Affairs.

(3-0) Cr. 3. S. *Prereq: Admission to Higher Education Program, HG ED 574*

Organization structures, role and function of student affairs staff; policies and decision-making for student affairs practice.

HG ED 576. Student Development in Higher Education.

(3-0) Cr. 3. F. *Prereq: Admission to Higher Education Program*

Theories of student development and their applications in student affairs programs, services, and activities are reviewed. Emphasis is placed on psychosocial, cognitive developmental, and learning theories as well as newer integrative theories.

HG ED 577. Campus Environments and Cultures.

(3-0) Cr. 3. F. *Prereq: Admission to Higher Education Program*
Study of the impact of the college environment on students and use of environmental theory to create positive learning situations for students.

HG ED 578. Students in American Higher Education.

(3-0) Cr. 3. F. *Prereq: Admission to Higher Education Program*
The relationship between college students and characteristics from 1950 to the present. Traditional assumptions about the impact of higher education on students will be reviewed and challenged. Campus issues and concerns relative to commuters and residential life. Participants will analyze institutional responses to students through college missions, organizational development, structure, core curriculum and retention.

HG ED 579. Advising and Helping Skills.

(3-0) Cr. 3. F. *Prereq: HG ED 574, HG ED 576*
Development of effective, basic counseling skills. Understanding of group dynamics. Ability to work effectively in groups.

HG ED 580. Current Topics in Community Colleges.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 580A. Current Topics in Community Colleges: Student Needs.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 580B. Current Topics in Community Colleges: General and Liberal Education.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 580C. Current Topics in Community Colleges: Counseling and Advising.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 580D. Current Topics in Community Colleges: Adult and Continuing Education.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 580E. Current Topics in Community Colleges: Development and Remedial Education.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 580F. Current Topics in Community Colleges: Student Services.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 580G. Current Topics in Community Colleges: Faculty and Staff Evaluation.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 580H. Current Topics in Community Colleges: Organization and Administration.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 580I. Current Topics in Community Colleges: Learning and Teaching.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 580J. Current Topics in Community Colleges: Human Relations.

(1-3) Cr. 1-3. *Prereq: Graduate classification*
Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

HG ED 582. The Comprehensive Community College.

(3-0) Cr. 3. *Prereq: Graduate classification*
The community college as a unique social and educational institution: its history, philosophy, functions, programs, faculty and student characteristics, organization and finance, trends, and issues. Reviews current research and exemplary community college practices internationally, nationally, and in Iowa.

HG ED 590. Special Topics.

Cr. 1-4. *Prereq: 9 credits in education*
Independent study on specific topics arranged with an instructor.

HG ED 590A. Special Topics: Student Services.

Cr. 1-4. *Prereq: 9 credits in education*
Independent study on specific topics arranged with an instructor.

HG ED 590B. Special Topics: Community Colleges.

Cr. 1-4. *Prereq: 9 credits in education*
Independent study on specific topics arranged with an instructor.

HG ED 590C. Special Topics: Current Issues.

Cr. 1-4. *Prereq: 9 credits in education*
Independent study on specific topics arranged with an instructor.

HG ED 590D. Special Topics: International Higher Education.

Cr. 1-4. *Prereq: 9 credits in education*
Independent study on specific topics arranged with an instructor.

HG ED 590E. Special Topics: Federal and State Affairs.

Cr. 1-4. *Prereq: 9 credits in education*
Independent study on specific topics arranged with an instructor.

HG ED 590F. Special Topics: Law in Higher Education.

Cr. 1-4. *Prereq: 9 credits in education*
Independent study on specific topics arranged with an instructor.

HG ED 590G. Special Topics: Institutional Research.

Cr. 1-4. *Prereq: 9 credits in education*
Independent study on specific topics arranged with an instructor.

HG ED 591. Supervised Field Experience.

Cr. 1-4. Repeatable. *Prereq: 9 credits graduate work*
Supervised on-the-job field experience.

HG ED 593. Workshops.

Cr. 1-5. Repeatable. *Prereq: 15 credits in education*

HG ED 598. Capstone Seminar.

(3-0) Cr. 3. S. *Prereq: Completion of 30 credits in EL PS*
This course is designed to integrate the learning experiences of students completing the Master's Degree Program in higher education. Such issues as ethics, continuing professional development, career planning and leadership will be explored.

HG ED 599. Creative Component.

Cr. arr. *Prereq: 9 credits in education*

Courses for graduate students:**HG ED 615. Seminars in Higher Education.**

Cr. 1-4.

HG ED 615A. Seminars in Higher Education: Student Services.

Cr. 1-4.

HG ED 615B. Seminars in Higher Education: Community Colleges.

Cr. 1-4.

HG ED 615C. Seminars in Higher Education: Current Issues.

Cr. 1-4.

HG ED 615D. Seminars in Higher Education: International Higher Education.

Cr. 1-4.

HG ED 615E. Seminars in Higher Education: Federal and State Affairs.

Cr. 1-4.

HG ED 615F. Seminars in Higher Education: Law in Higher Education.

Cr. 1-4.

HG ED 615G. Seminars in Higher Education: Institutional Research.

Cr. 1-4.

HG ED 615H. Seminars in Higher Education: Research Designs in Higher Education.

Cr. 1-4.

HG ED 664. College Organization and Administration.

(3-0) Cr. 3. F. *Prereq: HG ED 504*
Administrative organization and behavior: communications, leadership, finance, strategic planning, and institutional governance.

HG ED 665. Financing Higher Education.

(3-0) Cr. 3. S. *Prereq: HG ED 504*

Lectures, discussions, and individual investigation relating to financial administration in colleges and universities. Budgeting, auxiliary enterprises, administration of financial planning, fund raising, examination of theories on expenditures. Designed for persons aspiring to serve as college administrators.

HG ED 666. Academic Issues and Cultures.

(3-0) Cr. 3. S. *Prereq: HG ED 504*

Examination of institutional culture and issues in higher education focusing on the roles and responsibilities of faculty and academic administrators.

HG ED 676. Student Development Theory II.

(3-0) Cr. 3. S. *Prereq: HG ED 576*

An examination of social identity theories including those exploring race, ethnicity, gender, class, ability, sexuality, and spirituality. An exploration of how social identity is influenced by the dynamics of power and oppression in education and society and how to enhance the college experiences of students from diverse backgrounds.

HG ED 690. Advanced Special Topics.

Cr. 1-4. Repeatable. *Prereq: 9 credits in education*

HG ED 699. Research.

Cr. arr. Repeatable. *Prereq: 9 credits in education*

Historical, Philosophical, and Comparative Studies in Education (H P C)

Courses primarily for graduate students, open to qualified undergraduates:

H P C 504. Studies in the Foundations of Education in the United States.

(3-0) Cr. 3. SS. *Prereq: Admission to graduate licensure program in teacher education or permission of instructor*

Introduction to the historical and contemporary landscape of schooling in the United States. Emphasis is placed on topics and tensions in the relationship between school and society (e.g. equity of access to education and competing purposes of education) and the implications of these topics and tensions for teaching and learning in public schools. Designed for students in a graduate licensure program.

H P C 581. Philosophy of Education.

(Dual-listed with C I 481). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Introduction to Western philosophy of education. Emphasis is placed on enduring debates about the purposes(s) of education in a just society. Readings include classic and contemporary texts.

H P C 582. History of Education in the United States.

(3-0) Cr. 3. *Prereq: Graduate classification*

Survey course in the history of education in the United States, from the colonial era to the present. Emphasis is placed on enduring debates about the purpose(s) of public schooling. Readings include primary and secondary materials.

H P C 590. Special Topics.

Cr. 1-5. F.S. *Prereq: 9 graduate credits in education*

H P C 590A. Special Topics: History of Education.

Cr. 1-5. F.S. *Prereq: 9 graduate credits in education*

H P C 590B. Special Topics: Philosophy of Education.

Cr. 1-5. F.S. *Prereq: 9 graduate credits in education*

H P C 590C. Special Topics: Comparative Education.

Cr. 1-5. F.S. *Prereq: 9 graduate credits in education*

H P C 599. Creative Component.

Cr. 1-3. F.S.

Courses for graduate students:

H P C 615. Seminar.

Cr. 1-3. Repeatable, maximum of 3 credits.

H P C 615A, Seminar in History of Education.

H P C 615A. Seminar: History of Education.

Cr. 1. Repeatable.

Seminar in History of Education.

H P C 615B. Seminar: Philosophy of Education.

(1-3) Cr. 1-3. Repeatable.

H P C 615C. Seminar: Comparative Education.

(1-3) Cr. 1-3. Repeatable.

H P C 690. Advanced Special Topics.

Cr. 1-3. Repeatable. F.S.

Advanced special topics.

H P C 699. Research.

Cr. arr. Repeatable.

History (HIST)

Courses primarily for undergraduates:

HIST 195. Introduction to History.

(1-0) Cr. 1. *Prereq: classification as history major*

Introduction to the discipline of history and how historians think and work. Focus on research methodologies, writing and analytical practices of historians, and specialization in the discipline.

HIST 201. Introduction to Western Civilization I.

(3-0) Cr. 3. F.

Western civilization from ancient Mediterranean world to 1500. Social and cultural developments; economic and political ideas and institutions; problems of historical change and continuity.

Meets International Perspectives Requirement.

HIST 202. Introduction to Western Civilization II.

(3-0) Cr. 3. S.

Western civilization from 1500 to present. Social and cultural developments; economic and political ideas and institutions; problems of historical change and continuity.

Meets International Perspectives Requirement.

HIST 207. Chinese Civilization.

(3-0) Cr. 3.

Origins, development, decline and transformation of China from earliest times to present.

Meets International Perspectives Requirement.

HIST 221. Survey of United States History I.

(3-0) Cr. 3-5. F.

Colonial foundations: revolution, confederation, and constitution; nationalism and democracy; sectional disunity, Civil War, and reunion.

HIST 222. Survey of United States History II.

(3-0) Cr. 3. S.

Industrialization; emergence as a great power; boom and depression; war, internationalism and Cold War; modern industrial society.

HIST 240. Latina/o History.

(3-0) Cr. 3.

Historical and cultural heritage of Latinas/os in the United States. The histories of Mexican, Puerto Rican, Cuban, and other Latin American peoples in the U.S. emphasizing political and cultural convergence and congruencies.

Meets U.S. Diversity Requirement

HIST 280. Introduction to History of Science I.

(3-0) Cr. 3.

Ideas of nature from ancient Greece to the seventeenth-century scientific revolution.

Meets International Perspectives Requirement.

HIST 281. Introduction to History of Science II.

(3-0) Cr. 3.

Science from seventeenth-century scientific revolution to Darwin and Einstein.

Meets International Perspectives Requirement.

HIST 284. Wonders of the World, Ancient to Early Modern.

(3-0) Cr. 3. F.

Starting from the classical "Seven Wonders of the World," examines machines, structures, buildings, innovations, and technologies from Sumer, Egypt, Greece, and Rome, through China, Latin America, and the Islamic world, up to Europe's Industrial Revolution. Topics include developments in warfare and weaponry, architecture, agriculture, printing, religious ceremony, entertainment, and major engineering achievements.

Meets International Perspectives Requirement.

HIST 285. Modern Wonders of the World.

(3-0) Cr. 3. S.

Examines machines, structures, buildings, innovations, and technologies from the Industrial Revolution to the twenty-first century, including the US, Europe, Asia, and Middle East. Topics include developments in manufacturing, communication, electrification, automobiles, airplanes, warfare, computers, the atom bomb, and major engineering achievements.

HIST 304. Cultural Heritage of the Ancient World.

(Cross-listed with CL ST). (3-0) Cr. 3. *Prereq: Sophomore classification*

Historical examination of art, literature, thought, and religious beliefs of major civilizations of the ancient Mediterranean countries until the end of the 8th century.

HIST 307. American Popular Culture.

(3-0) Cr. 3. *Prereq: Sophomore classification*

Social practices, beliefs and material traits of everyday life in America from the mid-19th century to the present. Includes literature, music, theater and other entertainments. Dime novels, vaudeville, rock and roll music, Hollywood and establishment of professional athletic leagues are among the cultural artifacts and phenomena considered.

HIST 316. History of Medieval Europe, 300-1500.

(3-0) Cr. 3. *Prereq: Sophomore classification*

Survey of political, social, and cultural developments in western Europe for the entire medieval period, 300-1500.

HIST 318. History of Early Modern Europe, 1450-1789.

(3-0) Cr. 3. *Prereq: Sophomore classification*

Survey of major themes in the social, political, cultural, and religious history of early modern Europe, including the eras of renaissance and reformation, the age of exploration, development of the modern individual and household, and enlightenment.

HIST 321. History of the Mediterranean World.

(3-0) Cr. 3. *Prereq: Sophomore classification*

Southern Europe and North Africa, Classical Greece to the seventeenth century: political, social and cultural developments, including economic growth, trade, and interaction of cultures, with focus on the rise and decline of early modern Mediterranean states.

HIST 323. Science and Religion.

(Cross-listed with RELIG). (3-0) Cr. 3. *Prereq: Sophomore classification*

History of changing interplay of science and religion in our understanding nature, from the trial of Galileo to the reception of Darwin.

Meets International Perspectives Requirement.

HIST 325. Society and Politics in England, 1525-1700.

(3-0) Cr. 3. *Prereq: Sophomore classification*

Social, cultural, demographic, and economic experiences. Religious Reformation. Growth of the State (and Empire) and political institutions.

HIST 336. History of Modern China I.

(3-0) Cr. 3. *Prereq: Sophomore classification*

China from 1644 to 1912; internal and external stimuli on traditional structure leading to reform and revolution.

Meets International Perspectives Requirement.

HIST 337. History of Modern China II.

(3-0) Cr. 3. *Prereq: Sophomore classification*

China from 1912 to present; search for a new order and continuing Chinese revolution.

Meets International Perspectives Requirement.

HIST 338. Modern Japanese History.

(3-0) Cr. 3. *Prereq: Sophomore classification*

Japan 1600 to the present; emphasis on transformation of feudal Japan into a post-industrial society.

Meets International Perspectives Requirement.

HIST 339. US-Asian Relations.

(3-0) Cr. 3. *Prereq: Sophomore classification*

A survey of US-East Asian (Japan, China, Korea) relations from the late 18th century to the end of the Cold War.

Meets International Perspectives Requirement.

HIST 340. History of Latin America I.

(3-0) Cr. 3. *Prereq: Sophomore classification*

Colonial Latin America from European discovery and colonization to wars for independence.

HIST 341. History of Latin America II.

(3-0) Cr. 3. *Prereq: Sophomore classification*

Modern Latin America national origins from 1800 to present.

Meets International Perspectives Requirement.

HIST 353. History of African Americans I.

(Cross-listed with AF AM). (3-0) Cr. 3. *Prereq: Sophomore classification*

Examines African roots of black culture and the African American experience in the United States from the colonial period through the Civil War. Topics include Atlantic Slave Trade, slavery and American identity, abolition, the emergence of Black Nationalism, and black participation in the Civil War.

Meets U.S. Diversity Requirement

HIST 354. History of African Americans II.

(Cross-listed with AF AM). (3-0) Cr. 3. *Prereq: Sophomore classification*
Explores African American political thought and political action from Reconstruction to the present. Topics include rise of Jim Crow segregation, urban migration, Garvey movement, Harlem Renaissance, Depression and world wars, Pan-Africanism, civil rights, Black Power, and black feminism.
Meets U.S. Diversity Requirement

HIST 355. Early American Republic.

(3-0) Cr. 3. *Prereq: Sophomore classification*
Examination of the United States from the Constitutional Convention up to the Mexican War. Topics include the Washington, Jefferson, and Jackson administrations, the War of 1812, slavery and the South, economic and social development, Westward expansion and reform.

HIST 356. U.S. Civil War and Reconstruction Era.

(3-0) Cr. 3. *Prereq: Sophomore classification*
Examination of the social and economic contradictions that led to Civil War and the reconstruction of American freedom and democracy. Topics include the Mexican War, sectional conflict and the crisis of disunion, economic, political and social aspects of civil war, emancipation, and reconstruction.

HIST 360. U.S. 1900 to 1945.

(3-0) Cr. 3. *Prereq: Sophomore classification*
America in transition and crisis: Progressivism, World War I, the twenties, the Great Depression, and World War II.

HIST 361. U.S. 1945 to the Present.

(3-0) Cr. 3. *Prereq: Sophomore classification*
Modern American history with an emphasis on political, socio-cultural, ethno-racial, and military history. Topics include the Cold War, the wars in Korea and Vietnam, civil rights and Black/ethnic Power, modern feminism, and the conservative movement.

HIST 365. History of American Agriculture I.

(3-0) Cr. 3. *Prereq: Sophomore classification*
North American agricultural development to 1865. American Indian agricultural systems, European background and agricultural revolution, agriculture in the colonial era, early republic and antebellum period.

HIST 366. History of American Agriculture II.

(3-0) Cr. 3. *Prereq: Sophomore classification*
American agricultural development since 1865. Post-Civil War adjustments; westward expansion; economic boom and bust; mechanization; Dust Bowl and environmental challenges; Great Depression and New Deal; changing rural life; scientific and technological advances; farm crisis and late twentieth century challenges.

HIST 367. Topics in American Agriculture.

(3-0) Cr. 3. *Prereq: Sophomore classification*
Thematic approach to the development of the American agricultural system. Topics vary; examples include food and agriculture, animals in agriculture, and systems of production.

HIST 370. History of Iowa.

(3-0) Cr. 3. *Prereq: Sophomore classification*
Survey of major social, cultural and economic developments in Iowa from the late 1700s. Emphasis on minority groups, pioneer life, early economic development, industrial development, educational and religious development, and outstanding personalities.

HIST 374. Sex, Gender, and Culture in the Ancient Mediterranean World.

(Cross-listed with CL ST, W S). (3-0) Cr. 3. S. *Prereq: Any one course in Cl St, W S, Latin, or Greek*
Chronological and topical survey of the status of women and men, focusing on sex and gender issues in the Ancient Mediterranean world; study of constructs of the female and the feminine. Readings from ancient and modern sources. Emphasis on ancient Greece, Rome, and Egypt.
Meets International Perspectives Requirement.

HIST 380. History of Women in Science, Technology, and Medicine.

(Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification*
History of women's relationship to the fields of science, technology, and medicine, as students and professionals, consumers, subjects and patients, family members, workers and citizens. Concentrates especially on 19th and 20th century United States, concluding with an examination of current issues of special interest to women in science, technology, and medicine.
Meets U.S. Diversity Requirement

HIST 383. Technology, Public Science, and European Culture, 1715-Present.

(3-0) Cr. 3. *Prereq: Sophomore classification*
A survey from the Age of Enlightenment to the end of the twentieth century of the relationship between science, technology, and public or popular culture in a comparative European context (including Russia and the former Soviet Union).
Meets International Perspectives Requirement.

HIST 386. History of Women in America.

(Cross-listed with W S). (3-0) Cr. 3. *Prereq: Sophomore classification*
A survey of social, economic, and political aspects of women's role from colonial era to present; emphasis on employment, education, concepts of sexuality, and changing nature of the home.
Meets U.S. Diversity Requirement

HIST 388. History of Modern Astronomy.

(3-0) Cr. 3. *Prereq: Sophomore classification*
Changing conception of the universe from Galileo to Edwin Hubble and beyond.

HIST 389. American Military History.

(3-0) Cr. 3. *Prereq: Sophomore classification*
American military history from the colonial wars to the present, including Revolutionary War, Mexican War, Civil War, First and Second World Wars, Korean War, Vietnam War, and Gulf Wars.
Meets International Perspectives Requirement.

HIST 390. World Military History.

(3-0) Cr. 3. *Prereq: Sophomore classification*
Covers military history from the Napoleonic era through the mid- and late-19th century wars, the First and Second World Wars, and wars of national liberation and regional conflicts since 1945.
Meets International Perspectives Requirement.

HIST 391. American Diplomatic History.

(3-0) Cr. 3. *Prereq: Sophomore classification*
A study of US foreign relations during the twentieth century, including the rise to global power, the First World War, diplomacy during prosperity and depression, the Second World War, the Cold War, relations with Latin America, East and South Asia, and Africa, the search for markets, and the perceptions of American foreign policy held by the US, its allies and adversaries, and others.

HIST 396. Topics in History.

(3-0) Cr. 3. *Prereq: Sophomore classification or permission of instructor*
Specialized topics in history; topics vary each time offered.

HIST 396A. Topics in History: Europe.

(3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: Sophomore classification or permission of instructor*
Specialized topics in history; topics vary each time offered.

HIST 396B. Topics in History: U.S. and North America.

(3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: Sophomore classification or permission of instructor*
Specialized topics in history; topics vary each time offered.

HIST 396C. Topics in History: Global.

(3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: Sophomore classification or permission of instructor*
Specialized topics in history; topics vary each time offered.

HIST 402. Greek Civilization.

(Cross-listed with CL ST). (3-0) Cr. 3. *Prereq: Sophomore classification*
Ancient Greece from the Bronze Age to the Hellenistic period; evolution of the Greek polis and its cultural contributions, with a particular emphasis on the writings of Herodotus and Thucydides.

HIST 403. Roman Civilization.

(Cross-listed with CL ST). (3-0) Cr. 3. *Prereq: Sophomore classification*
Ancient Rome from the Regal Period to the fall of the Western Empire; evolution of Roman institutions and Rome's cultural contributions studied through original sources.

HIST 405. History of the Early Middle Ages.

(3-0) Cr. 3. *Prereq: Sophomore classification*
General coverage of political, economic, social, and cultural developments in early medieval Europe, 300-1000; in depth coverage of particular issues and topics.

HIST 406. History of the High Middle Ages.

(3-0) Cr. 3. *Prereq: Sophomore classification*
General coverage of political, economic, social, and cultural developments in high medieval Europe, 1000-1300; in-depth coverage of particular issues and topics.

HIST 407. History of the Late Middle Ages.(3-0) Cr. 3. *Prereq: Sophomore classification.*

General coverage of political, social, and cultural developments of high medieval Europe, 1300-1500; in-depth coverage of particular issues and topics including the medieval origins of Renaissance and Reformation.

HIST 408. Europe, 1500-1648.(3-0) Cr. 3. *Prereq: Sophomore classification*

Renaissance; Protestantism and the Age of Catholic reform; social, cultural, and economic changes; global expansion; religious warfare.

HIST 414. European Cultural and Intellectual History.(3-0) Cr. 3. *Prereq: Sophomore classification*

A study of the development of key themes in European thought: nature, man, God, society, history, and creativity from Rousseau to Post-Modernism.

HIST 420. France's Revolutionary Century, 1715-1815.(3-0) Cr. 3. *Prereq: Sophomore classification*

An in-depth investigation of the French Revolution, its causes and consequences, beginning in the Ancien Regime and ending with the fall of Napoleon.

HIST 421. History of Russia I.(3-0) Cr. 3. *Prereq: Sophomore classification*

Russia to 1850. Origins of Russian people; Byzantine influences; Mongol invasion; rise of Moscow; Westernization.

Meets International Perspectives Requirement.

HIST 422. History of Russia II.(3-0) Cr. 3. *Prereq: Sophomore classification*

Russia since 1850. Reform and revolution; transformation of society; USSR as a world power; recent changes.

Meets International Perspectives Requirement.

HIST 424. History of Modern Germany.(3-0) Cr. 3. *Prereq: Sophomore classification.*

Political, social, and cultural history of Germany from the 19th century to the present.

HIST 427. Crime and Policing in England 1550-1850.(3-0) Cr. 3. *Prereq: Sophomore classification*

Course examines different forms and ideas of criminality and the nature and development of law enforcement in England between 1550 and 1856. Significant issues will include the nature of criminal records and statistics, the legal system, the politics of the law and its links with social relations, policing, female crime, juvenile delinquency, organized crime, riots, "social crime," and the treatment of crime in creative literary texts.

HIST 428. Punishment, Mentalities, and Society in England, 1550-1868.(3-0) Cr. 3. *Prereq: Sophomore classification*

Explores the history of punishing criminals in England and shows how interdisciplinary perspectives, ideas, and practices of punishment are related to mentalities, and socio-economic change. Issues of significance examined: violence, civility, manners, madness, public punishment, execution, imprisonment, transportation, mercy, the rise of asylums, and penal reform.

HIST 429. "Monstrous London": London's Histories 1500-1800.(3-1) Cr. 3-4. *Prereq: Sophomore classification*

Study of London's social, economic, cultural, political, and environmental history 1500-1800, using both quantitative and qualitative methods to examine contemporary and secondary sources. Course combines standard lecture and discussion format with one week of intensive study abroad for 4th hour of course credit.

HIST 431. Modern England.(3-0) Cr. 3. *Prereq: Sophomore classification*

England since 1850. Parliamentary and constitutional development; social reform and economic change; imperial Britain; welfare state.

HIST 441. History of Modern Mexico and Central America.(3-0) Cr. 3. *Prereq: Sophomore classification.*

Political, economic, and social development of Mexico and Central America in nineteenth and twentieth centuries.

HIST 442. Rebellions and Revolutions in Latin America.(3-0) Cr. 3. *Prereq: Sophomore classification.*

Survey of rebellions, revolutionary movements, and social revolutions in the twentieth century, including Guatemalan, Cuban, Mexican, Chilean, and Nicaraguan cases.

Meets International Perspectives Requirement.

HIST 450. Colonial America.(3-0) Cr. 3. *Prereq: Sophomore classification*

Exploration, colonization, and development of political, economic, religious, and cultural institutions of North American colonies before 1754. Topics also include social history, emergence of African-American slavery, relations with American Indians.

HIST 451. American Revolutionary Era.(3-0) Cr. 3. *Prereq: Sophomore classification*

Participants, ideas, and events leading to independence and the foundation of the United States, 1754 to 1789. Topics include political, military, social, cultural history, also issues of gender and race relations.

HIST 453. Creation of American Law.(3-0) Cr. 3. *Prereq: Sophomore classification.*

Examines major topics in American legal history during the first century of American self-government. Focuses on the historical development of a specifically American corpus of law. Explores the ways in which jurists struggled to reconcile the essential consistency of the law with the rapidly changing demands of a modern commercial and increasingly democratic society.

HIST 456. American Family History.(3-0) Cr. 3. *Prereq: Sophomore classification*

The impact on American families from colonial times onward of agricultural change, industrialization, urbanization, and wars and depressions.

HIST 460. The Great Plains.(3-0) Cr. 3. *Prereq: Sophomore Classification*

History of the Great Plains from prehistoric period. Emphasis on agricultural and rural development, Native Americans, cattle ranching, land policy, agrarian reform movements and federal policy.

HIST 461. The Rural South.(3-0) Cr. 3. *Prereq: Sophomore classification*

History of the American South from colonial period to present. Emphasis on economic, social, and political change in this rural region.

HIST 465. The American West.(3-0) Cr. 3. *Prereq: Sophomore classification*

History of trans-Mississippi West from 1800 to present, concentrating on settlement and regional identity. Emphasis on the state, the environment, urbanization, agriculture, Native Americans, and minority communities.

HIST 468. History of Rural America.(3-0) Cr. 3. *Prereq: Sophomore classification*

History of rural America from the colonial period to the present. Emphasizes immigration, ethnicity, religion, social and cultural change, and agriculture in relation to rural settlement, institution building, demographic change, gender, class, and political and economic development.

HIST 472. U. S. Environmental History.(Cross-listed with ENV S). (3-0) Cr. 3. *Prereq: Sophomore classification*

Survey of the interactions of human communities with the North American environment. Focus on the period from presettlement to the present, with a particular concentration on natural resources, disease, settlement patterns, land use, and conservation policies.

HIST 473. Civil Rights and Ethnic Power.(Cross-listed with AF AM, US LS). (3-0) Cr. 3. *Prereq: Sophomore classification*

Comparative history of the civil rights and ethnic power movements (African American, Chicano, American Indian, Puerto Rican, among others) in the U.S. from World War II to the present. Topics include institutional foundations, leadership, gender and racial dynamics, and the convergences and divergences of these differing ethnic struggles for rights.

Meets U.S. Diversity Requirement

HIST 474. Tradition and Transformation of China's Foreign Affairs.(3-0) Cr. 3. *Prereq: Sophomore classification*

Evolution of China's external relations from the antiquities to our own times; conceptions, practices, and relationships that characterized the inter-state relations of the so-called "Chinese world order," interactions between "Eastern" and "Western," and "revolutionary" and "conventional" modes of international behaviors.

HIST 479. China and the Cold War.(3-0) Cr. 3. *Prereq: Sophomore classification*

Important events in China's Cold War involvement, connections between domestic and foreign affairs, factors and rationales in China's foreign policy making the relationship between China's Cold War experience and recent developments.

HIST 480. Field Experience for Secondary Teaching Preparation.

Cr. 0.5-2. Repeatable, maximum of 2 times. F.S. *Prereq: Permission of area coordinator required prior to enrollment*
 Observation and participation in a variety of school settings after admission to the teacher preparation program. (S/F grading may be used in some offerings of some sections.).

HIST 480A. Pre-Student Teaching Experience III: History/Social Sciences.

(Cross-listed with C I). Cr. 2. Repeatable, maximum of 2 times. F. *Prereq: Admission to Teacher Education*
 Supervised participation in a 5-12 school setting. Permission of History/Social Sciences coordinator required prior to enrollment. 1/2 day of time needed. Clinical Supervision Level 3.

HIST 482. Birth, Death, Medicine, and Disease.

(3-0) Cr. 3. *Prereq: Sophomore classification*
 History of medicine, sickness, and public health from ancient times to the twenty-first century in the US, Europe, and around the world. Topics include changing ideas of health and illness, development of doctors and hospitals, social and ethical issues in health care, and epidemics from cholera to AIDS.

HIST 488. American Stuff, Colonial Times to the Present.

(3-0) Cr. 3. *Prereq: Sophomore classification*
 Examines inventions, machines, innovations, artifacts, and material culture in the US, from homespun cloth and the Colt revolver through the transcontinental railroad and Model T, to the Big Mac and iPod.

HIST 490. Independent Study.

(3-0) Cr. 1-3. Repeatable, maximum of 6 credits. *Prereq: 9 credits in history; permission of department chair*
 Reading and reports on problems selected in conference with each student. No more than 6 credits of Hist 490 may be counted toward graduation with a major in History. No credits of Hist 490 may count toward a minor in History.

HIST 495. Historiography and Research Writing.

(3-0) Cr. 3. F.S. *Prereq: Senior history majors with at least 12 credits of 300+ level history courses*
 Variable topics seminar that focuses on historiographical and research skills and writing. Required of majors.

HIST 496. Advanced Topics in History.

(3-0) Cr. 3. *Prereq: Sophomore classification or permission of instructor.*
 Specialized topics in history, topics vary each time offered.

HIST 496A. Advanced Topics in History: Europe.

(3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: Sophomore classification or permission of instructor.*
 Specialized topics in history, topics vary each time offered.

HIST 496B. Advanced Topics in History: U.S. and North America.

(3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: Sophomore classification or permission of instructor.*
 Specialized topics in history, topics vary each time offered.

HIST 496C. Advanced Topics in History: Global.

(3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: Sophomore classification or permission of instructor.*
 Specialized topics in history, topics vary each time offered.

HIST 498. Methods of Teaching History/Social Sciences.

(Cross-listed with C I). (3-0) Cr. 3. F.S. *Prereq: Concurrent enrollment in HIST 480A; Admission to teacher education and 30 credits in subject-matter field*
 Concurrent enrollment in 480A; Admission to teacher education and 30 credits in subject-matter field. Theories and processes of teaching and learning secondary history/social sciences. Emphasis on development and enactment of current methods, assessments, and curriculum materials for providing appropriate learning experiences.

Courses primarily for graduate students, open to qualified undergraduates:**HIST 510. Proseminar in East Asian History.**

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in East Asian history. Topics vary each time offered.

HIST 511. Proseminar in American History.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in American history. Topics vary each time offered.

HIST 511A. Proseminar in American History: Colonial Period.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in American history. Topics vary each time offered.

HIST 511B. Proseminar in American History: Nineteenth Century.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in American history. Topics vary each time offered.

HIST 511C. Proseminar in American History: Twentieth Century.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in American history. Topics vary each time offered.

HIST 511D. Proseminar in American History: Environment.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in American history. Topics vary each time offered.

HIST 511E. Proseminar in American History: Social and Cultural.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in American history. Topics vary each time offered.

HIST 512. Proseminar in European History.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in European history.

HIST 512A. Proseminar in European History, Ancient.

(Cross-listed with CL ST). (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in European history.

HIST 512B. Proseminar in European History: Medieval and Early Modern.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in European history.

HIST 512C. Proseminar in European History: Modern.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in European history.

HIST 513. Proseminar in Latin American History.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
 Readings in Latin American history. Topics vary each time offered.

HIST 530. Proseminar in Modern Russian/Soviet History.

(3-0) Cr. 3. Repeatable. *Prereq: HIST 422*
 Readings in modern Russian history. Topics vary each time offered.

HIST 550. Proseminar in European Rural and Agricultural History.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

HIST 550B. Proseminar in European Rural and Agricultural History: Twentieth Century Europe.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

HIST 552. Proseminar in American Rural and Agricultural History.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

HIST 552A. Proseminar in American Rural and Agricultural History: American Agriculture.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

HIST 552B. Proseminar in American Rural and Agricultural History: Agrarian Reform Movements.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

HIST 552C. Proseminar in American Rural and Agricultural History: Midwestern Rural Society.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

HIST 552D. Proseminar in American Rural and Agricultural History: Women in Rural Life.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*

HIST 575. Seminar in General History of Technology.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: Permission of instructor*
 The history of technology with emphasis on the historical literature, differing interpretations of major problems, and problems identified for college-level teaching and for further scholarly research.

HIST 583. Historical Methods.

(3-0) Cr. 3.
 Study of evidence, theory, and methods.

HIST 583A. Historical Narrative.

(3-0) Cr. 3. *Prereq: Permission of instructor.*
 Study of evidence, theory, and methods.

HIST 583B. Historical Methods: Statistical Evidence and Analysis.

(3-0) Cr. 3. *Prereq: Permission of instructor.*
 Study of evidence, theory, and methods.

HIST 583C. Issues in Historiography.

(3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: Permission of instructor.*
 Study of evidence, theory, and methods.

HIST 586. Proseminar in Women's History and Feminist Theory.

(Cross-listed with W S). (3-0) Cr. 3. *Prereq: Permission of instructor*
Feminism as a movement and feminist theory from the early modern period to the present as it relates to the writing of women's history. Analysis of interpretations of European and U.S. women's history from patriarchal and postmodernist perspectives.

HIST 590. Special Topics.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*

HIST 593. Seminar in American History.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
Topics vary each time offered.

HIST 593A. Seminar in American History: Colonial Period.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
Topics vary each time offered.

HIST 593B. Seminar in American History: Nineteenth Century.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
Topics vary each time offered.

HIST 593C. Seminar in American History: Twentieth Century.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
Topics vary each time offered.

HIST 593D. Seminar in American History: Environmental.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
Topics vary each time offered.

HIST 594. Seminar in European History.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
Topics vary each time offered.

HIST 594A. Seminar in European History: Ancient.

(Cross-listed with CL ST). (3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
Topics vary each time offered.

HIST 594B. Seminar in European History: Medieval and Early Modern.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
Topics vary each time offered.

HIST 594C. Seminar in European History: Modern.

(3-0) Cr. 3. Repeatable. *Prereq: Permission of instructor*
Topics vary each time offered.

Courses for graduate students:**HIST 610. Seminar on American Rural Life.**

(3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: Permission of instructor*
Emphasis varies each time offered.

HIST 699. Research.

Cr. 1-6. Repeatable.
Graduate student thesis research.

Honors (HON)

Courses primarily for undergraduates:

HON 121. First-Year Honors Seminar.

(0-2) Cr. 1. F. *Prereq: Membership in the First-Year Honors Program*
Orientation to Iowa State University and to the University Honors Program.
Offered on a satisfactory-fail basis only.

HON 290. Special Problems.

Cr. arr. *Prereq: Membership in and permission of the University Honors Program*
Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores. Offered on a satisfactory-fail basis only.

HON 290H. Honors.

Cr. 1-2. F.S. *Prereq: Membership in and permission of the University Honors Program*
Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores. Offered on a satisfactory-fail basis only.

HON 290U. Undergraduate Research.

Cr. arr. F.S. *Prereq: Membership in and permission of the University Honors Program*
Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores. Offered on a satisfactory-fail basis only.

HON 302. Honors Leadership Seminar.

(1-2) Cr. 2. F. *Prereq: Selection as a leader of a First-Year Honors Seminar*
For students serving as leaders of First-Year Honors Seminars, under faculty supervision. Development of teaching and leadership skills within the context of an Honors education experience. Offered on a satisfactory-fail basis only.

HON 321. University Honors Seminars.

Cr. 1-2. F.S. *Prereq: Membership in the University Honors Program*
Interdisciplinary seminars on topics to be announced in advance. Offered on a satisfactory-fail basis only.

HON 322. University Honors Seminars.

Cr. 1-2. F.S. *Prereq: Membership in the University Honors Program*
Interdisciplinary seminars on topics to be announced in advance. Offered on a satisfactory-fail basis only.

HON 323. University Honors Seminars.

Cr. 1-2. F.S. *Prereq: Membership in the University Honors Program*
Interdisciplinary seminars on topics to be announced in advance. Offered on a satisfactory-fail basis only.

HON 324. University Honors Seminars.

Cr. 1-2. F.S. *Prereq: Membership in the University Honors Program*
Interdisciplinary seminars on topics to be announced in advance. Offered on a satisfactory-fail basis only.

HON 490. Independent Study.

Cr. arr. Repeatable. F.S. *Prereq: Membership in and permission of the University Honors Program*
Independent study on topics of an interdisciplinary nature. Intended primarily for juniors and seniors.

Horticulture (HORT)

Courses primarily for undergraduates:

HORT 110. Professional and Educational Development in Horticulture..

(1-0) Cr. 1. F.

Intended for first-year students and others new to the horticulture curriculum. Introduction to professional and educational development within horticulture. Focus is on university and career acclimation.

HORT 112. Orientation to Learning and Productive Team Membership.

(Cross-listed with AER E, CON E, FS HN, NREM). (2-0) Cr. 2. F.

Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

HORT 114. Developing Responsible Learners and Effective Leaders.

(Cross-listed with CON E, FS HN, NREM). (2-0) Cr. 2. S. *Prereq: Hort 112 or NREM 112*

Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

HORT 121. Home Horticulture.

(2-0) Cr. 2. F.S.

Growing plants in and around the home including requirements for growing house plants; plant propagation; designing and maintaining flower, fruit, and vegetable gardens; lawn, tree, and shrub maintenance.

HORT 122. Hands-On Home Horticulture.

(1-0) Cr. 1. F.S.

Demonstration and activities that illustrate principles of growing plants for the home garden. Topics include plant identification, propagation, selection, and management for indoor and outdoor gardens.

HORT 131. Floral Design.

(0-2) Cr. 1. S.

Introduces basic geometric design of fresh arrangements, corsages, and holiday arrangements. Includes use of tools and supplies.

HORT 193. Topics in Horticulture.

Cr. arr. Repeatable. F.S.SS.

Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193A. Topics in Horticulture: Greenhouse Crops.

Cr. arr. Repeatable. F.S.SS.

Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193B. Topics in Horticulture: Nursery Crops.

Cr. arr. Repeatable. F.S.SS.

Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193C. Topics in Horticulture: Turfgrass.

Cr. arr. Repeatable. F.S.SS.

Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193D. Topics in Horticulture: Fruit Crops.

Cr. arr. Repeatable. F.S.SS.

Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193E. Topics in Horticulture: Vegetable Crops.

Cr. arr. Repeatable. F.S.SS.

Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193F. Topics in Horticulture: Cross-Commodity.

Cr. arr. Repeatable. F.S.SS.

Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193G. Topics in Horticulture: Landscape Horticulture.

Cr. arr. Repeatable. F.S.SS.

Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 221. Principles of Horticulture Science.

(2-2) Cr. 3. F.S. *Prereq: Biol 211 or concurrent enrollment*

Biological principles of growing horticultural crops including anatomy, reproduction, light, temperature, water, nutrition, and growth and development. Laboratory exercises emphasize environmental factors and permit detailed observation of plant growth.

HORT 225. Spanish for Horticulture.

(3-0) Cr. 3. S.

Introduction to basic conversation and communication skills in Spanish, and cross-cultural skills for working with Spanish speakers in the Horticulture industry, emphasizing the use of vocabulary and expressions common in the workplace.

HORT 240. Trees, Shrubs, and Woody Vines for Landscaping.

(3-0) Cr. 3. F.

Identification of trees, shrubs, and woody vines. Factors influencing the horticultural use of woody plants. Field trips outside of regular class time may be required.

HORT 276. Understanding Grape and Wine Science.

(3-0) Cr. 3. S. *Prereq: High school biology and chemistry.*

A scientific introduction to viticulture (grape-growing) and enology (wine-making). Topics include grape species and varieties, viticulture practices, fruit quality, geography, history, principles of fermentation and aging, wine classification, appreciation, evaluation, storage and service, regulations, wine as food. No wine tasting.

HORT 281. Landscape Graphics.

(0-4) Cr. 2. F.

Introduction to computer and hand rendering techniques of landscape graphics. Students will gain proficiency in plan view and elevation graphics. Intensive studio and computer based instruction.

HORT 282. Educating Youth Through Horticulture.

(2-3) Cr. 3. Alt. S., offered even-numbered years.

Planning, developing, and implementing science-based educational programs in a garden setting. Through hands-on experiences students will learn about horticulture, learning theory, and the application of science principles as they pertain to educating youth.

HORT 283. Pesticide Application Certification.

(Cross-listed with AGRON, ENT, FOR). (2-0) Cr. 2. S.

Core background and specialty topics in agricultural, and horticultural pesticide applicator certification. Students can select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

HORT 321. Horticulture Physiology.

(3-0) Cr. 3. F. *Prereq: HORT 221 or BIOL 211*

Principles of plant physiology relating to growth and development of horticultural plants including plant water relations, membrane transport, photosynthesis, photomorphogenesis, respiration, and phytohormones. Emphasis on plant's responses to environmental factors (temperature, water, and light) including cellular and whole-plant physiology under stressful environments.

HORT 322. Plant Propagation.

(2-2) Cr. 3. S. *Prereq: HORT 221 or BIOL 211*

Fundamental principles underlying sexual and asexual propagation of plants; practice in reproducing plants by use of seeds, cuttings, layering, grafting and budding and tissue culture.

HORT 330. Herbaceous Ornamental Plants.

(2-2) Cr. 3. F. *Prereq: HORT 221 or by permission of instructor*

Identification, botanical characteristics, origins, propagation, uses and general culture of herbaceous annual and perennial plants for Midwestern gardens and landscapes.

HORT 331. Hydroponic Food Crop Production.

(2-2) Cr. 3. Alt. F., offered even-numbered years. *Prereq: HORT 221 or AGRON 114 or 3 credits in biological sciences*

Principles and practices of hydroponic systems, crop production and culture, aquaponic systems, and new food crops for hydroponic systems will be discussed. Laboratories will focus on demonstration and participation in practices and procedures used in hydroponic food crop production.

HORT 332. Greenhouse Operation and Management.(3-3) Cr. 4. S. *Prereq:* Hort 221

Operation and management of greenhouses and other controlled environment agriculture structures. Methods of monitoring and manipulating environmental, cultural, and management factors such as light, temperature, fertility, substrate, etc., to maximize production efficiency. Emphasis placed on the production of ornamental and food crops. Greenhouse design and specification project required. Field trips outside scheduled class time required.

HORT 338. Seed Science and Technology.(Cross-listed with AGRON). (2-3) Cr. 3. F. *Prereq:* AGRON 114 or HORT 221, BIOL 211

Seed production, maturation, dormancy, vigor, deterioration, and related aspects of enhancement, conditioning, storage, and quality evaluation. Aspects of the seed industry and regulation of seed marketing.

HORT 341. Woody Plant Cultivars: Shade Trees, Ornamental Trees and Woody Shrubs.(2-0) Cr. 2. S. *Prereq:* Hort 240 or L A 221 or L A 222

Cultivars of the most prevalent and economically important woody landscape plants will be taught. The importance of cultivars to the nursery and landscaping professions and suggestions for their proper usage will be discussed.

HORT 342. Landscape Plant Installation, Establishment, and Maintenance.(2-3) Cr. 3. F. *Prereq:* Hort 240 or L A 221 or L A 222

Principles and practices involved with establishment and maintenance of managed landscapes. Laboratory work involves site evaluation, installation techniques, postplant care, and maintenance of established landscape plants.

HORT 351. Turfgrass Establishment and Management.(Cross-listed with AGRON). (3-0) Cr. 3. F. *Prereq:* HORT 221 or AGRON 114 or BIOL 211

Principles and practices of turfgrass propagation, establishment, and management. Specialized practices relative to professional lawn care, golf courses, athletic fields, highway roadsides, and seed and sod production. The biology and control of turfgrass pests.

HORT 351L. Turfgrass Establishment and Management Laboratory.(Cross-listed with AGRON). (0-3) Cr. 1. F. *Prereq:* Credit or enrollment in HORT 351

Those enrolled in the horticulture curriculum are required to take 351L in conjunction with 351 except by permission of the instructor.

HORT 354. Soils and Plant Growth.(Cross-listed with AGRON). (3-0) Cr. 3. F.S. *Prereq:* AGRON 154 and BIOL 101 or BIOL 211

Effects of chemical, physical, and biological properties of soils on plant growth, with emphasis on nutritive elements, pH, organic matter maintenance, and rooting development.

HORT 354L. Soils and Plant Growth Laboratory.(Cross-listed with AGRON). (0-3) Cr. 1. F.S. *Prereq:* Agron or Hort major with credit or enrollment in AGRON 354

Laboratory exercises in soil testing that assess a soil's ability to support nutritive requirements for plant growth.

HORT 380. Principles of Garden Composition.(2-0) Cr. 2. S. *Prereq:* HORT 240

Functional and aesthetic aspects of landscape planning as a basis for design decisions; emphasis on spatial design and plant selection. Includes site analysis, development process, and design principles.

HORT 381. Beginning Garden Composition Studio.(0-4) Cr. 2. S. *Prereq:* HORT 240, HORT 281, HORT 330, concurrent enrollment in HORT 380

Introduction to landscape design process. Intensive studio-based projects implementing principles of landscape design, concept development, and graphic communication. Not available as credit for L A majors.

HORT 391. Horticultural Management Experience.Cr. 1. Repeatable. F.S.SS. *Prereq:* HORT 221 or permission of instructor

A structured work experience for the student to gain insight into management operations associated with production and management of horticultural crops. A report of 10 or more pages describing the student's experience is required. One credit is given for each term the student is enrolled in the course. A maximum of two credits may be used toward the horticultural sciences course requirements, and two additional credits may be used toward the 128 credits required for graduation.

HORT 398. Cooperative Education.Cr. R. Repeatable. F.S.SS. *Prereq:* Permission of department resource and career center coordinator

Students must register for this course before commencing each work period.

HORT 421. Introduction to Plant Breeding.(Cross-listed with AGRON). (3-0) Cr. 3. F. *Prereq:* GEN 320 or BIOL 313

Breeding methods used in the genetic improvement of self-pollinated, cross-pollinated and asexually reproducing agronomic and horticultural crops. Applications of biotechnology techniques in the development of improved cultivars.

HORT 422. Postharvest Technology.(3-3) Cr. 4. Alt. F., offered even-numbered years. *Prereq:* HORT 221 and junior or senior classification

Principles, methods, and techniques related to postharvest maintenance of quality of horticultural commodities. Emphasis on the effects of handling, storage facilities and techniques, and quality evaluation. Field trips outside scheduled class time required.

HORT 424. Sustainable and Environmental Horticulture Systems.

(Dual-listed with HORT 524). (Cross-listed with ENV S). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Inquiry into ethical issues and environmental consequences of horticultural cropping systems, production practices and managed landscapes. Emphasis on systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

HORT 434. Fall Greenhouse Crop Production.(2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* HORT 332

Principles and practices of greenhouse floriculture production. Emphasis is placed on production of foliage and containerized flowering species produced in greenhouses and other controlled environments. Field trips outside scheduled class time required. Greenhouse scheduling and costs of production projects are required.

HORT 435. Spring Greenhouse Crop Production.(2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* HORT 330 and HORT 332

Principles and practices of greenhouse production of ornamental crops for the spring garden market. Emphasis placed on the production of several ornamental crops, along with the complete palate of spring garden crops. Field trips outside scheduled class time required.

HORT 442. Nursery Production and Garden Center Management.(2-0) Cr. 2. Alt. F., offered odd-numbered years. *Prereq:* HORT 221

Nursery layout, design, and cultural practices important for growing and shipping field and container-grown nursery crops. Overview of garden center design and retailing and marketing strategies. Field trip(s) outside scheduled class time may be required.

HORT 444. Landscape Construction Management.

(2-3) Cr. 3. F.

Principles and practices of residential landscape construction. Encompasses business and project management, landscape estimating and overview of common landscape materials. Laboratory work involves construction project management and installation.

HORT 445. Horticulture Management and Administration.(2-0) Cr. 2. F. *Prereq:* HORT 221 and junior or senior classification

In-depth presentation and discussion of skills and strategies needed to manage a horticultural enterprise. Topics include motivating employees, managing meetings, conducting performance appraisals, dealing with conflict, and managing an increasingly diverse work force.

HORT 451. Professional Turfgrass Management.(2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq:* HORT 351

Turfgrass science including the study of (1) specific information on soil chemistry and soil modification as they relate to the development and maintenance of turfgrass areas, (2) specialized management practices used in athletic field care, professional lawn care, and golf course industries, and (3) construction methods for golf courses and sports fields.

HORT 452. Integrated Management of Diseases and Insect Pests of Turfgrasses.(Dual-listed with HORT 552). (Cross-listed with ENT, PL P). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* HORT 351

Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

HORT 453. Sports Turf Management.(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* HORT 351

Management techniques for today's specialized athletic fields. The horticultural and budgetary aspects of football, soccer, baseball, and softball fields will be presented. Field trips and laboratory exercises will develop a practical understanding of actual principles in field development, construction, and management.

HORT 454. Turf & Landscape Irrigation.

(3-0) Cr. 3. Alt. F., offered odd-numbered years.

Irrigation systems and principles for turf and landscape environments. Topics include design, installation, equipment, management, and trouble shooting of irrigation systems for golf, athletic fields, residential lawns and landscapes. Participation in practical exercises and local field trips to irrigation sites is required.

HORT 461. Fruit Crop Production and Management.

(2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: HORT 221*

Principles and practices of small fruit, tree fruit, and nut culture and production. Morphology, physiology of growth and development, plant establishment, pest management, pruning, training, harvesting, storage, and marketing of commercial temperate fruit and nut crops. Emphasis on sustainable practices. Participation in practical exercises and local field trips is required.

HORT 465. Horticulture Enterprise Management.

(Cross-listed with AGEDS). (1-6) Cr. 3. F. *Prereq: Junior or senior classification.*

Participation in the management and operation of fruit and vegetable enterprises for local markets. The class is responsible for the plans, records, and decision for planting, operating, harvesting, and marketing fruit and vegetables.

HORT 465A. Horticulture Enterprise Management - Planting.

(Cross-listed with AGEDS). (1-6) Cr. 3. S. *Prereq: Junior or senior classification.*

Participation in the management and operation of fruit and vegetable enterprises for local markets. Principles and practices of researching and developing a commercial business plan that will meet industry standards and that will be linked to the operations and production associated with the Hort 465 class. Laboratory work includes development of a horticulture enterprise business plan, high tunnel site preparation and planting, development of summer crop protocols, seedling production for the summer crop (if applicable) and land preparation and planting of a portion of the summer crop.

HORT 465B. Horticulture Enterprise Management: Harvesting.

(Cross-listed with AGEDS). (1-6) Cr. 3. SS. *Prereq: Junior or senior classification.*

Participation in the management and operation of fruit and vegetable enterprises for local markets. Principles and practices of harvesting and marketing high tunnel crops and the planting and growing of a variety of summer vegetables in the field. Laboratory work includes all operation and production aspects involved with the day-to-day running of a horticultural enterprise. The class will be responsible for crop selection and crop protocols for the fall high tunnel crop and seedling production for this crop (if applicable). Additionally, the class will be responsible for all crop maintenance decisions and record keeping during the season.

HORT 465C. Horticulture Enterprise Management: Marketing.

(Cross-listed with AGEDS). (1-6) Cr. 3. F. *Prereq: Junior or senior classification.*

Participation in the management and operation of fruit and vegetable enterprises for local markets. Principles and practices of researching and developing a commercial horticulture enterprise market plan that could be used by a startup business and that will be linked directly to the operations and production associated with the Hort 465 class. Laboratory work includes completing the summer crop harvest, development of a horticulture marketing plan, high tunnel site preparation and planting, development of spring high tunnel crop protocols and all crop maintenance decisions and the record keeping for the fall high tunnel crop.

HORT 471. Vegetable Production and Management.

(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: HORT 221*

Principles of vegetable production with emphasis on sustainable production practices, market outlets, business aspects, and risk management. Topics will include crop classification and rotation; planting methods; crop climatic conditions, physiological growth & development; soil, water, and pest management; cover cropping; season extension strategies; harvest and postharvest management and marketing. Course involves visits to growers fields to observe/experience their production enterprise.

HORT 471L. Vegetable Production and Management Lab.

(0-3) Cr. 1. Alt. S., offered even-numbered years. *Prereq: Junior or Senior status and concurrent enrollment in Hort 471 is required.*

Hands-on training in the area of vegetable crop production. Students will have an opportunity to grow a variety of vegetables in a heated greenhouse and also conduct greenhouse and lab experiments. The lab also involves visits to vegetable production sites in Iowa to observe/experience and learn from growers and other agricultural professionals.

HORT 475. Urban Forestry.

(Cross-listed with FOR). (2-3) Cr. 3. F. *Prereq: Junior or senior classification, 3 credits in biology*

Discussion of establishment and management of woody perennials in community-owned urban greenspaces, consideration of urban site and soil characteristics, plant physiology, plant culture, urban forest valuation, inventory methods, species selection, and urban forest maintenance (health care and pest management).

HORT 481. Advanced Garden Composition.

(0-4) Cr. 2. F. *Prereq: HORT 240 and HORT 330 and HORT 380 and HORT 381* Limited to Landscape Design Installation and Management option students.

Development of residential landscapes using design principles and the design process. Projects encompass site analysis, concept development, preliminary design, final design, and graphic presentation techniques. Techniques will include hand and computer rendering.

HORT 484. Organic Agricultural Theory and Practice.

(Dual-listed with HORT 584). (Cross-listed with AGRON). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 9 cr. in biological or physical sciences* Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

HORT 490. Independent Study.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490A. Independent Study: Greenhouse Crops.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490B. Independent Study: Nursery Crops.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490C. Independent Study: Turfgrass.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490D. Independent Study: Fruit Crops.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490E. Independent Study: Vegetable Crops.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490F. Independent Study: Cross-Commodity.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490G. Independent Study: Landscape Horticulture.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490H. Independent Study: Honors.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490I. Independent Study: International Study.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490J. Independent Study: Entrepreneurship.

Cr. arr. Repeatable. *Prereq: Junior or Senior classification in horticulture or permission of instructor*

Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 491. Seed Science Internship Experience.

(Cross-listed with AGRON). Cr. 1-2. Repeatable, maximum of 1 times. F.S.SS. *Prereq: Agron 338, advanced approval and participation of employer and instructor*

A professional work experience and creative project for seed science secondary majors. The project requires the prior approval and participation of the employer and instructor. The student must submit a written report.

HORT 493. Workshop in Horticulture.

Cr. arr. Repeatable.

Off campus. Offered as demand warrants. Workshops in horticulture.

HORT 494. Service Learning.

Cr. arr. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Permission of instructor*

Selected projects that result in outcomes benefiting a non-Iowa State University entity while instilling professional ethics and accomplishing student learning goals. Course expenses paid by student. A maximum of 4 credits of 494 may be used toward the Horticulture credits required for graduation.

HORT 494A. Service Learning: International.

Cr. arr. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Permission of instructor*

Selected projects that result in outcomes benefiting a non-Iowa State University entity while instilling professional ethics and accomplishing student learning goals. Course expenses paid by student. A maximum of 4 credits of 494 may be used toward the Horticulture credits required for graduation.

HORT 494B. Service Learning: Domestic.

Cr. arr. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Permission of instructor*

Selected projects that result in outcomes benefiting a non-Iowa State University entity while instilling professional ethics and accomplishing student learning goals. Course expenses paid by student. A maximum of 4 credits of 494 may be used toward the Horticulture credits required for graduation.

HORT 495. Horticulture Travel Course Preparation.

Cr. R. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Limited enrollment. Students enrolled in this course also intend to register for Hort 496 the following term. Topics include preparation for safe international travel, the horticultural/agricultural industries, climate, crops, economics, geography, history, marketing, soils, culture, traditions, and horticultural/agricultural development of the country to be visited. Students enroll in this course the term immediately before travel to the foreign country.

HORT 496. Horticulture Travel Course.

Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Limited enrollment. Study and tour of production methods in major horticultural regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, cultures, and history of horticultural crops. Location and duration of tours will vary. Tour expenses paid by students. Meets International Perspectives Requirement.

Courses primarily for graduate students, open to qualified undergraduates:

HORT 506. Crop Genetics.

(Cross-listed with AGRON). Cr. 3. F.

Introduction to genetics of reproductive systems, recombination, segregation and linkage analysis, inbreeding, quantitative inheritance, fertility regulation, and polyploidy to prepare students for subsequent courses in crop improvement. Enrollment is restricted to off-campus MS in Plant Breeding students.

HORT 511. Integrated Management of Tropical Crops.

(Cross-listed with ENT, PL P). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: PL P 408 or PL P 416 or ENT 370 or ENT 376 or HORT 221

Applications of Integrated Crop Management principles (including plant pathology, entomology, and horticulture) to tropical cropping systems. Familiarization with a variety of tropical agroecosystems and Costa Rican culture is followed by 10-day tour of Costa Rican agriculture during spring break, then writeup of individual projects.

Meets International Perspectives Requirement.

HORT 523. Plant Tissue, Cell, and Protoplast Culture.

(2-0) Cr. 2. Alt. F., offered odd-numbered years. *Prereq: BIOL 313 or HORT 321 or senior classification in a College of Agriculture and Life Sciences major*

Theory and techniques of plant tissue culture, including organogenesis, somatic embryogenesis, micropropagation, anther and embryo culture, protoplast isolation and culture, and transformation. Applications to agriculture.

HORT 524. Sustainable and Environmental Horticulture Systems.

(Dual-listed with HORT 424). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Inquiry into ethical issues and environmental consequences of horticultural cropping systems, production practices and managed landscapes. Emphasis on systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

HORT 530. Research Orientation.

(1-3) Cr. 2. F.

Instruction in scientific methods and communication skills.

HORT 542. Introduction to Molecular Biology Techniques.

(Cross-listed with B M S, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

HORT 542A. Introduction to Molecular Biology Techniques: DNA Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

HORT 542B. Introduction to Molecular Biology Techniques: Protein.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.SS. *Prereq: Graduate classification*

Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

HORT 542C. Introduction to Molecular Biology Techniques: Cell Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

HORT 542D. Introduction to Molecular Biology Techniques: Plant Transformation.

(Cross-listed with B M S, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

HORT 542E. Introduction to Molecular Biology Techniques: Proteomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

HORT 542F. Introduction to Molecular Biology Techniques: Metabolomics.
(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

HORT 542G. Introduction to Molecular Biology Techniques: Genomic.
(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

HORT 543. Seed Physiology.

(Cross-listed with STB). (2-0) Cr. 2. Alt. F., offered even-numbered years. *Prereq:* Admission to the Graduate Seed Technology and Business Program or approval of the instructor

Brief introduction to plant physiology. Physiological aspects of seed development, maturation, longevity, dormancy and germination. Links between physiology and seed quality.

HORT 546. Strategies for Diversified Food and Farming Systems.

(Cross-listed with AGRON, SUSAG). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* SUSAG 509

Project-focused engagement in food and farming systems using tools and perspectives drawn from multiple disciplines. Includes a field component.

HORT 551. Growth and Development of Perennial Grasses.

(Cross-listed with AGRON). (2-0) Cr. 2. Alt. S., offered even-numbered years.

Prereq: Junior or senior or graduate classification or permission of instructor
Selected topics on anatomy, morphology, and physiology relative to growth and development of perennial grasses. Emphasis on growth and development characteristics peculiar to grasses and variations of such characteristics under natural and managed conditions.

HORT 552. Integrated Management of Diseases and Insect Pests of Turfgrasses.

(Dual-listed with HORT 452). (Cross-listed with ENT, PL P). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* HORT 351

Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

HORT 584. Organic Agricultural Theory and Practice.

(Dual-listed with HORT 484). (Cross-listed with AGRON, SUSAG). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* 9 cr. in biological or physical sciences

Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

HORT 590. Special Topics.

Cr. arr. Repeatable. *Prereq:* a major or minor in horticulture

HORT 593. Workshop in Horticulture.

Cr. arr. Repeatable.

Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593A. Workshop in Horticulture: Greenhouse Crops.

Cr. arr. Repeatable.

Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593B. Workshop in Horticulture: Nursery Crops.

Cr. arr. Repeatable.

Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593C. Workshop in Horticulture: Turfgrass.

Cr. arr. Repeatable.

Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593D. Workshop in Horticulture: Fruit Crops.

Cr. arr. Repeatable.

Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593E. Workshop in Horticulture: Vegetable Crops.

Cr. arr. Repeatable.

Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593F. Workshop in Horticulture: Cross-Commodity.

Cr. arr. Repeatable.

Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593G. Workshop in Horticulture: Landscape Horticulture.

Cr. arr. Repeatable.

Workshops in horticulture, with emphasis on off-campus instruction.

HORT 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:

HORT 610. Graduate Seminar.

Cr. 1. Repeatable. F.S.

Offered on a satisfactory-fail basis only.

HORT 690. Advanced Topics.

Cr. arr. Repeatable.

HORT 696. Research Seminar.

(Cross-listed with AGRON, BBMB, FOR, GDCB, PLBIO). Cr. 1. Repeatable. F.S.

Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

HORT 698. Horticulture Teaching Practicum.

(1-0) Cr. 1. S. *Prereq:* Graduate student classification

Discussions are intended to foster the development of graduate students as teaching assistants and future horticulture/plant science teachers. Topics include establishing a classroom presence, improving lectures, motivating students, dealing with difficult or disruptive students, and developing a teaching philosophy. Offered on a satisfactory-fail basis only.

HORT 699. Thesis and Dissertation Research.

Cr. arr. Repeatable.

HORT 699A. Thesis and Dissertation Research: Greenhouse Crops.

Cr. arr. Repeatable.

HORT 699B. Thesis and Dissertation Research: Nursery Crops.

Cr. arr. Repeatable.

HORT 699C. Thesis and Dissertation Research: Turfgrass.

Cr. arr. Repeatable.

HORT 699D. Thesis and Dissertation Research: Fruit Crops.

Cr. arr. Repeatable.

HORT 699E. Thesis and Dissertation Research: Vegetable Crops.

Cr. arr. Repeatable.

HORT 699F. Thesis and Dissertation Research: Cross-Commodity.

Cr. arr. Repeatable.

HORT 699G. Thesis and Dissertation Research: Landscape Horticulture.

Cr. arr. Repeatable.

HORT 699I. Thesis and Dissertation Research: Biotechnology.

Cr. arr. Repeatable.

Hospitality Management (HSP M)

Courses primarily for undergraduates:

HSP M 101. Introduction to the Hospitality Industry.

(3-0) Cr. 3. F.S.

Introduction to the foodservice, lodging, and tourism components of the hospitality industry. Background information, current issues, and future challenges in various segments of the industry.

HSP M 189. Introduction to University Dining Services Management.

(1-0) Cr. 1. Alt. S., offered even-numbered years.

Overview of management concepts and distinct features of university dining services.

HSP M 230. Introduction to Hospitality Performance Analysis.

(3-0) Cr. 3.

Introduction to Uniform Systems of Accounts for hospitality industry, profitability, income statements, budgeting, managing cash, accounts receivable and payable, costs control, pricing, and evaluation related to restaurant, lodging, and club industry. Preparation for a hospitality accounting certification exam.

HSP M 233. Hospitality Sanitation and Safety.

(3-0) Cr. 3. F.S.

Sanitation and safety principles in hospitality operations. Issues impacting consumers and operators. Characteristics of food, supplies, and equipment as related to quality, sanitation and safety. Application of HACCP. Preparation for national foodservice sanitation certification examination.

HSP M 260. Global Tourism Management.

(3-0) Cr. 3. F.S.

Overview of the global tourism industry: hospitality and related services, destination/ attractions, tourist behaviors, and destination marketing. Introduction to destination mix, socio-economic and cultural impacts of tourism, destination organizations, tourist motivations, destination image, marketing, promotions, tourism distribution system, and the future of tourism. Meets International Perspectives Requirement.

HSP M 289. Contemporary Club Management.

(Cross-listed with EVENT). (2-0) Cr. 2. F.S. Prereq: HSP M 101

Organization and management of private clubs including city, country, and other recreational and social clubs. Field trip may be required.

HSP M 315. Hospitality Law.

(3-0) Cr. 3. S. Prereq: HSP M 101

Laws relating to ownership and operation of hospitality organizations. The duties and rights of both hospitality business operators and customers. Legal implications of various managerial decisions.

HSP M 320. Attractions and Amusement Park Administration.

(Cross-listed with EVENT). (3-0) Cr. 3. S. Prereq: HSP M 101 or permission of instructor

An examination of current issues in the attractions and amusement park industry will be conducted. Emphasis will be placed on development and design along with the functional departments of modern amusement parks and themed attractions.

HSP M 333. Hospitality Operations Cost Controls.

(3-0) Cr. 3. F. Prereq: Credit or enrollment in HSP M 380, HSP M 380L; 3 credits MATH

Introduction to revenue and cost systems in the hospitality industry. Application of principles related to procurement, production, and inventory controls.

HSP M 352. Lodging Operations Management I.

(3-0) Cr. 3. F. Prereq: Credit or enrollment in HSP M 101, AESHM 287

Introduction to functional department activities and current issues of lodging organizations with emphasis on front office and housekeeping. Reservation activities and night audit exercises. Case studies.

HSP M 380. Quantity Food Production Management.

(3-0) Cr. 3. F.S. Prereq: HSP M 233 or 2 cr MICRO; FS HN 111 or FS HN 214; FS HN 115 or 215; at least junior classification; enrollment in HSP M 380L

Principles of and procedures used in quantity food production management including menu planning, food costing, work methods, food production systems, quality control, and service.

HSP M 380L. Quantity Food Production and Service Management Experience.

(0-6) Cr. 2. F.S. Prereq: HSP M 233 or 2 cr MICRO; FS HN 111 or FS HN 214; FS HN 115 or FS HN 215; at least junior classification; enrollment in HSP M 380

Application of quantity food production and service management principles and procedures in the program's foodservice operation.

HSP M 383. Introduction to Wine, Beer, and Spirits.

(2-0) Cr. 2. F.S. Prereq: Must be at least 21 years old

Introduction to history and methods of production for a variety of wines, beers, spirits, and other beverages. Beverage tasting and sensory analysis; product knowledge; service techniques; sales; and alcohol service related to the hospitality industry.

HSP M 383L. Introduction to Wine, Beer and Spirits Laboratory.

(0-2) Cr. 1. F.S. Prereq: HSP M 383 or concurrent enrollment. Must be at least 21 years old

The application of the management principles and procedures related to the sale and service of alcohol and specialty beverages served in the beverage and hospitality industry. Beverage tasting and sensory analysis of products commonly served in the beverage industry.

HSP M 391. Foodservice Systems Management I.

(3-0) Cr. 3. F. Prereq: Credit or enrollment in HSP M 380, HSP M 380L

Principles and techniques related to basic management, leadership, and human resource management of foodservices in health care and other on-site foodservice settings. Food safety and sanitation for on-site foodservice operations. Credit for either HSP M 391 or AESHM 287 and AESHM 438 may count toward graduation. Not accepted for credit toward a major in Hospitality Management.

HSP M 392. Foodservice Systems Management II.

(3-0) Cr. 3. S. Prereq: HSP M 391

Introduction to cost control in foodservice departments: procedures for controlling food, labor, and other variable costs. Application of principles related to food product selection, specification, purchase, and storage in health care and other onsite operations. Credit for either HSP M 392 or HSP M 233 and HSP M 333 may count toward graduation. Not accepted for credit toward a major in Hospitality Management.

HSP M 433. Hospitality Financial Management.

(3-0) Cr. 3. S. Prereq: HSP M 333; ACCT 284; ECON 101; credit or enrollment in STAT 101

Use of common financial statements, accounting ratios, and financial techniques to impact management decisions.

HSP M 437. Hospitality Information Technology.

(3-0) Cr. 3. F. Prereq: HSP M 352

Introduction to hospitality information technology. Property management and point-of-sales system interfaces: customer relationship management, selecting and purchasing computer systems, electronic distribution systems, internet and its related application systems, managing internal and external communication networks. Case studies.

HSP M 439. Advanced Hospitality Human Resource Management.

(3-0) Cr. 3. F. Prereq: AESHM 438

Emphasis on development of management personnel in hospitality organizations. Case studies.

HSP M 452. Lodging Operations Management II.

(3-0) Cr. 3. S. Prereq: HSP M 352; credit or enrollment in HSP M 333

Development of business plan and evaluation of business performance in a simulated environment. Operational decision making practices by applying concepts of management, operations, marketing, and finance for a computer-mediated environment.

HSP M 455. Introduction to Strategic Management in Foodservice and Lodging.

(3-0) Cr. 3. S. Prereq: AESHM 340; credit or enrollment in HSP M 433 and AESHM 438

Introduction to strategic management principles and practices with an application of human resources, operations, marketing, and financial management concepts. Case studies.

HSP M 487. Fine Dining Management.

(Dual-listed with HSP M 587). (2-3) Cr. 3. F. Prereq: HSP M 380, HSP M 380L

Exploration of the historical and cultural development of the world food table. Creative experiences with U.S. regional and international foods. Application of management and financial principles in food preparation and service in fine dining settings. Individual special problems.

HSP M 489. Issues in Food Safety.

(Cross-listed with AN S, FS HN, VDPAM). (1-0) Cr. 1. S. Prereq: Credit or enrollment in FS HN 101 or FS HN 272 or HSP M 233; FS HN 419 or FS HN 420; FS HN 403

Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

HSP M 490. Independent Study.

Cr. arr. Repeatable. Prereq: Sections B-E: Program approval; Section H: Full membership in Honors Program

HSP M 490B. Independent Study: Hospitality Management.

Cr. arr. Repeatable. Prereq: Sections B-E: Program approval Independent Study in Hospitality Management.

HSP M 490D. Independent Study: Lodging Operations.

Cr. arr. Prereq: Sections B-E: Program approval; Section H: Full membership in Honors Program

HSP M 490E. Independent Study: Foodservice Operations.

Cr. arr. Prereq: Sections B-E: Program approval; Section H: Full membership in Honors Program

HSP M 490H. Independent Study: Honors.

Cr. arr. Prereq: Sections B-E: Program approval; Section H: Full membership in Honors Program

Courses primarily for graduate students, open to qualified undergraduates:**HSP M 505. Hospitality Management Scholarship and Applications.**

(0-1) Cr. 1. F.SS.

Focus on teaching and research scholarship involving the hospitality industry.

HSP M 506. Current Issues in Hospitality Management.

(0-1) Cr. 1. Repeatable. S.SS.

Focus on current issues related to the hospitality industry.

HSP M 533. Financial Decision Making in Hospitality Organizations.

(3-0) Cr. 3. Alt. F., offered even-numbered years. Prereq: HSP M 433

Concepts of financial management applied to strategic decision making.

HSP M 538. Human Resources Development in Hospitality Organizations.

(3-0) Cr. 3. Alt. F., offered even-numbered years. Prereq: AESHM 438

Theories of human resources management. Practices and principles related to development of management personnel.

HSP M 540. Strategic Marketing.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. Prereq: AESHM 340

Application of marketing principles in developing effective marketing strategies for hospitality, apparel, and retail organizations. Evaluation of multi-dimensional marketing functions in hospitality organizations.

HSP M 555. Strategic Management in Hospitality Organizations.

(3-0) Cr. 3. Alt. S., offered even-numbered years. Prereq: Courses in MKT, FIN, MGMT, and HSP M. Permission of instructor

Strategic management process as a planning and decision-making framework; integration of human resources, operations, marketing, and financial management concepts.

HSP M 587. Fine Dining Management.

(Dual-listed with HSP M 487). (2-3) Cr. 3. F. Prereq: HSP M 380, HSP M 380L

Exploration of the historical and cultural development of the world food table. Creative experiences with U.S. regional and international foods. Application of management and financial principles in food preparation and service in fine dining settings. Individual special problems.

HSP M 590. Special Topics.

Cr. arr. Repeatable, maximum of 3 credits. Prereq: 9 credits in HRI at 400 level or above; application process

Topics in hospitality management.

HSP M 590B. Special Topics: Hospitality Management.

Cr. arr. Repeatable, maximum of 3 credits. Prereq: 9 credits in HSP M at 400 level or above; application process.

HSP M 590C. Special Topics: Tourism.

Cr. arr. Repeatable, maximum of 3 credits. F.S.SS. Prereq: 9 credits in HSP M at 400 level or above; application process

Special topics in tourism.

HSP M 590D. Special Topics: Lodging Operations.

Cr. arr. Repeatable, maximum of 3 credits. Prereq: 9 credits in HSP M at 400 level or above; application process.

HSP M 590E. Special Topics: Commercial/Retail Foodservice Operations.

Cr. arr. Repeatable, maximum of 3 credits. Prereq: 9 credits in HSP M at 400 level or above; application process.

HSP M 590F. Special Topics: Onsite Foodservice Operations.

Cr. arr. Repeatable, maximum of 3 credits. Prereq: 9 credits in HSP M at 400 level or above; application process.

HSP M 599. Creative Component.

Cr. arr.

Creative component as arranged with instructor.

Courses for graduate students:**HSP M 604. Professional Writing.**

(2-0) Cr. 2. S.SS. Prereq: Enrollment in PhD program

Development of professional written communication with emphasis on abstracts, proposals, manuscripts, and technical reports.

HSP M 608. Administrative Problems.

Cr. arr. Repeatable, maximum of 4 credits. F.S.SS. Prereq: Permission of instructor; enrollment in PhD program

Advanced administrative problems; case studies in foodservice and lodging organizations.

HSP M 633. Advanced Hospitality Financial Management.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: HSP M 433; Enrollment in PhD program

Theories and research in financial management with emphasis on financial performance and financing decisions.

HSP M 638. Advanced Human Resources Management in Hospitality Organizations.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. Alt. SS., offered even-numbered years. Prereq: HSP M 538; Enrollment in PhD program

Research in human resources management with an emphasis on organization or unit administration.

HSP M 640. Seminar on Marketing Thoughts.

(3-0) Cr. 3. Alt. S., offered even-numbered years. Alt. SS., offered even-numbered years. Prereq: HSP M 540; STAT 401. Enrollment in PhD program

Conceptual and theoretical development of marketing strategies. Analytical and critical review of marketing research and industry practices.

HSP M 652. Advanced Lodging Operations.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. Alt. SS., offered even-numbered years. Prereq: Enrollment in PhD program

Analysis and applications of concepts and theories of operations research for lodging operations.

HSP M 680. Analysis of Research in Foodservice Operations.

(3-0) Cr. 3. Alt. S., offered even-numbered years. Alt. SS., offered odd-numbered years. Prereq: Enrollment in PhD program

Analysis and application of theories, research, and research methods in foodservice operations.

HSP M 690. Advanced Topics.

Cr. arr. Repeatable, maximum of 2 times. F.S.SS. Prereq: Enrollment in PhD program, application process

Advanced study of current topics in hospitality management.

HSP M 690B. Advanced Topics: Hospitality Management.

Cr. arr. Repeatable, maximum of 2 times. F.S.SS. Prereq: Enrollment in PhD program, application process

Advanced study of current topics in hospitality management.

HSP M 690C. Advanced Topics: Tourism.

Cr. arr. Repeatable, maximum of 2 times. F.S.SS. Prereq: Enrollment in PhD program, application process

Advanced study of current topics in hospitality management.

HSP M 690D. Advanced Topics: Lodging Operations.

Cr. arr. Repeatable, maximum of 2 times. F.S.SS. Prereq: Enrollment in PhD program, application process

Advanced study of current topics in hospitality management.

HSP M 690E. Advanced Topics: Commercial/Retail Foodservice Operations.

Cr. arr. Repeatable, maximum of 2 times. F.S.SS. Prereq: Enrollment in PhD program, application process

Advanced study of current topics in hospitality management.

HSP M 690F. Advanced Topics: Onsite Foodservice Operations.

Cr. arr. Repeatable, maximum of 2 times. F.S.SS. Prereq: Enrollment in PhD program, application process

Advanced study of current topics in hospitality management.

HSP M 699. Research.

Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in PhD program*
Research.

Human Computer Interaction (HCI)

Courses primarily for graduate students, open to qualified undergraduates:

HCI 504. Evaluating Digital Learning Environments.

(Cross-listed with C I). (3-0) Cr. 3. S. Prereq: C I 501

Principles and procedures to plan, design, and conduct effective evaluation studies (formative, summative, usability) in different settings are studied. Opportunities to engage in real or simulated evaluation projects of substantial scope are provided. Create evaluation instruments, develop methods with which to evaluate a product or program, conduct try-outs or usability sessions, analyze the data, report the findings, and recommendations are some of the course activities.

HCI 515. Statistical Natural Language Processing.

(Cross-listed with ENGL, LING). (3-0) Cr. 3. F. Prereq: STAT 330 or equivalent, recommended ENGL 219 or LING 219, or ENGL 511 or LING 511

Introduction to computational techniques involving human language and speech in applications such as information retrieval and extraction, automatic text categorization, word prediction, intelligent Web searching, spelling and grammar checking, speech recognition and synthesis, statistical machine translation, n-grams, POS-tagging, word-sense disambiguation, on-line lexicons and thesauri, markup languages, corpus analysis, and Python programming language.

HCI 520. Computational Analysis of English.

(Cross-listed with ENGL, LING). (3-0) Cr. 3. S. Prereq: ENGL 510 or LING 510, and ENGL 511 or LING 511

Concepts and practices for analysis of English by computer with emphasis on the applications of computational analysis to problems in applied linguistics such as corpus analysis and recognition of learner language in computer-assisted learning and language assessment.

HCI 521. Cognitive Psychology of Human Computer Interaction.

(Cross-listed with PSYCH). (3-0) Cr. 3. Prereq: Graduate classification or instructor approval

Biological, behavioral, perceptual, cognitive and social issues relevant to human computer interactions.

HCI 522. Scientific Methods in Human Computer Interaction.

(Cross-listed with PSYCH). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: PSYCH 521 and STAT 101 or equivalent

Basics of hypothesis testing, experimental design, analysis and interpretation of data, and the ethical principles of human research as they apply to research in human computer interaction.

HCI 525. Optimization Methods for Complex Designs.

(Cross-listed with M E). (3-0) Cr. 3. S. Prereq: M E 160, MATH 265

Optimization involves finding the 'best' according to specified criteria. Review of a range of optimization methods from traditional nonlinear to modern evolutionary methods such as Genetic algorithms. Examination of how these methods can be used to solve a wide variety of design problems across disciplines, including mechanical systems design, biomedical device design, biomedical imaging, and interaction with digital medical data. Students will gain knowledge of numerical optimization algorithms and sufficient understanding of the strengths and weaknesses of these algorithms to apply them appropriately in engineering design. Experience includes code writing and off-the-shelf routines. Numerous case-studies of real-world situations in which problems were modeled and solved using advanced optimization techniques.

HCI 558. Introduction to the 3D Visualization of Scientific Data.

(Cross-listed with COM S, GEOL). (2-2) Cr. 3. Alt. S., offered odd-numbered years. Prereq: Graduate-student standing in the mathematical or natural sciences

Introduction to visualizing scientific information with 3D computer graphics and their foundation in human perception. Overview of different visualization techniques and examples of 3D visualization projects from different disciplines (natural sciences, medicine, and engineering). Class project in interactive 3D visualization using the OpenDX, VTK or a similar system.

HCI 570. UX Lab Studies: Eyetracking & Other UX Tools.

(1-0) Cr. 1.

Practical introduction to User Experience (UX) tools and how to use them for research: Designing a UX study; developing meaningful user tasks; how to plan a research study that integrates eyetracking measures, UX measures, behavioral measures, surveys, interviews and IRB applications; analyzing UX data; and presenting UX study results.

HCI 571. Augmented Reality.

(3-0) Cr. 3. Prereq: ME/CprE/ComS 557 Computer Graphics and Geometric Modeling, or equivalent computer graphics experience

Fundamental technologies enabling augmented reality (AR) application development. Assessment and integration of the hardware and software systems necessary for AR including, tracking, image processing and rendering. Programming skills in C++ and GPU-based optimization are developed to enable evaluation of interaction devices and modalities afforded by AR.

HCI 572. Experimental Computer Game Prototyping.

Cr. 3. SS. Prereq: Permission from instructor.

A discourse on interactive game design concepts through the rapid prototyping of video games. Topics discussed include interdisciplinary views on fundamentals of game play, emergence, emotional affect, behavioral learning, player progression, optimal experience and others. Discussions on interactivity as an art form and its implications to various fields of human computer interaction.

HCI 573. User Interface Implementation for Web Application.

(3-0) Cr. 3. Prereq: previous experience editing HTML or other programming language helpful

Development of web-based interfaces for web applications and databases that follow ISO standards for human factors and usability. User-centered design of interaction patterns, dynamic queries using user feedback, usability within complex web applications, making appropriate choices in system security and user management. PHP, MySQL, and JavaScript implementation tools will be used for assignments.

HCI 574. Computational Implementation and Prototyping in HCI.

Cr. 3. S.

Fundamental concepts of software programming and the practical use of the Python programming language. Assignments include user interaction and interface design, information visualization, as well as other computational HCI tools. Intended for graduate students without prior background in software development. Requires programming during class lectures.

HCI 575. Computational Perception.

(Cross-listed with COM S, CPR E). (3-0) Cr. 3. S. Prereq: Graduate standing or permission of instructor

This class covers statistical and algorithmic methods for sensing, recognizing, and interpreting the activities of people by a computer. This semester we will focus on machine perception techniques that facilitate and augment human-computer interaction. The main goal of the class is to introduce computational perception on both theoretical and practical levels. Participation in small groups to design, implement, and evaluate a prototype of a human-computer interaction system that uses one or more of the techniques covered in the lectures.

HCI 580. Virtual Environments, Virtual Worlds, and Application.

(Cross-listed with M E). (3-0) Cr. 3. F. Prereq: Senior or Graduate status.

A systematic introduction to the underpinnings of Virtual Environments (VE), Virtual Worlds, advanced displays and immersive technologies; and an overview of some of the applications areas particularly virtual engineering.

HCI 585. Developmental Robotics.

(Cross-listed with CPR E). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: knowledge of C/C++ programming language.

An introduction to the emerging interdisciplinary field of Developmental Robotics, which crosses the boundaries between robotics, artificial intelligence, developmental psychology, and philosophy. The main goal of this field is to create autonomous robots that are more intelligent, more adaptable, and more useful than the robots of today, which can only function in very limited domains and situations.

HCI 589. Design and Ethics.

(Cross-listed with ARTGR). (3-0) Cr. 3. F.S. Prereq: Graduate classification or permission of instructor.

Issues in ethics and decision-making as they relate to technology, design, design research, HCI, and the design industry.

HCI 590. Special Topics.

Cr. arr. Repeatable.

Investigation of problems of special interest in human computer interaction.

HCI 591. Seminar in Human Computer Interaction.

Cr. 1-3. Repeatable.

HCI 592. Entrepreneurship Workshop.

(1-0) Cr. 1. F.

Students will be taken step-by-step through activities that must be undertaken when attempting to commercialize a technology or start their own company. Speakers will be brought in to introduce relevant topics, provide resources, answer questions, and provide working examples.

HCI 594. Managerial Application of Collaborative Technologies and Social Media.

Cr. 3. SS. *Prereq: Graduate classification.*

Building, managing, and using collaborative technologies. Collaborative uses of social media such as blogs, wikis, picture and video sharing, social networks, Second Life, and other new media. Exposure to concepts and hands on use and management of several collaborative technologies.

HCI 595. Visual Design of HCI.

Cr. 3. SS.

Human interaction design as it applies to HCI. Aspects of audience analysis, design methodologies for creating concepts and solutions, techniques of concept prototyping, and the fundamentals of visual design such as color, type, symbolism, and grid structure. Class discussions, tutorials, and hands-on projects.

HCI 596. Emerging Practices in Human-Computer Interaction.

Cr. 3. SS. *Prereq: HCI 521*

Usability evaluation with emphasis on requirements gathering, rapid prototyping, evaluation, and communicating results through report writing along with emerging practices.

HCI 597. Scientific Information Design.

Cr. 2. SS.

Use of principles of visual design such as color, typography, photography, graphs, charts, and layout to create effective poster and power point presentations. Experience with design software, create posters and presentations from their own data, and evaluate design solutions with regard to their visual and verbal communication. Principles of design and communication theory will be introduced.

HCI 598. HCI Design, Implementation and Implications.

Cr. 3. F.S. *Prereq: 21 credits in human computer interaction or permission of the instructor*

Capstone course in HCI. Through a significant design project, students demonstrate their mastery of core courses in HCI. This course is the final course for students in the HCI Online MS program.

HCI 599. Creative Component.

(3-0) Cr. 3.

Creative component for nonthesis option of Master of Science degree. Offered on a satisfactory-fail basis only.

Courses for graduate students:

HCI 603. Advanced Learning Environments Design.

(Cross-listed with C I). (3-0) Cr. 3. S. *Prereq: C I 503*

Exploration of advanced aspects of the instructional design process. Application of analysis, design, development and production, evaluation, implementation, and project management principles. Focus on the production and use of instructional technology with an emphasis on the instructional design consulting process. Theory and research in instructional technology provides the foundation for design decisions.

HCI 655. Organizational and Social Implications of Human Computer Interaction.

(Cross-listed with MIS). (3-0) Cr. 3. *Prereq: Graduate classification*

Examine opportunities and implications of information technologies and human computer interaction on social and organizational systems. Explore ethical and social issues appurtenant to human computer interaction, both from a proscriptive and prescriptive perspective. Develop informed perspective on human computer interaction. Implications on research and development programs.

HCI 681. Cognitive Engineering.

(Cross-listed with I E). (3-0) Cr. 3. *Prereq: I E 572 or I E 577 or PSYCH 516 or HCI/PSYCH 521 or equivalent*

Provides an overview of human cognitive capabilities and limitations in the design of products, work places, and large systems. Contexts vary broadly and could range from simple use of mobile devices to an air-traffic control or nuclear plant command center. Course focuses on what we can infer about users' thoughts and feelings based on what we can measure about their performance and physiological state. Covers the challenge of designing automated systems.

HCI 697. HCI Internship.

Cr. R. Repeatable. *Prereq: Permission of Director of Graduate Education, graduate classification*

HCI 699. Research.

Cr. arr. Repeatable.

Human Development and Family Studies (HD FS)

Courses primarily for undergraduates:

HD FS 102. Individual and Family Life Development.

(3-0) Cr. 3. F.S.SS.

Development of individuals, families, and their reciprocal relationships as affected by external factors; examined within a framework of life-span developmental tasks (physical, cognitive, language, social, emotional).

HD FS 103. Professional Principles for Working with Children and Youth.

(0.5-0) Cr. 0.5. F.S.

Introduction to professional principles and ethics, understanding of child abuse reporting, universal precautions. Completion of criminal background checks for ISU practica. Offered on a satisfactory-fail basis only. Only one of HD FS 103 or 105 may count towards graduation.

HD FS 105. Professional Principles for Working with Adults.

(0.5-0) Cr. 0.5. F.S.

Introduction to professional principles and ethics, understanding of child, dependent adults and elder abuse reporting, working with aging adults, universal precautions. Offered on a satisfactory-fail basis only. Only one of HD FS 103 or 105 may count towards graduation.

HD FS 110. Freshman Learning Community Orientation.

(1-0) Cr. 1. F. *Prereq: Membership in HD FS Learning Community*

Introduction to the Department of Human Development and Family Studies including academic requirements and opportunities, strategies for transitioning to college, learning and study strategies, reading and reflection, and career awareness.

HD FS 111. New Transfer Student Seminar.

(1-0) Cr. 1. F.S.

Introduction to HD FS curricula and faculty for students in ChFS, FCEDS or F C P. Department and University policies and procedures, degree audits, and registration. Exploration of campus resources and strategies for student success. Offered on a satisfactory-fail basis only.

HD FS 183. Personal Finance in Early Adulthood.

(1-0) Cr. 1. F.S.SS.

Introduction to basic concepts and budgeting practices for management of resources and prevention of financial problems commonly associated with college, including credit and student loans. Offered on a satisfactory-fail basis only.

HD FS 208. Early Childhood Education Orientation.

(Cross-listed with C I). Cr. 1. F.S. *Prereq: classification as ECE major*

Overview of early childhood education (birth-grade 3) teacher licensure requirements. Program planning and university procedures. Required of all students majoring in early childhood education. Offered on a satisfactory-fail basis only.

HD FS 218. Professional Orientation and Service Learning.

(2-0) Cr. 2. F.S. *Prereq: Credit or concurrent enrollment in HD FS 102. For child, adult and family services majors.*

Ethics, professional development, and career exploration in child, adult and family services. Visits to and service learning with programs that serve children, adults and families with diverse needs. Participation in service learning project required. Offered on a satisfactory-fail basis only.

HD FS 223. Child Development and Health.

(3-0) Cr. 3. F.S.

Typical and atypical development of children prenatal through middle childhood. Examination of healthy development and potential impact of health issues in children. Discussion of influence of the family and society on development.

HD FS 224. Development in Young Children: Birth through Age 8.

(3-1) Cr. 3. F.S. *Prereq: HD FS 102 and HD FS 103*

Learning, growth, and development (typical and atypical) of children from birth through age eight. Explores importance of family, programs, and a diverse society. Strategies for observing, recording, and interpreting children's cognitive, communication, motor, social, and emotional development. Practicum.

HD FS 226. Development and Guidance in Middle Childhood.

(3-0) Cr. 3. F. *Prereq: HD FS 102 or PSYCH 230*

Typical and atypical development from 5 to 12 years of age. Development in the contexts of family, school, and society. Guidance of children in family and group settings.

HD FS 227. Adolescent and Emerging Adulthood.

(3-0) Cr. 3. F.S. *Prereq: HD FS 102 or PSYCH 230*

Physical, cognitive, and socioemotional development of adolescents and young adults in the context of family, relationships, and culture.

HD FS 234. Adult Development and Aging.

(Cross-listed with GERON). (3-0) Cr. 3. S. *Prereq: HD FS 102*

Introductory exploration of the health, individual and social factors associated with adult development including young adulthood, middle age and older adulthood. Information is presented from a life-span developmental framework.

HD FS 239. Housing and Consumer Issues.

(3-0) Cr. 3. F.S.

Introduction to factors affecting consumer and housing decisions of individuals and families, including housing issues such as housing quality, accessibility and affordability, neighborhood/housing contexts for families; and consumer issues such as consumer protection, legislation and regulation, and consumer fraud. Meets U.S. Diversity Requirement

HD FS 240. Literature for Children.

(3-0) Cr. 3. F.S.

Evaluation of literature for children, including an emphasis on cultural, racial, ethnic, and social diversity. Roles of literature in the overall development of children. Literature selection and use. Meets U.S. Diversity Requirement

HD FS 249. Parenting and Family Diversity Issues.

(3-0) Cr. 3. F.S.

Parenting practices and family relationships across the lifespan. Practical knowledge and techniques about how to be an effective parent. Diverse families, discipline, and parent education programs. Meets U.S. Diversity Requirement

HD FS 269. Research in Human Development and Family Studies.

(3-0) Cr. 3. F.S. *Prereq: HD FS 102 or PSYCH 230*

Understanding and evaluating research. Use of primary and secondary data to identify and study problems related to human development and family issues, including finance and housing. An introduction to statistical concepts and computer analysis. Research participation.

HD FS 270. Family Communications and Relationships.

(3-0) Cr. 3. F.S.Alt. SS., offered odd-numbered years. *Prereq: HD FS 102 or PSYCH 230*

Family communication and its functions to develop, maintain, enrich and limit family relationships. Family theories related to communication and ethical considerations when working with families. Meets U.S. Diversity Requirement

HD FS 276. Human Sexuality.

(3-0) Cr. 3. F.S.SS.

Behavioral, biological, and psychological aspects of human sexuality within the social context of family, culture, and society. Role of sexuality in human development. Critical analysis of media and research. Communication and decision-making skills relating to sexuality issues and relationships. Meets U.S. Diversity Requirement

HD FS 283. Personal and Family Finance.

(3-0) Cr. 3. F.S.

Introduction to basic principles of personal and family finance. Budgeting, record keeping, checking and savings accounts, consumer credit, insurance, investments, and taxes.

HD FS 317. Field Experiences.

Cr. 1-6. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Consult department office for procedure. Supervised field experience in human development and family studies programs. Offered on a satisfactory-fail basis only.

HD FS 317A. Field Experiences: Early Childhood Education Programs..

Cr. 1-6. Repeatable. F.S.SS. *Prereq: HD FS 343.*

Consult department office for procedure. Supervised field experience in human development and family studies programs. Offered on a satisfactory-fail basis only.

HD FS 317B. Field Experiences: Family Services Programs..

Cr. 1-6. Repeatable. F.S.SS. *Prereq: 9 credits in HD FS.*

Consult department office for procedure. Supervised field experience in human development and family studies programs. Offered on a satisfactory-fail basis only.

HD FS 317C. Field Experiences: Early Childhood Special Education Programs..

Cr. 1-6. Repeatable. F.S.SS. *Prereq: HD FS 224*

Consult department office for procedure. Supervised field experience in human development and family studies programs. Offered on a satisfactory-fail basis only.

HD FS 317D. Field Experiences: School-Age Child Care Programs..

Cr. 1-6. Repeatable. F.S.SS. *Prereq: HD FS 226.*

Consult department office for procedure. Supervised field experience in human development and family studies programs. Offered on a satisfactory-fail basis only.

HD FS 317E. Field Experiences: Infant/Toddler Programs..

Cr. 1-6. Repeatable. F.S.SS. *Prereq: HD FS 340.*

Consult department office for procedure. Supervised field experience in human development and family studies programs. Offered on a satisfactory-fail basis only.

HD FS 317F. Field Experiences: Research.

Cr. 1-6. Repeatable. F.S.SS. *Prereq: HD FS 269.*

Consult department office for procedure. Supervised field experience in human development and family studies programs. Offered on a satisfactory-fail basis only.

HD FS 317G. Field Experiences: Family Finance Programs..

Cr. 1-6. Repeatable. F.S.SS.

Consult department office for procedure. Supervised field experience in human development and family studies programs. Offered on a satisfactory-fail basis only.

HD FS 317K. Field Experiences: Housing Programs..

Cr. 1-6. Repeatable. F.S.SS.

Consult department office for procedure. Supervised field experience in human development and family studies programs. Offered on a satisfactory-fail basis only.

HD FS 317L. Field Experiences: Policy Programs.

Cr. 1-6. Repeatable. F.S.SS.

Consult department office for procedure. Supervised field experience in human development and family studies programs. Offered on a satisfactory-fail basis only.

HD FS 340. Assessment and Curricula: Ages Birth through 2 Years.

(3-3) Cr. 4. F.S. *Prereq: HD FS 103; HD FS 224; admission to teacher education program*

Assessment strategies for infants and toddlers, including those with special needs. Curricula, learning environments, teaching strategies, health and nutritional practices, and schedules that are developmentally, individually, and culturally appropriate. Using assessment to plan, implement, and evaluate activities to promote physical, motor, cognitive, communication, and social emotional development; practicum.

HD FS 341. Housing Finance and Policy.

(3-0) Cr. 3. F. *Prereq: 6 credits in social sciences*

The social, economic, and governmental contexts of housing and financial decision-making at the household level. Financial considerations for residential property management.

HD FS 342. Guidance and Group Management in Early Childhood.

(2-2) Cr. 3. F.S. *Prereq: HD FS 103; HD FS 224*

Guiding prosocial development, self-regulation, and task engagement of children birth to age 8. Focus is on promoting prosocial behaviors through supportive relationships and environments within diverse home, center, or school settings. Functional behavior assessment and ongoing progress monitoring for targeted and intensive interventions. Practicum.

HD FS 343. Assessment and Programming: Ages 3 through 6 Years.

(3-3) Cr. 4. F.S. *Prereq: HD FS 103; HD FS 224; HD FS 240; admission to teacher education program*

Assessment strategies for preschool and kindergarten children, including those with special needs. Learning environments, schedules, activities, nutritional practices, and teaching strategies that are developmentally, individually, and culturally appropriate. Using assessment to plan, implement, and evaluate activities to promote physical motor, cognitive, communication, and social emotional development; practicum.

HD FS 344. Programming for Children in Early Care and Education.

(3-3) Cr. 4. F.S. *Prereq: HD FS 103; HD FS 224*

Programming in inclusive child care centers and family child care homes, including those with special needs, aged birth through 8 years. Developing, implementing, and evaluating learning environments; activities and materials; behavioral guidance and classroom management practices; health and nutritional practices; and schedules to ensure developmental, individual, and cultural appropriateness. Monitoring children's development and behavior to promote physical, motor, cognitive, communication, and social emotional development. Learning to collaborate effectively with parents and staff. Practicum.

HD FS 345. Adapting Programming in Inclusive Settings.

(3-0) Cr. 3. F.S. *Prereq: Credit or concurrent enrollment in HD FS 340 or HD FS 343; SP ED 250*

Adapting instruction, materials, and equipment to meet developmental needs of young children birth through age 8 with diverse learning needs and multiple disabilities in inclusive settings. Addressing individualized education programs; special health care needs, challenging behavior, and positioning and handling techniques.

HD FS 360. Housing and Services for Families and Children.

(3-0) Cr. 3. F. *Prereq: 6 credits in social sciences*

Approaches to and assessment of housing and services that assist those with special needs including those with disabilities, low-income, children at risk, single-parents, and the homeless. Emphasis on community settings; e.g., residential facilities, group housing, shelters and transitional housing.

Meets U.S. Diversity Requirement

HD FS 367. Abuse and Illness in Families.

(3-0) Cr. 3. F.S.Alt. SS., offered even-numbered years. *Prereq: HD FS 102 or PSYCH 230*

Causes and consequences of family stressors including physical, sexual, and emotional abuse; substance abuse; and mental and physical illness across the life span. Interplay between victims, offenders, and the treatment system.

HD FS 373. Death as a Part of Living.

(Cross-listed with GERON). (3-0) Cr. 3. F.S.Alt. SS., offered even-numbered years. *Prereq: HD FS 102*

Consideration of death in the life span of the individual and the family with opportunity for exploration of personal and societal attitudes.

HD FS 377. Aging and the Family.

(Cross-listed with GERON). (3-0) Cr. 3. F.Alt. SS., offered odd-numbered years. *Prereq: HD FS 102*

Interchanges of the aged and their families. Emphasis on role changes, social interaction, and independence as influenced by health, finances, life styles, and community development.

Meets U.S. Diversity Requirement

HD FS 378. Retirement Planning and Employee Benefits.

(Cross-listed with ECON, GERON). (3-0) Cr. 3. S. *Prereq: 3 credits in Principles of Economics and 3 credits in Human Development and Family Studies*

Economic well-being in the context of demographic change, the present and future of Social Security, family retirement needs analysis, investment strategies and characteristics of retirement plans, helping others to work towards financial security, family economic issues for retired persons. Overview of employee and retirement benefits.

Meets U.S. Diversity Requirement

HD FS 383. Fundamentals of Financial Planning.

(3-0) Cr. 3. F. *Prereq: HD FS 283*

Fundamental principles of the financial planning process, client/planner interactions, time value of money applications as well as analyses of ethics review, financial statements, cash flow and debt management, education planning, retirement planning, tax planning, and estate planning needs of families.

HD FS 395. Children, Families, and Public Policy.

(3-0) Cr. 3. F.S.Alt. SS., offered odd-numbered years. *Prereq: HD FS 269 or equivalent*

Public policy and politics as they affect children and families. Examination of how individuals and groups influence policy. Investigation of current issues and programs influencing the well-being and welfare of children and families.

HD FS 416. Human Development and Family Studies Seminar.

Cr. arr. Repeatable. F.S.SS. *Prereq: 8 credits in human development and family studies*

Intensive study of a selected topic in human development and family studies.

HD FS 417. Supervised Student Teaching.

Cr. 8. Repeatable. *Prereq: Reservation required*

HD FS 417C. Supervised Student Teaching: Early Childhood Special Education Programs..

Cr. 8. Repeatable. F.S. *Prereq:* GPA 2.5, full admission to teacher education program, HD FS 455; HD FS 456.

Teaching experience with preschool children with disabilities.

HD FS 418. Professional Practice Reflection/Discussion.

Cr. 0.5-2. Repeatable. F.S.

Discussion of professional practice experience. Offered on a satisfactory-fail basis only.

HD FS 418A. Professional Practice Reflection/Discussion: Teaching.

(0.5-0) Cr. 0.5. F.S. *Prereq:* Taken concurrently with HD FS 417

Discussion of HD FS 417 student teaching field experience. Offered on a satisfactory-fail basis only.

HD FS 418B. Professional Practice Reflection/Discussion: Internships.

(2-0) Cr. 2. F.S. *Prereq:* Junior classification

Process and development of skills necessary for professional preparation and practice including career planning, resume writing, and interviewing. Strategies for successful career management. Offered on a satisfactory-fail basis only.

HD FS 449. Program Evaluation and Proposal Writing.

(3-0) Cr. 3. F.S. *Prereq:* HD FS 269

Theory and practice of program evaluation and proposal writing in human services including needs assessment, outcome development and measurement, and proposal components. Assessment of programs' success in meeting goals.

HD FS 455. Curricula for Ages 3 through 6 Years.

(3-3) Cr. 4. F.S. *Prereq:* HD FS 343, HD FS 345, SP ED 355 and SP ED 455

Program models and methods leading to development and organization of appropriate curricula in preschool and kindergarten programs for young children with diverse learning needs. Government regulations and professional standards for child programming. Teaming with parents, colleagues, and paraprofessionals to plan, implement, and evaluate developmentally and culturally appropriate individualized education plans in inclusive settings; practicum.

HD FS 456. Building Partnerships and Engaging Families.

(3-0) Cr. 3. F.S. *Prereq:* HD FS 340 or HD FS 344

Family systems and the application of family centered principles in early intervention and home-based services. Impact of disability on families with young children and strategies for delivering family-centered interventions and service coordination. Understanding and measuring family outcomes of early intervention. Understanding foundations of theory and policy, establishing effective partnerships, and building family capacity through effective supports and services. Experiences with families.

HD FS 463. Environments for the Aging.

(Dual-listed with HD FS 563). (Cross-listed with ARTID, GERON). (3-0) Cr.

3. S. *Prereq:* HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies or permission of instructor

Emphasis on independent living within residential settings including specialized shelter, supportive services and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities. (on-line course offering via Distance Education).

Meets U.S. Diversity Requirement

HD FS 479. Family Interaction Dynamics.

(3-0) Cr. 3. F.S. *Prereq:* HD FS 102 or equivalent; HD FS 269 or equivalent; 9 hours in social sciences; junior or senior status

Analysis of research related to family interaction processes across the family life span. Emphasis on relationship dynamics and cultural differences.

HD FS 482. Family Savings and Investments.

(3-0) Cr. 3. F. *Prereq:* HD FS 283

Management of family financial resources; emphasis on savings and the investment planning process; issues facing financial planners who manage family assets. Identification of investment options including common stocks, fixed income securities, convertible securities, and related choices.

HD FS 484. Estate Planning for Families.

(3-0) Cr. 3. S. *Prereq:* HD FS 283

Study of estate planning focusing on efficient conservation and transfer of wealth, consistent with client's goals. Legal, tax, financial and non-financial aspects of estate planning process; trusts, wills, probate, advanced directives, charitable giving, wealth transfers and related taxes.

HD FS 485. Capstone Course in Family Financial Planning.

(3-0) Cr. 3. S. *Prereq:* HD FS 283, HD FS 378, HD FS 383, HD FS 484, HD FS 488, ACCT 485, FIN 361

Development and refinement of competencies required by personal financial planners to work with individuals and families in meeting financial objectives. Utilization of skills obtained in financial planning emphasis to complete one or more financial planning narratives.

HD FS 486. Administration of Programs for Children, Adults and Families.

(3-0) Cr. 3. F.S. *Prereq:* Junior classification; 6 credits in HD FS at 300 level and above

Examination of purpose, policies, staffing, operations, and clientele of organizations serving children, adults and families with diverse needs. Management/leadership principles and techniques, including an introduction to financial management involved. Administrators/supervisors role in staff hiring, supervision, evaluation and development, as well as program evaluation, goal setting, strategic planning, and advocacy will be explored..

HD FS 489. Financial Counseling.

(Dual-listed with HD FS 589). (2-0) Cr. 2. F.S. *Prereq:* Graduate classification

Personal, social/psychological and legal climates affecting family financial decisions. A life cycle approach to financial decision making. Development of financial counseling and planning skills to assist families and individuals to become self-sufficient in family financial management.

HD FS 489L. Financial Counseling Laboratory.

(Dual-listed with HD FS 589L). (0-4) Cr. 2. Repeatable, maximum of 4 credits. F.S. *Prereq:* Instructor permission

Practical experience in remedial, preventative, and productive approaches to both financial and housing counseling in one-on-one and/or group settings.

HD FS 490. Independent Study.

Cr. arr. *Prereq:* 6 credits in human development and family studies

Consult department office for procedure.

HD FS 490A. Independent Study: Child and Family Studies.

Cr. arr. *Prereq:* 6 credits in human development and family studies

Consult department office for procedure.

HD FS 490B. Independent Study: Housing.

Cr. arr. *Prereq:* 6 credits in human development and family studies

Consult department office for procedure.

HD FS 490C. Independent Study: Family Finance.

Cr. arr. *Prereq:* 6 credits in human development and family studies

Consult department office for procedure.

HD FS 490F. Independent Study: Early Childhood Education.

Cr. arr. *Prereq:* 6 credits in human development and family studies

Consult department office for procedure.

HD FS 490G. Independent Study: Early Childhood Special Education.

Cr. arr. *Prereq:* 6 credits in human development and family studies

Consult department office for procedure.

HD FS 490H. Independent Study: Honors.

Cr. arr. *Prereq:* 6 credits in human development and family studies

Consult department office for procedure.

HD FS 490I. Independent Study: Human Development and Family Studies.

Cr. arr. *Prereq:* 6 credits in human development and family studies

Consult department office for procedure.

HD FS 490L. Independent Study: Policy Programs.

Cr. arr. *Prereq:* 6 credits in human development and family studies

Consult department office for procedure.

HD FS 491. Internship.

Cr. 4-9. Repeatable, maximum of 9 credits. F.S.SS. *Prereq:* HD FS 418B; permission of instructor; senior classification; minimum 2.0 GPA; reservation required one semester before placement

Supervised work experience related to the student's curriculum. Offered on a satisfactory-fail basis only.

HD FS 493. Workshop.

(Dual-listed with HD FS 593). Cr. arr. Repeatable. F.S.SS. *Prereq:* Senior classification

Workshop in HD FS.

HD FS 499. Research.

Cr. arr. Repeatable, maximum of 6 credits. F.S.SS. *Prereq:* Consult department office for procedures.

Supervised research experience.

Courses primarily for graduate students, open to qualified undergraduates:

HD FS 501. Graduate Study Orientation.

(2-0) Cr. 2. F. *Prereq: Admission to HD FS Graduate program*
Orientation to graduate study, professional development and the field of human development and family studies. Curriculum, portfolios, faculty research interests, research ethics, dissemination of research, career planning, and teaching philosophies discussed.

HD FS 503. Quantitative Research Methods.

(4-0) Cr. 4. F. *Prereq: Permission of instructor*
Concepts, methods, and strategies for research in human development and family studies. Topics include the nature of scientific research, measurement, types of research in human development and family studies, validity of research designs, methods of data gathering, and strategies for and issues in the study of change.

HD FS 504. Qualitative Research Methods.

(3-0) Cr. 3. F. *Prereq: 9 credits of social sciences or permission of instructor*
Introduction to qualitative research methodology. Application of fieldwork methods, analysis, interpretation, and writing through individual qualitative research projects.

HD FS 505. Application of Quantitative Research Methods.

(3-0) Cr. 3. S. *Prereq: HD FS 503 or permission of instructor*
Introduction to descriptive analyses and regression. Practical applications with interactive statistical software.

HD FS 510. Theories of Human Development.

(3-0) Cr. 3. F.SS. *Prereq: 9 credits of social sciences or permission of instructor*
Theoretical approaches and current research in child, adolescent, and adult development. Individual life span perspectives. Policy implications. (Summer course offering is on-line).

HD FS 511. Family Theory.

(3-0) Cr. 3. S. *Prereq: 9 credits in social sciences or permission of instructor*
Theoretical approaches and current research in family development. Review the nature and value of theory to the study of the family and evaluate the use of theory in empirical research. Policy implications.

HD FS 530. Perspectives in Gerontology.

(Cross-listed with GERON). (3-0) Cr. 3. F.
Overview of current aging issues including theory and research, critical social and political issues in aging, the interdisciplinary focus of gerontology, career opportunities, and aging in the future. (on-line course offering via Distance Education).

HD FS 534. Adult Development.

(Cross-listed with GERON). (3-0) Cr. 3. S.
Exploration of the biological, psychological and social factors associated with aging. Although the focus is on the later years, information is presented from a life-span developmental framework. Empirical studies are reviewed and their strengths, limitations and implications for normative and optimal functioning are discussed. (on-line course offering via Distance Education).

HD FS 538. Developmental Disabilities.

(Cross-listed with PSYCH). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: 9 credits in human development and family studies or psychology or permission of instructor*
Theories, research, and current issues regarding the intersection of development and disabilities. Investigation of interventions with individuals and families. (on-line course offering via Distance Education).

HD FS 541. Housing and Real Estate in Family Financial Planning.

(Cross-listed with FFP). (3-0) Cr. 3. Alt. SS., offered even-numbered years.
The role of housing and real estate in the family financial planning process, including taxation, mortgages, financial calculations, legal concerns, and ethical issues related to home ownership and real estate investments. Emphasis on emerging issues in the context of housing and real estate. (on-line course offering via Distance Education).

HD FS 545. Economics, Public Policy, and Aging.

(Cross-listed with GERON). (3-0) Cr. 3. F.
Policy development in the context of the economic status of the older adult population. Retirement planning and the retirement decisions; social security and public transfer programs; intra-family transfers to/from the aged; private pensions; financing medical care; prospects and issues for the future.

HD FS 555. Current Issues and Research in Early Childhood Services.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 9 credits in social sciences or permission of instructor*
Analysis of contemporary and historical early childhood/early intervention/early childhood special education model programs and services. Examination of relationships among service systems and implementation, program quality, teacher effectiveness, and outcomes for children with and without disabilities. (on-line course offering via Distance Education).

HD FS 563. Environments for the Aging.

(Dual-listed with HD FS 463). (Cross-listed with ARTID, GERON). (3-0) Cr. 3. S. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies or permission of instructor*
Emphasis on independent living within residential settings including specialized shelter, supportive services and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities. (on-line course offering via Distance Education).
Meets U.S. Diversity Requirement

HD FS 566. Family Policy.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 9 credits in social sciences or permission of instructor*
Explores current, enduring, and some controversial family policies and programs. Examines the effect of public policies on families and children, especially those at risk. Describes work roles in family policy and the interaction of family researchers and policymakers.

HD FS 567. Family Stress, Abuse, and Illness.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 9 credits in social sciences or permission of instructor*
Explores research related to family stress within romantic, parent-child, and sibling relationships. Examines contemporary theory and research on the nature, causes, and consequences of family stressors. These stressors include, but are not limited to economic distress; physical and emotional abuse; substance abuse; and mental and physical illness across the life span. (on-line course offering via Distance Education).

HD FS 568. Individual and Family Assessment.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: HD FS 510 or permission of instructor*
Use of interviews, observational assessments, direct tests with individuals and families for research and intervention. Opportunities to practice assessments.

HD FS 575. Cross-cultural Perspectives about Families and Children.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: 6 credits in social sciences or permission of instructor*
Review about cultural influences on the development of children, youth, and family life here in the United States and internationally. Using various strategies including DVDs, readings, and interviews, students will reflect upon their own culture and the child rearing practices, family roles, values, and traditions in different cultures. Discussion may also include the impact on human rights and social justice of particular practices. (on-line course offering via Distance Education).
Meets International Perspectives Requirement.

HD FS 577. Aging in the Family Setting.

(Cross-listed with GERON). (3-0) Cr. 3. S. *Prereq: 9 credits in social sciences or permission of instructor*
Theories and research related to personal and family adjustments in later life affecting older persons and their intergenerational relationships. Related issues including demographics also are examined through the use of current literature. (on-line course offering via Distance Education) Spring 2016: on campus.

HD FS 579. Family Well-being Across the Lifespan.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: 9 credits in social sciences or permission of instructor*
Review of current research to provide a theoretical and practical understanding of the economic, social, and psychological factors that influence interpersonal relationships and individual well-being within the institution of the family system. Economic and policy effects considered. (on-line course offering via Distance Education).

HD FS 581. International Study in Human Development and Family Studies.

Cr. 1-12. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Permission by application*
Limited enrollment. Supervised international study experiences in Human Development and Family Studies. Countries vary.

HD FS 581A. International Study in HD FS: Practicum.

Cr. 1-12. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Permission by application*
Limited enrollment. Supervised international study experiences in Human Development and Family Studies. Countries vary.

HD FS 581B. International Study in HD FS: Exchange.

Cr. 1-12. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Permission by application*
Limited enrollment. Supervised international study experiences in Human Development and Family Studies. Countries vary.

HD FS 581C. International Study in HD FS: Group Study.

Cr. 1-12. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Permission by application*

Limited enrollment. Supervised international study experiences in Human Development and Family Studies. Countries vary.

HD FS 583. Investing for the Family's Future.

(Cross-listed with FFP). (3-0) Cr. 3. F. *Prereq: HD FS 483*

Evaluation of investment markets for the household. Analysis of how families choose where to put their savings. Emphasis is on using the family's overall financial and economic goals to help inform investment choices. (on-line course offering via Distance Education).

HD FS 584. Program Evaluation and Research Methods in Gerontology.

(Cross-listed with GERON). (3-0) Cr. 3. S.

Overview of program evaluation, research methods, and grant writing in gerontology. Includes application of quantitative and qualitative methods in professional settings. (on-line course offering via Distance Education).

HD FS 585. Program Evaluation.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: 6 credits in graduate level social sciences or permission of instructor*

Theoretical and practical issues related to design and implementation of program evaluation in social sciences. Includes theory, design, implementation, analysis and report writing to assist programs to be successful in meeting program goals.

HD FS 588. Family Economics.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: 6 credits in sociology or economics*

Analysis of family income, wealth, and economic well-being. Emphasis on effects of family behavior and public policies on the adequacy and security of income across the family life cycle. Implications of resource allocation within the family for adult and child well-being.

HD FS 589. Financial Counseling.

(Dual-listed with HD FS 489). (2-0) Cr. 2. F.S. *Prereq: Graduate classification*

Personal, social/psychological and legal climates affecting family financial decisions. A life cycle approach to financial decision making. Development of financial counseling and planning skills to assist families and individuals to become self-sufficient in family financial management.

HD FS 589L. Financial Counseling Laboratory.

(Dual-listed with HD FS 489L). (0-4) Cr. 2. Repeatable, maximum of 4 credits. F.S. *Prereq: Instructor permission*

Practical experience in remedial, preventative, and productive approaches to both financial and housing counseling in one-on-one and/or group settings.

HD FS 590. Special Topics.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

Consult department office on procedure for filing a written plan of study.

HD FS 590I. Special Topics: Human Development and Family Studies.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

Consult department office on procedure for filing a written plan of study.

HD FS 591. Internship.

Cr. arr. Repeatable. F.S.SS. *Prereq: 10 graduate credits*

Supervised experience in an area of human development and family studies.

HD FS 591I. Internship: Human Development and Family Studies.

Cr. arr. Repeatable. F.S.SS. *Prereq: 10 graduate credits*

Supervised experience in an area of human development and family studies.

HD FS 593. Workshop.

(Dual-listed with HD FS 493). Cr. arr. Repeatable. F.S.SS. *Prereq: Senior classification*

Workshop in HD FS.

HD FS 594. Professional Seminar in Gerontology.

(Cross-listed with GERON). (3-0) Cr. 3. SS.

An integrative experience for gerontology students designed to be taken near the end of the degree program. By applying knowledge gained in earlier coursework, students will strengthen skills in ethical decision-making behavior, applying these skills in gerontology-related areas such as advocacy, professionalism, family and workplace issues. Students from a variety of professions will bring their unique perspectives to bear on topics of common interest. (on-line course offering via Distance Education).

HD FS 599. Creative Component.

Cr. arr. F.S.SS. *Prereq: 9 graduate credits in HD FS*

Nonthesis students creative component (e.g., a special report, capstone course, integrated field experience, annotated bibliography, research project, design, or other creative endeavor). A minimum of five credits of independent work is required on the programs of study (POS). Creative component format determined cooperation with the POS committee.

Courses for graduate students:**HD FS 603. Advanced Quantitative Methods.**

(3-0) Cr. 3. F. *Prereq: HD FS 503, HD FS 505; STAT 402 or STAT 404 or permission of instructor*

Methodological and analytical issues in research in human development and family studies. Advanced research design and measurement, selection of statistical techniques, and issues in the interpretation of findings.

HD FS 604. Advanced Qualitative Methods.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: HD FS 504 or permission of instructor*

Research methodologies including phenomenology, grounded theory, ethnography, and case studies. Methods of data collection and analysis procedures. Issues of ethics and interpretation of findings. (on-line course offering via Distance Education).

HD FS 605. Multi-level Modeling.

(Cross-listed with PSYCH). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: HD FS 503 and HD FS 505 or STAT 404 or permission of instructor

Rationale for and interpretation of random coefficient models. Strategies for the analysis of multi-level and panel data including models for random intercepts, random slopes, and growth curves. Applications including HLM, SAS, PROC MIX, and MPLUS.

HD FS 606. Advanced Structural Equation and Longitudinal Modeling.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: HD FS 603 or STAT 404 or permission of instructor*

Rationale for and interpretation of advanced structural equation modeling for the analysis of longitudinal data. Emphasis will be placed on developing a working familiarity with some of the common statistical procedures, coupled with their application through the use of statistical software.

HD FS 607. Mixed Methods.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: HD FS 503, HD FS 504, HD FS 505, or permission of instructor*

Foundations of mixed methods research, controversies, and philosophical concerns. Rationale for and interpretation of mixed methods designs. Research design, sampling, data collection, data analysis, results, and interpretation. (on-line course offering via Distance Education).

HD FS 608. Grant Writing for Research.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: HD FS 503, HD FS 505, and HD FS 504 or permission of instructor*

Understand how to identify funding sources as well as the fundamental components of a federal research grant proposal such as the abstract or summary, background and significance, specific aims/goals and objectives, project design and methods, sustainability, assessment, broader impacts, dissemination, budget, budget justification, and cover letter.

HD FS 616. Seminar.

Cr. arr.

May be repeated. F.S.SS.

HD FS 631. Child Health and Development.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: HD FS 510 or permission of instructor*

Young children's cognitive, physical, communication, and social-emotional health and development will be examined. Both typical and atypical trajectories will be explored. Research on current trends in the field will be emphasized. (on-line course offering via Distance Education).

HD FS 632. Support and Interventions in Early Childhood.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: HD FS 510 or permission of instructor*

Issues related to special learning needs of children ages 3-8. Design and implementation of group and individual intervention strategies including Positive Behavioral Interventions and Supports. Discussion of coaching strategies to improve intervention implementation. (on-line course offering via Distance Education).

HD FS 633. Infant Mental Health.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: HD FS 510 or permission of instructor*

Examination of the individual, interpersonal, and familial factors that influence infant (birth through age 3) mental health. Analysis of the risk and protective factors that influence these systems and their potential effects on social-emotional development. Current issues relating to effective programs for improving parent-infant interactions and additional supports available to families.(on-line course offering via Distance Education).

HD FS 634. Adolescent and Emerging Adult Health and Development.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: HD FS 510 or permission of instructor*

Theory and research on biopsychosocial, cognitive, physical and sexual health and development from early adolescence to emerging adulthood. Contexts of development including families, peers, schools, neighborhoods, romantic relationships, economics and public policies are considered.(on-line course offering via Distance Education).

HD FS 635. Adult Development, Aging, and Health.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: HD FS 510 or permission of instructor*

Review of the impact of the growing older adult population as well as individual development and aging on individuals, families, and society. Exploration of theoretical perspectives applied to adult development and aging and distinction of normative and non-normative changes in adulthood. Discussion of methods to assess development across adulthood and consideration of the role of individual and environmental factors impacting efforts to optimize adult development.(on-line course offering via Distance Education).

HD FS 690. Advanced Topics.

Cr. arr. Repeatable. *Prereq: Permission of instructor and enrollment in Ph.D. program*

HD FS 690I. Advanced Topics: Human Development and Family Studies.

Cr. arr. Repeatable. *Prereq: Permission of instructor and enrollment in Ph.D. program*

HD FS 691. Internship.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Supervised practice and experience in the following specified areas:. Offered on a satisfactory-fail basis only.

HD FS 691A. Internship: College Teaching.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Supervised practice and experience in the following specified areas:. Offered on a satisfactory-fail basis only.

HD FS 691B. Internship: Research.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Supervised practice and experience in the following specified areas:. Offered on a satisfactory-fail basis only.

HD FS 691D. Internship: Professional Experience.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Supervised practice and experience in the following specified areas:. Offered on a satisfactory-fail basis only.

HD FS 699. Research.

Cr. arr. Repeatable.

Offered on a satisfactory-fail basis only.

HD FS 699I. Research: Human Development and Family Studies.

Cr. arr. Repeatable.

Offered on a satisfactory-fail basis only.

Human Sciences (H SCI)

Courses primarily for undergraduates:

H SCI 110. Orientation and Human Sciences Career Exploration.

(2-0) Cr. 2. F.S.

Orientation and adjustment to the university and college; policies and procedures; academic resources; and development of a long-term curriculum plan.

Comprehensive approach to career development; intensive self-analysis; and in-depth examination of majors in Human Sciences. Required for all students declared as Open Option in the College of Human Sciences.

H SCI 150. Dialogues on Diversity.

(1-0) Cr. 1. F.S.

An exploration of diversity within the context of the Iowa State University community through understanding human relations issues.

Meets U.S. Diversity Requirement

H SCI 482. The Dean's International Leadership Seminar.

(Dual-listed with H SCI 582). (3-0) Cr. 3. S.SS. *Prereq: Permission of the seminar leader*

Leadership strategies and effective use of leadership skills in an international setting. Compare leadership theories and practices in the U.S. and foreign countries. Construct individual leadership strategies to deal with complex issues in a global environment. Use discussion, personal assessment inventories, and simulated experiences to evaluate leadership strategies. Develop and improve skills in meeting the challenges of teamwork. Learn about the culture of a foreign country.

Meets International Perspectives Requirement.

H SCI 490. Independent Study.

Cr. 1-4.

H SCI 490E. Entrepreneurship.

Cr. 1-4.

Courses primarily for graduate students, open to qualified undergraduates:

H SCI 582. The Dean's International Leadership Seminar.

(Dual-listed with H SCI 482). (3-0) Cr. 3. S.SS. *Prereq: Permission of the seminar leader*

Leadership strategies and effective use of leadership skills in an international setting. Compare leadership theories and practices in the U.S. and foreign countries. Construct individual leadership strategies to deal with complex issues in a global environment. Use discussion, personal assessment inventories, and simulated experiences to evaluate leadership strategies. Develop and improve skills in meeting the challenges of teamwork. Learn about the culture of a foreign country.

Immunobiology (IMBIO)

Courses for graduate students:

IMBIO 602. Current Topics Workshop in Immunology.

(1-0) Cr. 1. Repeatable. F.

Lectures provided by off-campus experts. Students are required to participate in discussion sessions with lecturers.

IMBIO 604. Seminar in Immunobiology.

(1-0) Cr. 1. Repeatable. S.

Student and faculty presentation.

IMBIO 661. Comparative Immunology and Infectious Disease.

(Cross-listed with V PTH). (2-0) Cr. 2. Alt. S., offered odd-numbered years.

Prereq: Graduate level Immunology or permission of instructor.

Discuss and define similarities and differences of varied host responses to infectious challenge. Learning will focus on comparative aspects of the host response and the unique aspects of immunity from different organisms, while highlighting molecular and mechanistic similarities of pathogen recognition, response and resolution.

IMBIO 690. Special Topics.

Cr. arr. Repeatable.

Advanced study of specific topics in specialized field of immunobiology.

IMBIO 697. Graduate Research Rotation.

Cr. arr. Repeatable.

Graduate research projects performed under the supervision of selected faculty members in the Interdepartmental Immunobiology major.

IMBIO 699. Research.

Cr. arr. Repeatable.

Industrial Design (IND D)

Courses primarily for undergraduates:

IND D 201. Industrial Design Studio I.

(0-12) Cr. 6. F. Prereq: Admission to the industrial design program, enrollment in IND D 231.

Product scale form development and visual communication.

IND D 202. Industrial Design Studio II.

(0-12) Cr. 6. S. Prereq: IND D 201

Principles of structure and function in products.

IND D 231. Introduction to Industrial Design.

(3-0) Cr. 3. F. Prereq: DSN S 102 and DSN S 131, enrollment in 201; admission to the industrial design program through department review or permission of instructor.

The history, definition, scope, and basic principles of industrial design. Overview of technical, artistic, and sociological context of the profession.

IND D 232. Creative Thinking for Industrial Design.

(3-0) Cr. 3. S. Prereq: IND D 231

Exploration of strategies, methods, and processes associated with creative thinking skills and problem solving. Discussion of the nature of creativity and its implications in different contexts that cross content boundaries.

IND D 301. Industrial Design Studio III.

(0-12) Cr. 6. F. Prereq: IND D 202

Systematic design methodology and integration of creative thinking techniques.

IND D 302. Industrial Design Studio IV.

(0-12) Cr. 6. F.S. Prereq: IND D 301 or permission of instructor

Exploration of commercial factors in industrial design.

IND D 332. Design Research Methods.

(3-0) Cr. 3. F. Prereq: IND D 231 or permission of instructor.

Survey of qualitative and quantitative methods with an emphasis on contextual user-centered research. Integration of user data collection, visualization, and synthesis as a source for design. Experience of a small-scale research practice related to industrial design.

IND D 334. Materials and Processes for Industrial Design.

(3-0) Cr. 3. S. Prereq: IND D 201 and IND D 231.

Introduction to materials and manufacturing methods for mass production and distribution of products.

IND D 341. Computer Aided Industrial Design I.

(0-6) Cr. 3. F.S. Prereq: IND D 301

Emphasis on the computer as an industrial design and visualization tool.

IND D 351. Applied Human Factors Lab.

(0-1) Cr. 1. F. Prereq: IND D 231 and enrollment in ARTID 251

Theory and application of human factors issues in the industrial design field, specifically their impact on the relationship of the user, the product, and the product systems.

IND D 387. History of Industrial Design I.

(3-0) Cr. 3. F. Prereq: 30 credits earned at ISU

Historical perspective of industrial objects starting at the Industrial Revolution 1830 to 1960. Discussion of social, political, cultural and technological context for industrial design.

IND D 388. History of Industrial Design II.

(3-0) Cr. 3. S. Prereq: 30 credits earned at ISU.

Historical perspective of industrial objects 1960 to present. Discussion of social, political, cultural and technological context for industrial design.

IND D 397. Industrial Design Internship.

(0-12) Cr. 6. F.S.SS. Prereq: IND D 202, 18 credits in industrial design, permission of instructor.

Professional industrial design, off-campus experience.

IND D 401. Industrial Design Studio.

(0-12) Cr. 6. F.S. Prereq: IND D 301 or permission of instructor

Advanced topics focused on industrial design applications. Topics vary each time offered.

IND D 490. Special Topics.

Cr. arr. Repeatable. F.S.SS. Prereq: Completion of industrial design studio or permission of instructor.

Advanced topics focused on industrial design applications. Topics vary each time offered. .A. Theory, Criticism, Methodology,B. Experimental Techniques,C. Three Dimensional Design,D. Distributed Collaboration.

IND D 490A. Special Topics: Theory, Criticism, Methodology.

Cr. arr. Repeatable. F.S.SS. Prereq: Completion of industrial design studio or permission of instructor.

Advanced topics focused on industrial design applications. Topics vary each time offered.

IND D 490B. Special Topics: Experimental Techniques.

Cr. arr. Repeatable. F.S.SS. Prereq: Completion of industrial design studio or permission of instructor.

Advanced topics focused on industrial design applications. Topics vary each time offered.

IND D 490C. Special Topics: Three-Dimensional Design.

Cr. arr. Repeatable. F.S.SS. Prereq: Completion of industrial design studio or permission of instructor.

Advanced topics focused on industrial design applications. Topics vary each time offered.

IND D 490D. Special Topics: Distributed Collaboration.

Cr. arr. Repeatable. F.S.SS. Prereq: Completion of industrial design studio or permission of instructor.

Advanced topics focused on industrial design applications. Topics vary each time offered.

IND D 495. Study Abroad Option.

(0-12) Cr. 6. F.S.SS. Prereq: IND D 202 and permission of instructor

International study abroad program. Visits to design studios, showrooms, museums and manufacturing facilities.

IND D 499. Senior Project.

(0-12) Cr. 6. S. Prereq: IND D 495 or IND D 507 and senior standing

Advanced practice in specialized area of industrial design. Topics vary.

Courses primarily for graduate students, open to qualified undergraduates:

IND D 501. Industrial Design Studio Intensive I.

(0-12) Cr. 6. F. Prereq: Admission into the Graduate Intensive Track or graduate standing in the industrial design program.

Basic concepts and techniques for industrial design. Emphasis on form development, structure, function and communication.

IND D 502. Industrial Design Studio Intensive II.

(0-12) Cr. 6. S. Prereq: Admission into the Graduate Intensive Track or graduate standing in the industrial design program.

Advanced concepts and techniques for industrial design. Emphasis on systematic design methodology and commercial factors, and visual and verbal communication of design problems and solutions.

IND D 503. Industrial Design Studio I.

(0-12) Cr. 6. F. Prereq: Admission to the industrial design graduate program or completion of Graduate Intensive Track.

Advanced, project-based application of industrial design concepts and techniques.

IND D 504. Industrial Design Studio II.

(0-12) Cr. 6. S. Prereq: IND D 502.

Advanced, project based application of industrial design concepts and techniques, with an emphasis on service and system design, and its implications for the community.

IND D 507. Industrial Design Practicum.

(0-12) Cr. 6. F.S. Prereq: Evidence of satisfactory experience in area of specialization; admitted by application and written permission of instructor only. Studio project focused on topics generated with external partners. Topics vary.

IND D 511. Colloquium.

(1-0) Cr. 1. Repeatable. F.S. Prereq: Admission into the Graduate Intensive Track or graduate standing in the industrial design program.

Presentation and discussion of creative activity carried out in various design disciplines and their relationship to industrial design. Seminar sessions focusing on exemplary pieces of design research undertaken by faculty and graduate students in the design field.

IND D 532. Design Thinking.

(3-0) Cr. 3. S. *Prereq: Admission into the Graduate Intensive Track or graduate standing in the industrial design program, or permission of instructor.*

Exploration of problem-solving methods for systems, products, and processes across all contexts. Strategies for problem-solution co-evolution process, with a focus on collaborative and interdisciplinary design to investigate real-world problems and opportunities.

IND D 534. Product Realization for Industrial Design.

(3-0) Cr. 3. S. *Prereq: Admission into the Graduate Intensive Track or graduate standing in the industrial design program.*

Introduction to materials and manufacturing methods for products. Exploration of emerging materials and new applications.

IND D 540. Visual Communication for Industrial Design.

(0-6) Cr. 3. F. *Prereq: Admission into the Graduate Intensive Track or graduate standing in the industrial design program.*

Exploration of multiple visual communication techniques used in industrial design and product development.

IND D 541. Computer Aided Industrial Design.

(0-6) Cr. 3. F.S. *Prereq: Completion of industrial design studio or permission of instructor.*

Exploration of the computer as an industrial design and visualization tool. Advanced concepts in computer to machine interface for manufacture.

IND D 543. Portfolio and Professional Practice.

(1-4) Cr. 3. F.S. *Prereq: Senior or Graduate standing in the industrial design program.*

Discussion of industrial design practice and career planning. Development and preparation of personal promotional materials for a range of media.

IND D 551. Human Factors.

(3-0) Cr. 3. S. *Prereq: IND D 532*

Human factors issues and the study of relationships between the user, the product, and the human body and its physical functions. Investigations of bio-mechanics, anthropometry, instrumental displays and control, and their measurement as they relate to the design process.

IND D 590. Special Topics.

(1-4) Cr. 3. Repeatable. F.S.SS. *Prereq: Completion of industrial design studio or permission of instructor.*

Advanced topics focused on industrial design applications. Topics include theory, criticism, methodology, experimental techniques, three dimensional design, distributed collaboration.

IND D 592. Special Projects.

Cr. arr. Repeatable. F.S.SS. *Prereq: Completion of industrial design studio or permission of instructor.*

Planned projects in topics related to theory, criticism, methodology, experimental techniques, three dimensional design, distributed collaboration.

IND D 595. Study Abroad Option.

(0-12) Cr. 6. Repeatable. F.S.SS. *Prereq: Completion of industrial design studio or permission of instructor.*

International study abroad program. Visits to design studios, showrooms, museums and manufacturing facilities.

IND D 597. Internship.

(0-12) Cr. 6. Repeatable. F.S.SS. *Prereq: Completion of Industrial design studio or permission of instructor.*

Professional industrial design, off-campus experience.

Courses for graduate students:**IND D 601. Graduate Project I.**

(0-12) Cr. 6. F. *Prereq: IND D 632*

Advanced creative component in specialized area of focus within industrial design. Culminates in a development plan and supporting documentary.

IND D 602. Graduate Project II.

(0-12) Cr. 6. S. *Prereq: IND D 601*

Advanced creative component in specialized area of focus within industrial design. Culminates in a physical or digital artifact and supporting documentation.

IND D 631. Design Research Methods.

(3-0) Cr. 3. F. *Prereq: Admission into the Graduate Intensive Track, graduate standing in the industrial design program, or permission of instructor.*

Cross-disciplinary research methods to examine the impact of industrial design on humans, environments, and social contexts. Examination and critique of current research methods employed in the field, and application of a selection of these methods to a variety of research questions.

IND D 632. Thesis Preparation.

(3-0) Cr. 3. S. *Prereq: IND D 631*

Exploration and formulation of graduate thesis or project topics, with proposed studies and investigations. Introduction to structuring a design research prospectus and university requirements for graduation. Determine Faculty Committee and Program of Study and file forms with Graduate College.

IND D 699. Thesis.

(0-12) Cr. 6. Repeatable. F.S.SS. *Prereq: IND D 632*

Advanced research component in specialized area of focus within industrial design. Culminates in a thesis document.

Industrial Engineering (I E)

Courses primarily for undergraduates:

I E 101. Industrial Engineering Profession.

Cr. R. F.S.

(1-0) Introduce students to the industrial engineering profession, its scope, industrial engineering tools, and future trends.

I E 148. Information Engineering.

(2-2) Cr. 3. F.S. Prereq: Credit or enrollment in MATH 143

Development of information solutions for engineering problems. Fundamentals of the software development process. Engineering computations and the human/computer interface. Data models and database development. Program connectivity and network applications.

I E 222. Design & Analysis Methods for System Improvements.

(3-0) Cr. 3. S. Prereq: I E 248; credit or enrollment in I E 271.

Study of system improvement methods and strategies. Specific areas of lean system improvements include continuous improvement, setup reduction, workplace organization, inventory and waste minimization. Methods and strategies to analyze and quantify the impact of changes.

I E 248. Engineering System Design, Manufacturing Processes and Specifications.

(2-2) Cr. 3. F. Prereq: MATH 166 and PHYS 221. Credit or enrollment in I E 101 and MAT E 273.

Introduction to metrology, engineering drawings and specifications. Engineering methods for designing and improving systems. Theory, applications, and quality issues related to machining processes.

I E 271. Applied Ergonomics and Work Design.

(3-0) Cr. 3. S. Prereq: PHYS 221

Basic concepts of ergonomics and work design. Their impact on worker and work place productivity, and cost. Investigations of work physiology, biomechanics, anthropometry, work methods, and their measurement as they relate to the design of human-machine systems.

I E 298. Cooperative Education.

Cr. R. F.S.SS. Prereq: Permission of department and Engineering Career Services

First professional work period in the cooperative education program. Students must register for this course before commencing work.

I E 305. Engineering Economic Analysis.

(3-0) Cr. 3. F.S.SS. Prereq: MATH 166

Economic analysis of engineering decisions under uncertainty. Financial engineering basics including time value of money, cash flow estimation, and asset evaluation. Make versus buy decisions. Comparison of project alternatives accounting for taxation, depreciation, inflation, and risk.

I E 312. Optimization.

(3-0) Cr. 3. F. Prereq: Credit or enrollment in MATH 267.

Concepts, optimization and analysis techniques, and applications of operations research. Formulation of mathematical models for systems, concepts, and methods of improving search, linear programming and sensitivity analysis, network models, and integer programming.

I E 341. Production Systems.

(3-0) Cr. 3. F. Prereq: STAT 231; credit or enrollment in I E 312

Introduction of key concepts in the design and analysis of production systems. Topics include inventory control, forecasting, material requirement planning, project planning and scheduling, operations scheduling, and other production systems such as Just-In-Time (JIT), warehousing, and global supply chains.

I E 348. Solidification Processes.

(Cross-listed with MAT E). (2-2) Cr. 3. S. Prereq: I E 248 and MAT E 273, or MAT E 215

Theory and applications related to metal casting, welding, polymer processing, powder metallurgy, and composites manufacturing.

I E 361. Statistical Quality Assurance.

(Cross-listed with STAT). (2-2) Cr. 3. F.S. Prereq: STAT 231, STAT 301, STAT 326 or STAT 401

Statistical methods for process improvement. Simple quality assurance principles and tools. Measurement system precision and accuracy assessment. Control charts. Process capability assessment. Experimental design and analysis for process improvement. Significant external project in process improvement.

I E 396. Summer Internship.

Cr. R. Repeatable. SS. Prereq: Permission of department and Engineering Career Services

Summer professional work period.

I E 397. Engineering Internship.

Cr. R. Repeatable. F.S. Prereq: Permission of department and Engineering Career Services

Professional work period for a maximum of one semester per academic year. Offered on a satisfactory-fail basis only.

I E 398. Cooperative Education.

Cr. R. F.S.SS. Prereq: I E 298, permission of department and Engineering Career Services

Second professional work period in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

I E 403. Introduction to Sustainable Production Systems.

(Dual-listed with I E 503). (3-0) Cr. 3. Prereq: Credit or enrollment I E 341

Quantitative introduction of sustainability concepts in production planning and inventory control. Review of material recovery (recycling) and product/component recovery (remanufacturing) from productivity perspectives. Sustainability rubrics ranging from design and process to systems. Application to multi-echelon networks subject to forward/backward flow of material and information. Closed-loop supply chains. Comparative study of sustainable vs. traditional models for local and global production systems.

I E 413. Stochastic Modeling, Analysis and Simulation.

(4-0) Cr. 4. F. Prereq: MATH 267, STAT 231

Development and analysis of simulation models using a simulation language. Application to various areas of manufacturing and service systems such as assembly, material handling, and customer queues. Utilizing model output to make important business decisions. Fitting of data to statistical distributions. Introduction to Markov processes and other queuing models.

I E 432. Industrial Automation.

(2-3) Cr. 3. S. Prereq: Phys 222

Overview of electrical circuit theory and its relationship to industrial control systems. Theory and application of transducers in the form of sensors and actuators, with applications in manufacturing, distribution and mechanical systems. Programmable Logic Controllers (PLC), their programming and use for automation solutions. Introduction of automated identification systems such as Radio Frequency Identification (RFID) and Bar Coding technologies.

I E 441. Industrial Engineering Design.

(1-6) Cr. 3. F.S. Prereq: I E 248, I E 271, I E 361; credit or enrollment in I E 341, I E 413, and I E 448

A large, open-ended design project related to an enterprise. Application of engineering design principles including problem definition, analysis, synthesis, and evaluation.

I E 446. Geometric Variability in Manufacturing.

(Dual-listed with I E 546). (3-0) Cr. 3. Prereq: I E 348, or MAT E 216, or ME 324 Assessment, accommodation, and control of geometric variability in manufacturing processes, specifically composites, metalcasting, welding, machining, and powder metallurgy. Techniques include the design of the component, tooling and process plan. The use of contact and noncontact measurement methods to assess variation.

I E 447. Biomedical Design and Manufacturing.

(Dual-listed with I E 547). (3-0) Cr. 3. Prereq: Students with two semesters or less before graduation

Exploration of biology, materials, body mechanics, manufacturing, quality control, and ethics and the intersection of these subjects as they relate to biomedical manufacturing.

I E 448. Manufacturing Systems Engineering.

(3-0) Cr. 3. S. Prereq: I E 248, I E 305

Fixturing and tooling requirements for manufacturing process planning, geometric dimensioning and tolerancing, computer aided inspection, cellular and flexible manufacturing, and facility layout. Lean manufacturing principles and controlled flow production.

I E 449. Computer Aided Design and Manufacturing.

(Dual-listed with I E 549). (3-0) Cr. 3. Prereq: Prereq: I E 248 or similar manufacturing engineering course, MATH 265.

Representation and interpretation of curves, surfaces and solids. Parametric curves and surfaces and solid modeling. Use of CAD software and CAD/CAM integration. Computer numerical control, CNC programming languages, and process planning.

I E 450. Technical Sales for Engineers I.

(3-0) Cr. 3. F. Prereq: Credit or enrollment in I E 305.

Sales process methodology, techniques for building professional relationships, sales automation software, prospecting and account development, market analysis and segmentation, responding to RFQ's and RFP's in written and verbal form. Developing technical value propositions and competitive positioning, evaluating organizational decision processes and people, technical marketing strategies, sales closing strategies.

I E 451. Technical Sales for Engineers II.

(3-0) Cr. 3. S. Prereq: I E 450

Case studies and experiential lessons on the development and application of technical sales strategies. Specific topics include developing pricing and distribution strategies, managing a sales staff and channel, developing sales teams and global sales plans, bid and negotiation strategies, time management skills, and implementing sales automation technologies.

I E 466. Multidisciplinary Engineering Design.

(Cross-listed with A B E, AER E, CPR E, E E, ENGR, M E, MAT E). (1-4) Cr. 3. Repeatable. F.S. Prereq: Student must be within two semesters of graduation and permission of instructor.

Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

I E 467. Multidisciplinary Engineering Design II.

(Cross-listed with AER E, CPR E, E E, ENGR, M E, MAT E). (1-4) Cr. 3. Repeatable, maximum of 2 times. F.S. Prereq: Student must be within two semesters of graduation or receive permission of instructor.

Build and test of a conceptual design. Detail design, manufacturability, test criteria and procedures. Application of design tools such as CAD and CAM and manufacturing techniques such as rapid prototyping. Development and testing of a full-scale prototype with appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

I E 481. e-Commerce Systems Engineering.

(Dual-listed with I E 581). (3-0) Cr. 3. Prereq: I E 148

Design, analysis, and implementation of e-commerce systems. Information infrastructure, enterprise models, enterprise processes, enterprise views. Data structures and algorithms used in e-commerce systems, SQL, exchange protocols, client/server model, web-based views.

I E 483. Knowledge Discovery and Data Mining.

(Dual-listed with I E 583). (3-0) Cr. 3. Prereq: I E 148, I E 312, and STAT 231 Introduction to data warehouses and knowledge discovery. Techniques for data mining, including probabilistic and statistical methods, genetic algorithms and neural networks, visualization techniques, and mathematical programming. Advanced topics include web-mining and mining of multimedia data. Case studies from both manufacturing and service industries. A computing project is required.

I E 490. Independent Study.

Cr. 1-5. Repeatable. Prereq: Senior classification, permission of instructor Independent study and work in the areas of industrial engineering design, practice, or research.

I E 490H. Independent Study: Honors.

Cr. 1-5. Repeatable. Prereq: Senior classification, permission of instructor Independent study and work in the areas of industrial engineering design, practice, or research.

I E 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. Prereq: I E 298, permission of department and Engineering Career Services

Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:**I E 501. M.S. Research Basics and Communications.**

Cr. R. Repeatable. Prereq: Enrollment in M.S. or M.Eng. program in Industrial Engineering.

Principles and practices for research tasks at the M.S. level including proposal writing, presentations, paper preparation, and project management. Offered on a satisfactory-fail basis only.

I E 502. M.S. Research Conduct.

Cr. R. Repeatable. Prereq: Enrollment in M.S. program in Industrial Engineering. Responsible conduct of research at the M.S. level, including ethical issues in peer review, conflicts of interest, mentoring, human subjects and live animals, data management, and collaboration. Offered on a satisfactory-fail basis only.

I E 503. Introduction to Sustainable Production Systems.

(Dual-listed with I E 403). (3-0) Cr. 3. Prereq: Credit or enrollment I E 341 Quantitative introduction of sustainability concepts in production planning and inventory control. Review of material recovery (recycling) and product/component recovery (remanufacturing) from productivity perspectives. Sustainability rubrics ranging from design and process to systems. Application to multi-echelon networks subject to forward/backward flow of material and information. Closed-loop supply chains. Comparative study of sustainable vs. traditional models for local and global production systems.

I E 508. Design and Analysis of Allocation Mechanisms.

(3-0) Cr. 3. Prereq: I E 312 or MATH 307

Market-based allocation mechanisms from quantitative economic systems perspective. Pricing and costing models designed and analyzed with respect to decentralized decision processes, information requirements, and coordination. Financial Engineering Techniques. Case studies and examples from industries such as regulated utilities, semiconductor manufacturers, and financial engineering services.

I E 510. Network Analysis.

(3-0) Cr. 3. Prereq: I E 312

Formulation and solution of deterministic network flow problems including shortest path, minimum cost flow, and maximum flow. Network and graph formulations of combinatorial problems including assignment, matching, and spanning trees. Introduction to deterministic and stochastic dynamic programming.

I E 513. Analysis of Stochastic Systems.

(3-0) Cr. 3. Prereq: STAT 231

Introduction to modeling and analysis of manufacturing and service systems subject to uncertainty. Topics include the Poisson process, renewal processes, Markov chains, and Brownian motion. Applications to inventory systems, production system design, production scheduling, reliability, and capacity planning.

I E 514. Production Scheduling.

(3-0) Cr. 3. Prereq: I E 312, I E 341

Introduction to the theory of machine shop systems. Complexity results for various systems such as job, flow and open shops. Applications of linear programming, integer programming, network analysis. Enumerative methods for machine sequencing. Introduction to stochastic scheduling.

I E 519. Simulation Modeling and Analysis.

(3-0) Cr. 3. Prereq: COM S 311, STAT 401

Event scheduling, process interaction, and continuous modeling techniques. Probability and statistics related to simulation parameters including run length, inference, design of experiments, variance reduction, and stopping rules. Aspects of simulation languages.

I E 531. Quality Control and Engineering Statistics.

(Cross-listed with STAT). (3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: STAT 401; STAT 342 or STAT 447

Statistical methods and theory applicable to problems of industrial process monitoring and improvement. Statistical issues in industrial measurement; Shewhart, CUSUM, and other control charts; feedback control; process characterization studies; estimation of product and process characteristics; acceptance sampling, continuous sampling and sequential sampling; economic and decision theoretic arguments in industrial statistics.

I E 533. Reliability.

(Cross-listed with STAT). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 342 or STAT 432 or STAT 447

Probabilistic modeling and inference in engineering reliability; lifetime models, product limit estimator, probability plotting, maximum likelihood estimation for censored data, Bayesian methods in reliability, system reliability models, competing risk analysis, acceleration models and analysis of accelerated test data; analysis of recurrence data; planning studies to obtain reliability data.

I E 534. Linear Programming.

(3-0) Cr. 3. Prereq: I E 312

Develop linear models. Theory and computational aspects of the simplex method. Duality theory and sensitivity analysis. Introduction to interior point methods and column generation. Multiobjective linear programs.

I E 537. Reliability and Safety Engineering.(3-0) Cr. 3. *Prereq: STAT 231 or STAT 401*

Mathematical basics for dealing with reliability data, theory, and analysis. Bayesian reliability analysis. Engineering ethics in safety evaluations. Case studies of accidents in large technological systems. Fault and event tree analysis.

I E 541. Inventory Control and Production Planning.(3-0) Cr. 3. *Prereq: I E 341*

Economic Order Quantity, dynamic lot sizing, newsboy, base stock, and (Q,r) models. Material Requirements Planning, Just-In-Time (JIT), variability in production systems, push and pull production systems, aggregate and workforce planning, and capacity management. Supply Chain Contracts.

I E 543. Wind Energy Manufacturing.(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: Undergraduate engineering degree or permission of instructor.*

Materials, processes and systems required to produce the major components (blades, towers, nacelles) of megawatt scale wind turbines. Transportation, manufacturing siting and procurement decisions as it relates to these large components in an expanding industry.

I E 545. Rapid Prototyping and Manufacturing.(3-0) Cr. 3. *Prereq: Prereq: I E 248 or similar manufacturing engineering course, Math 265. Undergraduates: Permission of instructor.*

Introduction to rapid prototyping processes and other rapid manufacturing methodologies. Operating principles and characteristics of current and developing rapid prototyping processes. Use of rapid prototypes in product design, development, and service. Selection of rapid prototyping systems based on rapid methodologies used in manufacturing processes and rapid tooling approaches.

I E 546. Geometric Variability in Manufacturing.(Dual-listed with I E 446). (3-0) Cr. 3. *Prereq: I E 348, or MAT E 216, or M E 324* Assessment, accommodation, and control of geometric variability in manufacturing processes, specifically composites, metalcasting, welding, machining, and powder metallurgy. Techniques include the design of the component, tooling and process plan. The use of contact and noncontact measurement methods to assess variation.**I E 547. Biomedical Design and Manufacturing.**(Dual-listed with I E 447). (3-0) Cr. 3. *Prereq: Students with two semesters or less before graduation*

Exploration of biology, materials, body mechanics, manufacturing, quality control, and ethics and the intersection of these subjects as they relate to biomedical manufacturing.

I E 549. Computer Aided Design and Manufacturing.(Dual-listed with I E 449). (3-0) Cr. 3. *Prereq: Prereq: I E 248 or similar manufacturing engineering course, MATH 265.*

Representation and interpretation of curves, surfaces and solids. Parametric curves and surfaces and solid modeling. Use of CAD software and CAD/CAM integration. Computer numerical control, CNC programming languages, and process planning.

I E 561. Continuous Quality Improvement of Process.(3-0) Cr. 3. *Prereq: I E 361*

Methods for continuous quality improvement in process analysis. The systems analysis for process improvement model based on W. Edwards Deming. Quality function deployment methods. Case studies of applications to manufacturing and other heavy industries. Use of process analysis computerized programs and tools for design analysis.

I E 565. Systems Engineering and Analysis.(Cross-listed with AER E, E E). (3-0) Cr. 3. *Prereq: Coursework in basic statistics* Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated systems. Life cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test and evaluation, and systems engineering planning and organization. Not available for degrees in industrial engineering.**I E 566. Applied Systems Engineering.**(3-0) Cr. 3. *Prereq: I E 565*

Design for reliability, maintainability, usability, supportability, producibility, disposability, and life cycle costs in the context of the systems engineering process. Students will be required to apply the principles of systems engineering to a project including proposal, program plan, systems engineering management plan, and test and evaluation plan. Not available for degrees in industrial engineering.

I E 570. Systems Engineering and Project Management.(3-0) Cr. 3. *Prereq: Coursework in basic statistics*

Systems view of projects and the processes by which they are implemented. Focuses on qualitative and quantitative tools and techniques of project management. Specific systems concepts, methodologies, and tools for effective management of both simple and complex projects. Introduction of important performance parameters for planning, cost control, scheduling, and productivity, including discussions of traditional and state of the art tools and systems.

I E 571. Occupational Biomechanics.(3-0) Cr. 3. *Prereq: E M 274, STAT 231*

Anatomical, physiological, and biomechanical bases of physical ergonomics. Anthropometry, body mechanics, strength of biomaterials, human motor control. Use of bioinstrumentation, passive industrial surveillance techniques and active risk assessment techniques. Acute injury and cumulative trauma disorders. Static and dynamic biomechanical modeling. Emphasis on low back, shoulder and hand/wrist biomechanics.

I E 572. Design and Evaluation of Human-Computer Interaction.(3-0) Cr. 3. *Prereq: I E 577 or instructor's permission*

Human factors methods applied to interface requirements, design, prototyping, and evaluation. Concepts related to understanding user characteristics, design principles, usability analysis, methods and techniques for design and evaluation of the interface. The evaluation and design of the information presentation characteristics of a wide variety of interfaces: web sites (e-commerce), mobile applications, and information presentation systems (cockpits, instrumentation, etc.).

I E 576. Human Factors in Product Design.(3-0) Cr. 3. *Prereq: I E 572 or I E 577*

Investigation of the human interface to consumer and industrial systems and products, providing a basis for their design and evaluation. Discussions of human factors in the product design process: modeling the human during product use; usability; human factors methods in product design evaluation; user-device interface; safety, warnings, and instructions for products; considerations for human factors in the design of products for international use.

I E 577. Human Factors.(3-0) Cr. 3. *Prereq: I E 271 or graduate classification*

Physical and psychological factors affecting human performance in systems. Signal detection theory, human reliability modeling, information theory, and performance shaping applied to safety, reliability, productivity, stress reduction, training, and human/equipment interface design. Laboratory assignments related to system design and operation.

I E 581. e-Commerce Systems Engineering.(Dual-listed with I E 481). (3-0) Cr. 3. *Prereq: I E 148*

Design, analysis, and implementation of e-commerce systems. Information infrastructure, enterprise models, enterprise processes, enterprise views. Data structures and algorithms used in e-commerce systems, SQL, exchange protocols, client/server model, web-based views.

I E 582. Enterprise Modeling and Integration.(3-0) Cr. 3. *Prereq: 3 credits in information technology or information systems*

The design and analysis of enterprise models to support information engineering of enterprise-wide systems. Representation of system behavior and structure including process modeling, information modeling, and conceptual modeling. Applications in enterprise application integration, enterprise resource planning systems, product data management systems, and manufacturing execution systems.

I E 583. Knowledge Discovery and Data Mining.(Dual-listed with I E 483). (3-0) Cr. 3. *Prereq: I E 148, I E 312, and STAT 231*

Introduction to data warehouses and knowledge discovery. Techniques for data mining, including probabilistic and statistical methods, genetic algorithms and neural networks, visualization techniques, and mathematical programming. Advanced topics include web-mining and mining of multimedia data. Case studies from both manufacturing and service industries. A computing project is required.

I E 585. Requirements Engineering.(3-0) Cr. 3. *Prereq: 3 credits in information technology or information systems*

Principles and practices for requirements engineering as part of the product development process with emphasis on software systems engineering. Problem definition, problem analysis, requirements analysis, requirements elicitation, validation, specifications. Case studies using requirements engineering methods and techniques.

I E 588. Information Systems for Manufacturing.(3-0) Cr. 3. *Prereq: I E 148, I E 448*

Design and implementation of systems for the collection, maintenance, and usage of information needed for manufacturing operations, such as process control, quality, process definition, production definitions, inventory, and plant maintenance. Topics include interfacing with multiple data sources, methods to utilize the information to improve the process, system architectures, and maintaining adequate and accurate data for entities internal and external to the enterprise to achieve best manufacturing practices.

I E 590. Special Topics.

Cr. 1-3. Repeatable.

Advanced study of a research topic in the field of industrial engineering.

Courses for graduate students:**I E 601. Ph.D. Research Basics and Communications.**Cr. R. Repeatable. *Prereq: Enrollment in Ph.D. program in Industrial Engineering.*

Principles and practices for conducting research at the Ph.D. level, including problem definition, proposal writing, presentations, conference proceedings, paper preparation, and project management. Offered on a satisfactory-fail basis only.

I E 602. Ph.D. Research Conduct.Cr. R. Repeatable. *Prereq: Enrollment in Ph.D. program in Industrial Engineering*

Responsible conduct of research at the Ph.D. level, including ethical issues in peer review, conflicts of interest, mentoring, human subjects and live animals, data management, and collaboration. Offered on a satisfactory-fail basis only.

I E 613. Stochastic Production Systems.(3-0) Cr. 3. *Prereq: I E 513*

Modeling techniques to evaluate performance and address issues in design, control, and operation of systems. Markov models of single-stage make-to-order and make-to-stock systems. Approximations for non-Markovian systems. Impact of variability on flow lines. Open and closed queuing networks.

I E 631. Nonlinear Programming.(3-0) Cr. 3. *Prereq: I E 534*

Develop nonlinear models, convex sets and functions, optimality conditions, Lagrangian duality, unconstrained minimization techniques. Constrained minimization techniques covering penalty and barrier functions, sequential quadratic programming, the reduced gradient method.

I E 632. Integer Programming.(3-0) Cr. 3. *Prereq: I E 534*

Integer programming including cutting planes, branch and bound, and Lagrangian relaxation. Introduction to complexity issues and search-based heuristics.

I E 633. Stochastic Programming.(3-0) Cr. 3. *Prereq: I E 513 or STAT 447, I E 534 or equivalent*

Mathematical programming with uncertain parameters; modeling risk within optimization; multi-stage recourse and probabilistically constrained modes; solution and approximation algorithms including dual decomposition and progressive hedging; and applications to planning, allocation and design problems.

I E 634. Computational Optimization.(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: I E 534 or equivalent.*

Theory, algorithm, and computer implementation of optimization models. Simplex, Benders decomposition, computational complexity, mixed integer linear program, linear program with complementarity constraints, inverse optimization, bilevel discrete optimization. CPLEX, Matlab, and Tomlab will be used for computer implementation.

I E 642. Simultaneous Engineering in Manufacturing Systems.(3-0) Cr. 3. *Prereq: I E 549 or M E 415*

Current engineering methods for the product life cycle process. Feature-based design, computer-aided process planning, and data-driven product engineering.

I E 671. Research Practicum in Human Factors and Ergonomics.(3-0) Cr. 3. Repeatable. *Prereq: I E 571 or I E 577 or I E 572*

Research topic development, literature evaluation, experimental design, use of bioinstrumentation, data collection, basic data interpretation, statistical analysis, manuscript preparation.

I E 681. Cognitive Engineering.(Cross-listed with HCI). (3-0) Cr. 3. *Prereq: I E 572 or I E 577 or PSYCH 516 or HCI/PSYCH 521 or equivalent*

Provides an overview of human cognitive capabilities and limitations in the design of products, work places, and large systems. Contexts vary broadly and could range from simple use of mobile devices to an air-traffic control or nuclear plant command center. Course focuses on what we can infer about users' thoughts and feelings based on what we can measure about their performance and physiological state. Covers the challenge of designing automated systems.

I E 690. Advanced Topics.Cr. 1-3. Repeatable. *Prereq: Permission of the instructor*

Advanced topics related to Ph.D. research in industrial engineering under the direction of the instructor.

I E 697. Engineering Internship.Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department*

Professional work period for a maximum of one semester per academic year. Offered on a satisfactory-fail basis only.

I E 699. Research.

Cr. arr. Repeatable.

Information Assurance (INFAS)

Courses primarily for undergraduates:

INFAS 131. Introduction to Computer Security Literacy.

(Cross-listed with CPR E). (1-0) Cr. 1.

Basic concepts of practical computer and Internet security: passwords, firewalls, antivirus software, malware, social networking, surfing the Internet, phishing, and wireless networks. This class is intended for students with little or no background in information technology or security. Basic knowledge of word processing required. Offered on a satisfactory-fail basis only.

INFAS 332. Cyber Defense Competition.

(Cross-listed with CPR E). (0-2) Cr. 1. Repeatable. S.

Participation in cyber defense competition driven by scenario-based network design. Includes computer system setup, risk assessment and implementation of security systems, as well as defense of computer and network systems against trained attackers. Team based. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

INFAS 530. Network Protocols and Security.

(Cross-listed with CPR E). (3-0) Cr. 3. *Prereq: CPR E 381 or equivalent*

Detailed examination of networking standards, protocols, and their implementation. TCP/IP protocol suite, network application protocols. Network security issues, attack and mitigation techniques. Emphasis on laboratory experiments.

INFAS 531. Information System Security.

(Cross-listed with CPR E). (3-0) Cr. 3. *Prereq: CPR E 489 or CPR E 530 or COM S 586 or MIS 535*

Computer, software, and data security: basic cryptography, security policies, multilevel security models, attack and protection mechanisms, legal and ethical issues.

INFAS 532. Information Warfare.

(Cross-listed with CPR E). (3-0) Cr. 3. S. *Prereq: CPR E 531*

Computer system and network security: implementation, configuration, testing of security software and hardware, network monitoring. Authentication, firewalls, vulnerabilities, exploits, countermeasures. Study and use of attack tools. Ethics in information assurance. Emphasis on laboratory experiments.

INFAS 533. Cryptography.

(Cross-listed with CPR E, MATH). (3-0) Cr. 3. S. *Prereq: MATH 301 or CPR E 310 or COM S 330*

Basic concepts of secure communication, DES and AES, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, applications. Relevant material on number theory and finite fields.

INFAS 534. Legal and Ethical Issues in Information Assurance.

(Cross-listed with CPR E, POL S). (3-0) Cr. 3. S. *Prereq: Graduate classification; CPR E 531 or INFAS 531*

Legal and ethical issues in computer security. State and local codes and regulations. Privacy issues.

INFAS 535. Steganography and Digital Image Forensics.

(Cross-listed with CPR E, MATH). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: E E 524 or MATH 317 or MATH 407 or COM S 330*

Basic principles of covert communication, steganalysis, and forensic analysis for digital images. Steganographic security and capacity, matrix embedding, blind attacks, image forensic detection and device identification techniques. Related material on coding theory, statistics, image processing, pattern recognition.

INFAS 536. Computer and Network Forensics.

(Cross-listed with CPR E). (3-0) Cr. 3. *Prereq: CPR E 489 or CPR E 530*

Fundamentals of computer and network forensics, forensic duplication and analysis, network surveillance, intrusion detection and response, incident response, anonymity and pseudonymity, privacy-protection techniques, cyber law, computer security policies and guidelines, court testimony and report writing, and case studies. Emphasis on hands-on experiments.

INFAS 538. Reverse Engineering and Security Testing.

(Cross-listed with CPR E). (2-3) Cr. 3. S. *Prereq: COM S 321 or CPR E 381, COM S 352 or CPR E 308*

Techniques and tools for understanding the behavior of software/hardware systems based on reverse engineering. Flaw hypothesis, black, grey, and white box testing as well as other methods for testing the security of software systems. Discussion of counter-reverse engineering techniques.

INFAS 592. Seminar in Information Assurance.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Projects or seminar in Information Assurance.

Courses for graduate students:

INFAS 632. Information Assurance Capstone Design.

(Cross-listed with CPR E). (3-0) Cr. 3. *Prereq: INFAS 531, INFAS 532, INFAS 534*

Capstone design course which integrates the security design process. Design of a security policy. Creation of a security plan. Implementation of the security plan. The students will attack each other's secure environments in an effort to defeat the security systems. Students evaluate the security plans and the performance of the plans. Social, political and ethics issues. Student self-evaluation, journaling, final written report.

INFAS 697. Information Assurance Summer Internship.

Cr. R. *Prereq: Permission of department, graduate classification*

One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

Integrated Studio Arts (ARTIS)

Courses primarily for undergraduates:

ARTIS 201. Creative Visual Thinking.

(0-6) Cr. 3. F.S.

Exploration of the nature of visual perception in relation to issues of visual communication, problem solving, envisioning information, and visual thinking. Studio assignments to be digitized and sent to instructor electronically for evaluation and critique.

ARTIS 202. Studio Fundamentals: Wood.

(0-8) Cr. 2. F.S. Prereq: Open to all students; sophomore level and above. Required of all ISA BFA majors

Half-semester course. Introduction to wood's physical properties, its potential as an expressive medium, and basic wood working hand tools and techniques.

ARTIS 203. Studio Fundamentals: Jewelry/Metalsmithing.

(0-8) Cr. 2. F.S. Prereq: Open to all students; sophomore level and above. Required of all ISA BFA majors

Half semester course. Introduction to basic jewelry/metals design and fabrication. Forming, texturing, and joining techniques (soldering/riveting) will be explored and applied to two projects.

ARTIS 204. Studio Fundamentals: Ceramics.

(0-8) Cr. 2. F.S. Prereq: Open to all students, sophomore level and above. Half-semester course providing an introduction to ceramic techniques including hand-building, high fire and low fire glaze applications and expressive approaches. The emphasis is on creative communication through ceramics. Course is open to all students and required for all Integrated Studio Arts BFA majors.

ARTIS 206. Studio Fundamentals: Printmaking.

(0-8) Cr. 2. F.S. Prereq: Open to all students, sophomore level and above. Introduction to relief, monoprint, lithographic and intaglio printing as methods for visual communication and expression. Course is open to all students and required for all Integrated Studio Arts BFA majors.

ARTIS 208. Color.

(0-6) Cr. 3. F.S. Prereq: DSN S 102, DSN S 131, and DSN S 183. Open to all students, sophomore level and above. Required for all ISA BFA students. The impact of changing visual relationships emphasizing physical and psychological and cultural color concepts. Additive and subtractive mixing and color interaction exercises and assignments using various color media. Required for all Integrated Studio Arts BFA majors.

ARTIS 210. Studio Fundamentals: Photo.

(0-8) Cr. 2. F.S. Prereq: Open to all students, sophomore level and above. Introduction to camera operation and traditional black and white darkroom methods as means of visual communication and creative expression. Course is open to all students and required for all Integrated Studio Arts BFA majors.

ARTIS 212. Studio Fundamentals: Computers.

(0-8) Cr. 2. F.S. Prereq: Open to all students, sophomore level and above. Half-semester course. Introduction to image acquisition, Adobe PhotoShop and Illustrator. Course is open to all students and required for all Integrated Studio Arts BFA majors.

ARTIS 213. Studio Fundamentals: Painting.

(0-8) Cr. 2. F.S. Prereq: Open to all students, sophomore level and above. Half-semester course. Introduction to preparation of painting grounds, color mixing, manipulation of paint and pictorial space as methods for visual communication and expression. Course is open to all students and required for all Integrated Studio Arts BFA majors.

ARTIS 214. Studio Fundamentals: Textiles.

(0-8) Cr. 2. F.S. Prereq: Open to all students, sophomore level and above. Half semester course. Introduction to two-dimensional and three-dimensional textile techniques used for visual communication and expression. Course is open to all students and required for all Integrated Studio Arts BFA majors.

ARTIS 227. Introduction to Creative Digital Photography.

(0-6) Cr. 3. Prereq: DSN S 102, DSN S 131 and DSN S 183 or permission of instructor.

This course will include the functions and operations of the digital camera, scanning and other image input devices, digital image manipulation, software usage and support, color management and printing, presentation of images, compositional dynamics and the development of "seeing" as a medium of design, expression, and communication. Students should have access to a good or high quality digital camera with the ability to separately adjust shutter speed, f/stop and exposure, a laptop with updated Adobe Photoshop software, and enough digital storage for all class assignments.

ARTIS 227H. Introduction to Creative Digital Photography: Honors.

(0-6) Cr. 3-4. Prereq: DSN S 102, DSN S 131 and DSN S 183

This course will include the functions and operations of the digital camera, scanning and other image input devices, digital image manipulation, software usage and support, color management and printing, presentation of images, compositional dynamics and the development of "seeing" as a medium of design, expression, and communication. Students should have access to a good or high quality digital camera with the ability to separately adjust shutter speed, f/stop and exposure, a laptop with updated Adobe Photoshop software, and enough digital storage for all class assignments.

ARTIS 229. Introduction to Darkroom Photography.

(0-6) Cr. 3. Prereq: DSN S 102, DSN S 131 and DSN S 183 or permission of instructor

Photography as a creative medium of art, design, expression and communication. Camera techniques and black and white wet lab processing taught. Alternative processes explored as time permits. 35 mm camera with manual exposure controls is required.

ARTIS 229H. Introduction to Darkroom Photography, Honors.

(0-6) Cr. 3-4. Prereq: DSN S 102, DSN S 131 and DSN S 183 or permission of instructor

Photography as a creative medium of art, design, expression and communication. Camera techniques and black and white wet lab processing taught. Alternative processes explored as time permits. 35 mm camera with manual exposure controls is required.

ARTIS 230. Drawing II.

(0-6) Cr. 3. F.S. Prereq: DSN S 102, DSN S 183 and DSN S 131

A continuation of DSN S 131 (Design Representation). Further development of perceptual drawing skills from a variety of subject matter. Continued practice with drawing materials and techniques with emphasis on tonal and color media.

ARTIS 233. Watercolor Painting.

(0-6) Cr. 3. Prereq: ARTIS 230

Fundamentals of painting using water-based media applied to observation-based painting. Subject matter may include working from actual or two-dimensional references of still life, landscape, architectural space, and the human form.

ARTIS 233H. Watercolor Painting: Honors.

(0-6) Cr. 3-4. Prereq: ARTIS 230

Fundamentals of painting using water-based media applied to observation-based painting. Subject matter may include working from actual or two-dimensional references of still life, landscape, architectural space, and the human form.

ARTIS 238. Painting I.

(0-6) Cr. 3. F.S. Prereq: ARTIS 230

Fundamentals of painting using acrylic and oil media applied to observation-based painting. Subject matter may include working from actual or two-dimensional references of still life, landscape, and the human form.

ARTIS 238H. Painting I: Honors.

(0-6) Cr. 3-4. F.S. Prereq: ARTIS 230

Fundamentals of painting using acrylic and oil media applied to observation-based painting. Subject matter may include working from actual or two-dimensional references of still life, landscape, and the human form.

ARTIS 305. Integrated Media.

(Dual-listed with ARTIS 505). (0-6) Cr. 3. Repeatable. Prereq: 6 credits of 200 level studio

Integration and exploration of materials and methods that combine traditional and innovative approaches. Emphasis on conceptual development.

ARTIS 308. Computer Modeling, Rendering and Virtual Photography.

(0-6) Cr. 3. Prereq: ARTIS 230 or permission of instructor

Introduction to 3D modeling using computer and available software. Modeling, texturing, lighting, and rendering with respect to 3D object and still scene creation.

ARTIS 308H. Computer Modeling, Rendering and Virtual Photography; Honors.

(0-6) Cr. 3-4. *Prereq: ARTIS 230 or permission of instructor*
Introduction to 3D modeling using computer and available software. Modeling, texturing, lighting, and rendering with respect to 3D object and still scene creation.

ARTIS 310. Sources and Methods of Visual Design.

(1-4) Cr. 3.
Study and application of methods used by contemporary artists for the purpose of generating ideas for new work. Field trip.

ARTIS 311. Contemporary Issues in Studio Art.

Cr. 3.
Exploration of issues and directions in current art. Readings, discussions, and studio research projects to build an experimental and applied knowledge base for understanding each student's place in the contemporary art world.

ARTIS 319. Studio Furniture.

(3-0) Cr. 3. F.
Overview of American studio furniture since 1940 including noted makers, important examples, and diverse approaches. Discussion of workmanship and the principles of furniture design. Field trip.

ARTIS 320. Introduction to Furniture Design.

(0-6) Cr. 3. *Prereq: ARTIS 202 or permission of instructor.*
Design and production of basic furniture forms in wood. Introduction to power tools. Develop an individual design process including an understanding of scale and proportion. Develop a deeper understanding of wood and the social and environmental implications of choices in regards to materials and processes used in furniture production.

ARTIS 320H. Introduction to Furniture Design: Honors.

(0-6) Cr. 3-4. *Prereq: ARTIS 202 or permission of instructor.*
Design and production of basic furniture forms in wood. Introduction to power tools. Develop an individual design process including an understanding of scale and proportion. Develop a deeper understanding of wood and the social and environmental implications of choices in regards to materials and processes used in furniture production.

ARTIS 322. Intermediate Ceramics Studio.

(0-6) Cr. 3. *Prereq: ARTIS 204*
Further investigation of expressive forms and techniques in ceramics; introduction to throwing on the wheel, to exploration of utilitarian and sculptural approaches in the medium, and to glaze research and electric kiln firing.

ARTIS 322H. Intermediate Ceramics Studio: Honors.

(0-6) Cr. 3-4. *Prereq: ARTIS 204*
Further investigation of expressive forms and techniques in ceramics; introduction to throwing on the wheel, to exploration of utilitarian and sculptural approaches in the medium, and to glaze research and electric kiln firing.

ARTIS 323. Scientific Illustration Principles and Techniques.

(Cross-listed with BPM I). (0-6) Cr. 3. Repeatable. *Prereq: 6 credits in art and design and 3 credits in biological sciences*
Studio basics and professional techniques in black & white, continuous tone, and color. Emphasis on tools, materials, and rendering.

ARTIS 324. Jewelry/Metalsmithing II.

(0-6) Cr. 3. *Prereq: ARTIS 203 or permission of instructor*
Continued study of traditional and contemporary metalsmithing fabrication techniques applicable to jewelry and object construction, including container forms. Emphasis on design, modeling and rendering techniques and progressive skill development. Basic stone setting and lost wax casting introduced.

ARTIS 324H. Jewelry/Metalsmithing II: Honors.

(0-6) Cr. 3-4. *Prereq: ARTIS 203 or permission of instructor*
Continued study of traditional and contemporary metalsmithing fabrication techniques applicable to jewelry and object construction, including container forms. Emphasis on design, modeling and rendering techniques and progressive skill development. Basic stone setting and lost wax casting introduced.

ARTIS 325. Integrated Studio Arts Seminar.

(2-0) Cr. 2. Repeatable, maximum of 6 credits. *Prereq: Open to ISA BFA majors*
Contemporary issues in studio arts explored through lectures, presentations and critiques.

ARTIS 326. Illustration and Illustration Software.

(Cross-listed with BPM I). (0-6) Cr. 3. Repeatable. *Prereq: ARTIS 323*
Application of painting, drawing, and image making techniques to communication. Development of technical abilities using illustration software. Digital and print production techniques.

ARTIS 327. Illustration as Communication.

(Cross-listed with BPM I). (0-6) Cr. 3. *Prereq: ARTIS 326*
Studio problems in illustration emphasizing composition and communication. Problem solving methodologies.

ARTIS 329. Creative Photography.

(0-6) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ARTIS 210 or ARTIS 229 or permission of instructor*
Continuation and expansion of concepts and processes from introductory photography. Individual thematic work is enriched by connection to photographic history and pluralist perspectives.

ARTIS 329H. Creative Photography, Honors.

(0-6) Cr. 3-4. Repeatable, maximum of 6 credits. *Prereq: ARTIS 210 or ARTIS 229 or permission of instructor*
Continuation and expansion of concepts and processes from introductory photography. Individual thematic work is enriched by connection to photographic history and pluralist perspectives.

ARTIS 330. Drawing III: Life Drawing.

(0-6) Cr. 3. Repeatable. *Prereq: ARTIS 230*
Drawing from the human figure.

ARTIS 330H. Drawing III: Life Drawing, Honors.

(0-6) Cr. 3-4. Repeatable. *Prereq: ARTIS 230*
Drawing from the human figure.

ARTIS 331. Alternative materials for Artist/Designer.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: 200 level ISA studio courses, or permission of instructor*
Exploration of alternative materials (primarily non-metallics, both natural and manufactured) applicable to the design and creation of small designed objects and adornment. Students will learn additive and reductive processes, experiment with found object inclusion, rubber mold- making, and resin casting. A series of finished pieces will result. Open to all majors in the College of Design.

ARTIS 335. Three-Dimensional Studio.

(Cross-listed with ARCH). (1-4) Cr. 3. Repeatable, maximum of 6 credits.
This course deals with three dimensional problems in visual invention, organization, and expression emphasizing creative manipulation of tools, materials, and techniques as means for three dimensional thinking. Projects cover the additive (modeling), subtractive (carving), substitutional (casting) as well as constructive techniques.

ARTIS 337. Application of Scientific Illustration Techniques.

(Cross-listed with BPM I). (0-6) Cr. 3. Repeatable, maximum of 6 credits. S. *Prereq: ARTIS 327*
Rendering techniques applied to different types of biological and scientific subjects emphasizing communication. The use of traditional and digital media. Term project required.

ARTIS 338. Painting II.

(0-6) Cr. 3. Repeatable. *Prereq: ARTIS 238 or ARTIS 213 and ARTIS 230*
Painting using acrylic and oil media; composition and expression.

ARTIS 338H. Painting II: Honors.

(0-6) Cr. 3-4. Repeatable. *Prereq: ARTIS 238 or ARTIS 213 and ARTIS 230*
Painting using acrylic and oil media; composition and expression.

ARTIS 345. Woven Textile Structures.

(0-6) Cr. 3. Repeatable. *Prereq: ARTIS 214 or permission of instructor*
Introduction to woven textile construction using commercial and hand-dyed yarns. Emphasis on technical development of weaving as a means for personal expression as well as an understanding of its role within the applied arts.

ARTIS 345H. Woven Textile Structures, Honors.

(0-6) Cr. 3-4. Repeatable. *Prereq: ARTIS 214 or permission of instructor*
Introduction to woven textile construction using commercial and hand-dyed yarns. Emphasis on technical development of weaving as a means for personal expression as well as an understanding of its role within the applied arts.

ARTIS 346. Textile Surface Design.

(0-6) Cr. 3-4. Repeatable. F.S. *Prereq: ARTIS 214 or permission of instructor*
Textile hand-dyeing and discharge methods on fabric to create complex surfaces. Other surface embellishment techniques, such as hand and machine stitching and application of textile pigments, will be introduced. Emphasis is on technical skill development and research, as well as creative use of textile surface design techniques for artistic expression.

ARTIS 346H. Textile Surface Design: Honors.

(0-6) Cr. 3-4. Repeatable. *Prereq: ARTIS 214 or permission of instructor.*
Textile hand-dyeing and discharge methods on fabric to create complex surfaces. Other surface embellishment techniques, such as hand and machine stitching and application of textile pigments, will be introduced. Emphasis is on technical skill development and research, as well as creative use of textile surface design techniques for artistic expression.

ARTIS 347. Printed Textile Design.

(0-6) Cr. 3-4. Repeatable. F.S. *Prereq: ARTIS 214 or permission of instructor*
Textile hand-printing methods on fabric including block, stencil and screen-printing using dyes, discharging agents and pigments. Digital printing on fabric will be introduced. Experimental printing methods will also be explored. Emphasis on research and development of surface design techniques as a means for personal expression.

ARTIS 347H. Printed Textile Design: Honors.

(0-6) Cr. 3-4. Repeatable. F.S. *Prereq: ARTIS 214 or permission of instructor*
Textile hand-printing methods on fabric including block, stencil and screen-printing using dyes, discharging agents and pigments. Digital printing on fabric will be introduced. Experimental printing methods will also be explored. Emphasis on research and development of surface design techniques as a means for personal expression.

ARTIS 356. Relief Printmaking: Digital/Traditional.

(Dual-listed with ARTIS 556). (0-6) Cr. 3-4. Repeatable, maximum of 6 credits. F.S. *Prereq: ARTIS 206 and ARTIS 230*
In-depth exploration of digital or traditional design and block cutting processes (computer/laser cutter/CNC router or drawing/chisels). Use relief printmaking to create a unified body of prints from those blocks. Emphasis is on experimental and creative use of printmaking with study of contemporary trends.

ARTIS 356H. Relief Printmaking: Digital/Traditional, Honors.

(0-6) Cr. 3-4. Repeatable, maximum of 6 credits. F.S. *Prereq: ARTIS 206 and ARTIS 230*
Explore the techniques and aesthetic qualities of black and white and color relief printmaking primarily through woodcuts and photopolymer plates. Emphasis is on experimental and creative use of printmaking for artistic expression.

ARTIS 357. Intaglio and Monotype Printmaking: Digital / Traditional.

(Dual-listed with ARTIS 557). (0-6) Cr. 3-4. Repeatable, maximum of 9 credits. F.S. *Prereq: ARTIS 206 and 230*
Explore the techniques and aesthetic qualities of black and white and color intaglio printmaking primarily through etching, aquatint, laser-cut plates and collagraph processes. Students will generate imagery through traditional drawing, collage and digital processes. Unique, one-of-a-kind black and white and color prints from Plexiglas will also be introduced. Emphasis is on experimental and creative use of printmaking for artistic expression.

ARTIS 357H. Intaglio and Monotype Printmaking: Digital / Traditional, Honors.

(0-6) Cr. 3-4. Repeatable, maximum of 9 credits. F.S. *Prereq: ARTIS 206 and ARTIS 230*
Explore the techniques and aesthetic qualities of black and white and color intaglio printmaking primarily through etching, aquatint, laser-cut plates and collagraph processes. Students will generate imagery through traditional drawing, collage and digital processes. Unique, one-of-a-kind black and white and color prints from Plexiglas will also be introduced. Emphasis is on experimental and creative use of printmaking for artistic expression.

ARTIS 358. Lithography: Digital / Traditional.

(Dual-listed with ARTIS 558). (0-6) Cr. 3. Repeatable. F.S. *Prereq: ARTIS 206 and credit or enrollment in ARTIS 230*
Examine the techniques and aesthetic qualities of lithography primarily through hand-drawn and photographic plates. Students may generate imagery through traditional drawing, collage or digital processes. Emphasis is on experimental and creative use of printmaking for artistic expression. For those taking the course for a second semester, focus is on stone lithography and increased work with color.

ARTIS 358H. Lithography: Digital / Traditional, Honors.

(0-6) Cr. 3-4. Repeatable. F.S. *Prereq: ARTIS 206 and credit or enrollment in ARTIS 230*
Examine the techniques and aesthetic qualities of lithography primarily through hand-drawn and photographic plates. Students may generate imagery through traditional drawing, collage or digital processes. Emphasis is on experimental and creative use of printmaking for artistic expression. For those taking the course for a second semester, focus is on stone lithography and increased work with color.

ARTIS 360. Sustainable Design and Fabrication of Furniture.

(0-6) Cr. 3. F.S.
An introduction to issues of design and fabrication of furniture focusing on sustainability. Exploration of the effect of consumers on design and how this affects our environment and our global society.

ARTIS 362. Artists, Designer and Sustainable Development.

(0-6) Cr. 3. S. *Prereq: Junior level standing in the University*
The artist/designer's role in sustainable development with a focus on cultural understanding of the collaborating communities. Class discussion, visual exercises, and the creation of creative collaborative service-learning projects, such as product design, habitat design, and visual arts projects. Preorientation for travel to Ghana in ARTIS 363.

ARTIS 363. Studio Abroad: Ghana.

(0-6) Cr. 3. SS. *Prereq: ARTIS 362*
Traveling studio to Ghana, West Africa; an experiential tour of arts and history combined with design focused, collaborative service-learning projects. Projects may include product development, design consultation, sustainable building design, and learning and teaching of visual arts. Student teams will develop projects in partnership with Ghanaians.
Meets International Perspectives Requirement.

ARTIS 399. BFA Professional Practice.

(2-0) Cr. 2. S. *Prereq: Junior classification in ISA BFA curriculum.*
Introduction to professional practices including development of portfolio (visual and written components). Lecture and presentation topics include applying to graduate school, internships, applying for jobs, grants/funding opportunities, professional networking, exhibition opportunities, and best practices for studio artists. Half-semester course. Required of all ISA majors.

ARTIS 407. Principles of 3D Character Animation.

(Dual-listed with ARTIS 507). (0-6) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: ARTIS 308*
Animation techniques using the computer and available software. Principles of character animation. Prior knowledge of modeling, lighting, texturing and rendering with available software is assumed.

ARTIS 408. Principles of 3D Animation.

(0-6) Cr. 3. Repeatable. *Prereq: ARTIS 308*
Animation techniques using the computer and available software. Principles of animation. Prior knowledge of modeling, lighting, texturing, animation and rendering with computer and available software is assumed.

ARTIS 408H. Principles of 3D Animation: Honors.

(0-6) Cr. 3-4. Repeatable. *Prereq: ARTIS 308*
Animation techniques using the computer and available software. Principles of animation. Prior knowledge of modeling, lighting, texturing, animation and rendering with computer and available software is assumed.

ARTIS 409. Computer/Video Game Design and Development.

(Dual-listed with ARTIS 509). (0-6) Cr. 3. Repeatable, maximum of 12 credits. *Prereq: Permission of instructor. Programming emphasis: COM S 227, COM S 228, COM S 229 or equivalent in engineering; art or graphics emphasis: ARTIS 230 and ARTIS 308; writing emphasis: an English course in creative writing or writing screen plays; business or marketing students: Junior classification*
Independent project based creation and development of "frivolous and non-frivolous" computer games in a cross-disciplinary team. Projects require cross-disciplinary teams. Aspects of Indie development and computer/video game history will be discussed.

ARTIS 420. Advanced Furniture Design.

(Dual-listed with ARTIS 520). (0-6) Cr. 3-4. Repeatable, maximum of 12 credits. F.S. *Prereq: ARTIS 320*
Design and creation of more complex furniture forms with consideration of precedents and innovative techniques and approaches. Continued development of a unique personal approach to the design and making of furniture. Refine your sensitivity to wood and understand the social and environmental implications of various materials used in furniture design and production.

ARTIS 420H. Advanced Furniture Design: Honors.

(0-6) Cr. 3-4. Repeatable, maximum of 12 credits. F.S. *Prereq: ARTIS 320*
Design and creation of more complex furniture forms with consideration of precedents and innovative techniques and approaches. Continued development of a unique personal approach to the design and making of furniture. Refine your sensitivity to wood and understand the social and environmental implications of various materials used in furniture design and production.

ARTIS 422. Ceramics Studio.

(Dual-listed with ARTIS 522). (0-6) Cr. 3. Repeatable, maximum of 12 credits. F.S. *Prereq: ARTIS 322*

In-depth investigation of ceramic forms and surfaces with an emphasis on personal art expression. Gas kiln firings, research into contemporary ceramic artists and development of increasingly skilled work are emphasized.

ARTIS 422H. Ceramics Studio: Honors.

(0-6) Cr. 3-4. Repeatable, maximum of 12 credits. F.S. *Prereq: ARTIS 322*

In-depth investigation of ceramic forms and surfaces with an emphasis on personal art expression. Gas kiln firings, research into contemporary ceramic artists and development of increasingly skilled work are emphasized.

ARTIS 424. Jewelry/Metalsmithing III.

(Dual-listed with ARTIS 524). (0-6) Cr. 3. Repeatable, maximum of 12 credits. F.S. *Prereq: ARTIS 324 or permission of instructor*

Emphasis on metal fabrication and hollow construction techniques applicable to jewelry, functional objects and sculptural art forms. Processes introduced include raising, forming, and anticlastic shell forming techniques. Introduction to mechanisms and tool making. Advanced students are encouraged to integrate alternative materials and technologies. A focus is placed on independent research, professional engagement and portfolio development.

ARTIS 424H. Jewelry/Metalsmithing III: Honors.

(0-6) Cr. 3. Repeatable, maximum of 12 credits. F.S. *Prereq: ARTIS 324 or permission of instructor*

Emphasis on metal fabrication and hollow construction techniques applicable to jewelry, functional objects and sculptural art forms. Processes introduced include raising, forming, and anticlastic shell forming techniques. Introduction to mechanisms and tool making. Advanced students are encouraged to integrate alternative materials and technologies. A focus is placed on independent research, professional engagement and portfolio development.

ARTIS 429. Advanced Photography.

(Dual-listed with ARTIS 529). (0-6) Cr. 3. Repeatable. F.S. *Prereq: ARTIS 329*
Independent, advanced work in traditional alternative and/or digital photographic processes. Emphasis is on development of a unified body of work and research into contemporary photographers and aesthetic concern.

ARTIS 429H. Advanced Photography: Honors.

(0-6) Cr. 3-4. Repeatable. F.S. *Prereq: ARTIS 329*

Independent, advanced work in traditional alternative and/or digital photographic processes. Emphasis is on development of a unified body of work and research into contemporary photographers and aesthetic concern.

ARTIS 430. Drawing IV.

(Dual-listed with ARTIS 530). (0-6) Cr. 3. Repeatable, maximum of 9 credits. F.S. *Prereq: ARTIS 330*

Figurative and/or non-figurative drawing with advanced work in media, composition, and theory.

ARTIS 430H. Drawing IV: Honors.

(0-6) Cr. 3-4. Repeatable, maximum of 9 credits. F.S. *Prereq: ARTIS 330*

Figurative and/or non-figurative drawing with advanced work in media, composition, and theory.

ARTIS 438. Painting III.

(Dual-listed with ARTIS 538). (0-6) Cr. 3. Repeatable, maximum of 9 credits. F.S. *Prereq: ARTIS 338*

Figurative and non-figurative painting with advanced work in media, composition, and theory.

ARTIS 438H. Painting III: Honors.

(0-6) Cr. 3-4. Repeatable, maximum of 9 credits. F.S. *Prereq: ARTIS 338*

Figurative and non-figurative painting with advanced work in media, composition, and theory.

ARTIS 447. Printed Textile Design.

(Dual-listed with ARTIS 547). (0-6) Cr. 3. Repeatable. F.S. *Prereq: ARTIS 347 or permission of instructor.*

Exploration of hand-printing methods on fabric including block, stencil, and screen-printing using dyes, discharging agents, and pigments. Individualized research and development of surface design techniques as means for personal expression.

ARTIS 448. Digital Textile Design.

(Dual-listed with ARTIS 548). (0-6) Cr. 3. Repeatable. F.S. *Prereq: Junior classification in either College of Design or Apparel, Merchandising, Design*

This hands-on studio course will allow students to explore digital printing technology and its application to textile design for those working within industry as well as independent studio practitioners. Digital design development includes pattern repeats and photo manipulation to create unique textile designs for fashion, interior and fine art applications.

ARTIS 458. Advanced Printmaking.

(0-6) Cr. 3. Repeatable. F.S. *Prereq: ARTIS 356, ARTIS 357, or ARTIS 358, and permission of instructor*

Independent, advanced work in printmaking processes. Emphasis is on development of a unified body of work and research into contemporary artists.

ARTIS 458H. Advanced Printmaking: Honors.

(0-6) Cr. 3-4. Repeatable. F.S. *Prereq: ARTIS 356, ARTIS 357, or ARTIS 358, and permission of instructor*

Independent, advanced work in printmaking processes. Emphasis is on development of a unified body of work and research into contemporary artists.

ARTIS 482. Selected Topics in Studio Art.

(Dual-listed with ARTIS 582). Cr. 1-3. Repeatable. F.S. *Prereq: Permission of instructor*

Special issues related to studio art. Topics vary each time offered.

ARTIS 490. Independent Study.

Cr. 1-6. Repeatable. F.S.SS. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed craft design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490B. Independent Study: Ceramics.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490C. Independent Study: Computer Art and Design.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490D. Independent Study: Drawing.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490E. Independent Study: Textiles.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490F. Independent Study: Illustration.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490G. Independent Study: Metals.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490H. Independent Study: Honors.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490I. Independent Study: Painting.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490J. Independent Study: Photography.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490K. Independent Study: Printmaking.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490L. Independent Study: Furniture.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 490M. Independent Study: Mixed Media.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*
Student must have completed coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTIS 493. Workshop.

Cr. 1-3. Repeatable. SS. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493B. Workshop: Ceramics.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493C. Workshop: Computer Art and Design.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493D. Workshop: Drawing.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493E. Workshop: Textiles.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493F. Workshop: Illustration.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493G. Workshop: Metals.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493H. Workshop: Honors.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493I. Workshop: Painting.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493J. Workshop: Photography.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493K. Workshop: Printmaking.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493L. Workshop: Furniture.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 493M. Workshop: Mixed Media.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*
Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 494. Integrated Studio Arts in Europe Seminar.

(1-0) Cr. 1. *Prereq: Permission of instructor and planned enrollment in ARTIS 495*
Cultural and historical aspects of art and design in Western Europe in preparation for study abroad. Area of study varies each time offered. Offered on a satisfactory-fail basis only. Offered on a satisfactory-fail basis only. Meets International Perspectives Requirement.

ARTIS 495. Integrated Studio Arts in Europe.

(Dual-listed with ARTIS 595). Cr. 3. *Prereq: Graduate classification, ARTIS 494 or equivalent, permission of instructor*
International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities. Related activities depending on specific area of study which may vary each time offered. Meets International Perspectives Requirement.

ARTIS 496. Art and Design Field Study.

Cr. R. Repeatable. *Prereq: Concurrent enrollment in an art and design studio or integrated studio arts course and permission of instructor*
Study and tours of museums, galleries, artist and/or designer studios and other areas of interest within art and design. Offered on a satisfactory-fail basis only.

ARTIS 497. Studio Internship.

Cr. 1-6. Repeatable, maximum of 6 credits. *Prereq: Advanced classification in a department curriculum*
Written approval of supervising instructor and department chair on required form in advance of semester of enrollment. Supervised experience with a cooperating artist or studio. Offered on a satisfactory-fail basis only. Offered on a satisfactory-fail basis only.

ARTIS 499. BFA Exhibition.

(1-0) Cr. 1. S. *Prereq: ARTIS 399 and senior classification in the ISA BFA Curriculum.*

Capstone experience for the BFA degree, including the refinement of a final portfolio (visual and written components). Guest lecturers cover range of topics relevant to the professional practice of art and design. Course culminates in the planning, design and installation of the BFA group exhibition in a formal gallery setting. Half-semester course. Required of all ISA majors.

Courses primarily for graduate students, open to qualified undergraduates:**ARTIS 505. Integrated Media.**

(Dual-listed with ARTIS 305). (0-6) Cr. 3. Repeatable. *Prereq: 6 credits of 200 level studio*

Integration and exploration of materials and methods that combine traditional and innovative approaches. Emphasis on conceptual development.

ARTIS 507. Principles of 3D Character Animation.

(Dual-listed with ARTIS 407). (0-6) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: ARTIS 308*

Animation techniques using the computer and available software. Principles of character animation. Prior knowledge of modeling, lighting, texturing and rendering with available software is assumed.

ARTIS 508. Computer Aided Animation and Visualization.

(0-6) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ARTIS 408 or graduate classification and permission of instructor*

Further investigations begun in ARTIS 408. Attention given to the workflow and management of creating animation and visualizations.

ARTIS 509. Computer/Video Game Design and Development.

(Dual-listed with ARTIS 409). (0-6) Cr. 3. Repeatable, maximum of 12 credits. *Prereq: Permission of instructor. Programming emphasis: COM S 227, COM S 228, COM S 229 or equivalent in engineering; art or graphics emphasis: ARTIS 230 and ARTIS 308; writing emphasis: an English course in creative writing or writing screen plays; business or marketing students: Junior classification*

Independent project based creation and development of "frivolous and non-frivolous" computer games in a cross-disciplinary team. Projects require cross-disciplinary teams. Aspects of Indie development and computer/video game history will be discussed.

ARTIS 511. Seminar in Teaching.

(3-0) Cr. 3. *Prereq: Graduate classification*

Readings and discussion of university level design education issues, studio/classroom observation, development of a teaching philosophy, lesson planning and presentation.

ARTIS 520. Advanced Furniture Design.

(Dual-listed with ARTIS 420). (0-6) Cr. 3-4. Repeatable, maximum of 12 credits. F.S. *Prereq: ARTIS 320*

Design and creation of more complex furniture forms with consideration of precedents and innovative techniques and approaches. Continued development of a unique personal approach to the design and making of furniture. Refine your sensitivity to wood and understand the social and environmental implications of various materials used in furniture design and production.

ARTIS 522. Ceramics Studio.

(Dual-listed with ARTIS 422). (0-6) Cr. 3. Repeatable, maximum of 12 credits. F.S. Prereq: ARTIS 322

In-depth investigation of ceramic forms and surfaces with an emphasis on personal art expression. Gas kiln firings, research into contemporary ceramic artists and development of increasingly skilled work are emphasized.

ARTIS 524. Jewelry/Metalsmithing III.

(Dual-listed with ARTIS 424). (0-6) Cr. 3. Repeatable, maximum of 12 credits. F.S. Prereq: ARTIS 324 or permission of instructor

Emphasis on metal fabrication and hollow construction techniques applicable to jewelry, functional objects and sculptural art forms. Processes introduced include raising, forming, and anticlastic shell forming techniques. Introduction to mechanisms and tool making. Advanced students are encouraged to integrate alternative materials and technologies. A focus is placed on independent research, professional engagement and portfolio development.

ARTIS 529. Advanced Photography.

(Dual-listed with ARTIS 429). (0-6) Cr. 3. Repeatable. F.S. Prereq: ARTIS 329 Independent, advanced work in traditional alternative and/or digital photographic processes. Emphasis is on development of a unified body of work and research into contemporary photographers and aesthetic concern.

ARTIS 530. Drawing IV.

(Dual-listed with ARTIS 430). (0-6) Cr. 3. Repeatable, maximum of 9 credits. F.S. Prereq: ARTIS 330

Figurative and/or non-figurative drawing with advanced work in media, composition, and theory.

ARTIS 538. Painting III.

(Dual-listed with ARTIS 438). (0-6) Cr. 3. Repeatable, maximum of 9 credits. F.S. Prereq: ARTIS 338

Figurative and non-figurative painting with advanced work in media, composition, and theory.

ARTIS 547. Printed Textile Design.

(Dual-listed with ARTIS 447). (0-6) Cr. 3. Repeatable. F.S. Prereq: ARTIS 347 or permission of instructor.

Exploration of hand-printing methods on fabric including block, stencil, and screen-printing using dyes, discharging agents, and pigments. Individualized research and development of surface design techniques as means for personal expression.

ARTIS 548. Digital Textile Design.

(Dual-listed with ARTIS 448). (0-6) Cr. 3. Repeatable. F.S. Prereq: Junior classification in either College of Design or Apparel, Merchandising, Design

This hands-on studio course will allow students to explore digital printing technology and its application to textile design for those working within industry as well as independent studio practitioners. Digital design development includes pattern repeats and photo manipulation to create unique textile designs for fashion, interior and fine art applications.

ARTIS 556. Relief Printmaking: Digital/Traditional.

(Dual-listed with ARTIS 356). (0-6) Cr. 3-4. Repeatable, maximum of 6 credits. F.S. Prereq: ARTIS 206 and ARTIS 230

In-depth exploration of digital or traditional design and block cutting processes (computer/laser cutter/CNC router or drawing/chisels). Use relief printmaking to create a unified body of prints from those blocks. Emphasis is on experimental and creative use of printmaking with study of contemporary trends.

ARTIS 557. Intaglio and Monotype Printmaking: Digital / Traditional.

(Dual-listed with ARTIS 357). (0-6) Cr. 3-4. Repeatable, maximum of 9 credits. F.S. Prereq: ARTIS 206 and 230

Explore the techniques and aesthetic qualities of black and white and color intaglio printmaking primarily through etching, aquatint, laser-cut plates and collagraph processes. Students will generate imagery through traditional drawing, collage and digital processes. Unique, one-of-a-kind black and white and color prints from Plexiglas will also be introduced. Emphasis is on experimental and creative use of printmaking for artistic expression.

ARTIS 558. Lithography: Digital / Traditional.

(Dual-listed with ARTIS 358). (0-6) Cr. 3. Repeatable. F.S. Prereq: ARTIS 206 and credit or enrollment in ARTIS 230

Examine the techniques and aesthetic qualities of lithography primarily through hand-drawn and photographic plates. Students may generate imagery through traditional drawing, collage or digital processes. Emphasis is on experimental and creative use of printmaking for artistic expression. For those taking the course for a second semester, focus is on stone lithography and increased work with color.

ARTIS 571. Critique Seminar.

(2-0) Cr. 2. Prereq: Admission into graduate program in the College of Design Ongoing weekly critiques and dialog about sources, methods, and progress of studio projects. Graduate students will learn to articulate their ideas from concept to creation. The interaction of students at different levels in a broad spectrum of studio courses will reveal commonalities and connections between all of the visual arts, accelerating individual creative development.

ARTIS 571A. Critique Seminar: Grants, Residencies, Exhibitions.

(2-0) Cr. 2. Prereq: Admission into graduate program in the College of Design Ongoing critiques and dialog about progress of studio projects. Graduate students will learn to articulate their ideas from concept to creation. Emphasis will be on the examination of professional practices of artists.

ARTIS 571B. Critique Seminar: Entrepreneurialism.

(2-0) Cr. 2. Prereq: Admission into graduate program in the College of Design Ongoing critiques and dialog about progress of studio projects. Graduate students will learn to articulate their ideas from concept to creation. Emphasis will be on the examination of creative business opportunities related to students' areas of interest.

ARTIS 571C. Critique Seminar: Critique and Creative Process.

(2-0) Cr. 2. Repeatable, maximum of 4 credits. Prereq: Admission into graduate program in the College of Design

Ongoing weekly critiques and dialog about sources, methods, and progress of studio projects. Graduate students will learn to articulate their ideas from concept to creation. The interaction of students at different levels in a broad spectrum of studio courses will reveal commonalities and connections between all of the visual arts, accelerating individual creative development.

ARTIS 582. Selected Topics in Studio Art.

(Dual-listed with ARTIS 482). Cr. 1-3. Repeatable. F.S. Prereq: Permission of instructor

Special issues related to studio art. Topics vary each time offered.

ARTIS 590. Special Topics.

Cr. arr. F.S.SS. Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area
Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590B. Special Topics: Ceramics.

Cr. arr. Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area
Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590C. Special Topics: Computer Art and Design.

Cr. arr. Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area
Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590D. Special Topics: Drawing.

Cr. arr. Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area
Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590E. Special Topics: Textiles.

Cr. arr. Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area
Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590F. Special Topics: Illustration.

Cr. arr. Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area
Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590G. Special Topics: Metals.

Cr. arr. Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area
Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590I. Special Topics: Painting.

Cr. arr. Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area
Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590J. Special Topics: Photography.

Cr. arr. *Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area*

Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590K. Special Topics: Printmaking.

Cr. arr. *Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area*

Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590L. Special Topics: Furniture.

Cr. arr. *Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area*

Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 590M. Special Topics: Mixed Media.

Cr. arr. *Prereq: Bachelor degree in art and/or design, or evidence of satisfactory equivalency in specialized area*

Written approval of instructor and department chair on required form in advance of semester of enrollment.

ARTIS 593. Workshop.

Cr. 1-3. Repeatable. SS. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593B. Workshop: Ceramics.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593C. Workshop: Computer Art and Design.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593D. Workshop: Drawing.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593E. Workshop: Textiles.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593F. Workshop: Illustration.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593G. Workshop: Metals.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593I. Workshop: Painting.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593J. Workshop: Photography.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593K. Workshop: Printmaking.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593L. Workshop: Furniture.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 593M. Workshop: Mixed Media.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

ARTIS 595. Integrated Studio Arts in Europe.

(Dual-listed with ARTIS 495). Cr. 3. *Prereq: Graduate classification, ARTIS 494 or equivalent, permission of instructor*

International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities. Related activities depending on specific area of study which may vary each time offered.

Meets International Perspectives Requirement.

Courses for graduate students:**ARTIS 605. Research Methods.**

(3-0) Cr. 3. *Prereq: Permission of instructor*

Research strategies related to fine art and technology. Application of selected methods to specific issues.

ARTIS 607. Intermedia.

(0-6) Cr. 3. F.S. *Prereq: Graduate classification and permission of instructor.*

Exploration and application of media with various materials, methods and ideas.

ARTIS 697. Studio Internship.

Cr. arr. *Prereq: Graduate classification and approval of POS committee*

Supervised off-campus learning experience with a prominent artist, designer, or firm.

ARTIS 698. Current Issues in Studio Arts.

Cr. 1-3. Repeatable, maximum of 9 credits. F.S. *Prereq: Graduate classification and permission of instructor.*

Selected issues in contemporary studio arts. Topics and readings vary each time offered.

ARTIS 699. Research.

Cr. arr. Repeatable.

Research in Integrated Studio Arts.

ARTIS 699A. Research: Thesis.

Cr. arr. Repeatable.

Research thesis.

ARTIS 699B. Research: Thesis-exhibition.

Cr. arr. Repeatable.

Research exhibition.

Interdisciplinary Graduate Studies (IGS)

Courses primarily for graduate students, open to qualified undergraduates:

IGS 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:

IGS 699. Thesis Research.

Cr. arr. Repeatable.

Interior Design (ARTID)

Courses primarily for undergraduates:

ARTID 250. Fundamentals of Interior Design.

(2-0) Cr. 2. F.

The profession, issues, and the role of interior design.

ARTID 251. Human Factors in Design.

(3-0) Cr. 3. F.

Overview of issues related to the human/built environment interface: introduction to health and safety factors, ergonomics, anthropometrics, sensory perception, psycho-behavioral response, physical performance, cultural factors and universal design. Emphasis on application of human factor methods to the analysis, solution, and evaluation of design problems.

ARTID 255. Forces That Shape Interior Space.

(3-0) Cr. 3. F.S.

A survey of variables influencing the nature and function of "interior" environments. Review of professional, geo-political, utilitarian, social-cultural, economic, humanistic, historical, technological, and other factors as generators of form and space.

ARTID 259. Sophomore Field Study.

Cr. R. Prereq: Enrollment in interior design studio course

Study and tours of areas of interest within the interior design profession such as manufacturers, design studios, showrooms and museums. Offered on a satisfactory-fail basis only.

ARTID 261. Graphic Communication for Interior Design I.

(2-4) Cr. 3. F. Prereq: Admission to the interior design program through program review and enrollment in ARTID 265

Perspective drawing, design sketching, and presentation drawings. Introduction to technical drawing conventions, and design drawings. Emphasis on drawing layout, line quality, and lettering. Use of various rendering media and techniques on 2D and 3D drawings. Overview of presentation techniques, both visual and verbal.

ARTID 263. Graphic Communication for Interior Design II.

(2-4) Cr. 3. S. Prereq: ARTID 261, enrollment in ARTID 267

Computer visualization techniques and applications; projects employing computer graphic methods.

ARTID 265. Interior Design Studio I.

(1-6) Cr. 4. F. Prereq: Credit or enrollment in ARTID 250 and ARTID 261; admission to the interior design program through program review

Enhanced creative interior design problem solving. Emphasis on research, spatial composition theories and graphic ideation and communication as applied to the interior design of small scale environments. Modeling and manual visualization techniques.

ARTID 267. Interior Design Studio II.

(1-6) Cr. 4. S. Prereq: ARTID 265

Human factors issues including ergonomics, human behavior and the requirements of special groups. Color theories related to interior spaces. Residential interior design and medium scale projects. Detail drawings, and expansion of visualization techniques.

ARTID 350. Interior Finish Materials and Systems.

(3-0) Cr. 3. F. Prereq: Completion of the College of Design Core.

Exploration of concepts, materials, and assemblies associated with development of planar interior elements including floors, walls, ceiling, windows, and finishes. Fiber, plastic, sheet metal, and other surfacing materials. Attention to related human factors, testing, detailing, specifications writing and end-use application.

ARTID 351. Interior Health and Safety Systems.

(3-0) Cr. 3. S. Prereq: Completion of the College of Design Core.

Exploration of interior design concepts, materials, and assemblies as they contribute to the user, health, safety and general well-being. Wood, steel, masonry, and glass assemblies. Attention to related human factors, testing, codes, detailing, specifications writing and end-use application.

ARTID 352. Interior Environmental Control Systems.

(3-0) Cr. 3. S. Prereq: Completion of the College of Design Core.

Exploration of concepts, materials, assemblies associated with building service systems. Overview of electrical, lighting, acoustical, HVAC, plumbing and other non-structural building features. Attention to related human factors, testing, codes, detailing, specifications writing and end-use application.

ARTID 353. Interior Building Systems and Details.

(3-0) Cr. 3. F. Prereq: Completion of the College of Design Core.

Exploration of building construction concepts, materials, and assemblies and their influence on interior design. Attention to human factors, codes, detailing, and other interior design issues related to buildings.

ARTID 355. Interior Design History/Theory/Criticism I.

(3-0) Cr. 3. S.

Theoretical approaches to evaluation of interior finishes, furnishings, and decorative arts in relation to parallel developments in art and architecture, from a critical, historical and multicultural perspective. Focus on pre-1850.

ARTID 356. Interior Design History/Theory/Criticism II.

(3-0) Cr. 3. F. Prereq: Credit or enrollment in ARTID 355 or permission of instructor

Advanced theoretical approaches to evaluation of interior finishes, furnishings, and decorative arts in relation to parallel developments in art and architecture from a critical, historical, and multicultural perspective. Focus on mid-nineteenth and twentieth century.

ARTID 357. Made in Italy.

(2-0) Cr. 2. F. Prereq: Participation in Study Abroad Rome program

An investigation of the 20th century roots of modern Italian design and its contemporary form. Lectures and seminar presentations highlight major Italian designers and internationally significant design in the 20th century. Focus is on innovative design that exhibits a synthesis of formal and social functions. Meets International Perspectives Requirement.

ARTID 359. Junior Field Study.

Cr. R. F. Prereq: Enrollment in third year interior design studio course

Study and tours of areas of interest within the interior design profession such as manufacturers, design studios, showrooms, and museums. Offered on a satisfactory-fail basis only.

ARTID 360. Interior Design Internship Seminar.

(0-1) Cr. 0.5. Repeatable, maximum of 1 credits. Prereq: Enrollment in interior design program.

Procedural and ethical concerns relating to interior design internship. Preparation of placement credentials and formulation of personal goals. Internship plans and agreements. Offered on a satisfactory-fail basis only.

ARTID 365. Interior Design Studio III.

(1-6) Cr. 4. F. Prereq: ARTID 263, ARTID 267, and enrollment in ARTID 359

Refined methods of problem identification design programming and problem solving, including theoretically-based concept development and refinement. Emphasis and compliance with codes and standards. Produce small and large scale projects. Alternative manual and computer-based visualization methods. Teamwork. Multi-cultural, study abroad option.

ARTID 367. Interior Design Studio IV.

(1-6) Cr. 4-5. S. Prereq: ARTID 365

Emphasis on three-dimensional spatial development in large scale, multiple scale unit institutional projects. Inclusion of extensive design documentation. Expansion of alternative manual and computer-based visualization methods. Teamwork.

ARTID 367H. Interior Design Studio IV: Honors.

(1-6) Cr. 4-5. S. Prereq: ARTID 365

Emphasis on three-dimensional spatial development in large scale, multiple scale unit institutional projects. Inclusion of extensive design documentation. Expansion of alternative manual and computer-based visualization methods. Teamwork.

ARTID 459. Senior Field Study.

Cr. R. Prereq: Enrollment in fourth year interior design studio course

Study and tours of areas of interest within the interior design profession such as manufacturers, design studios, showrooms and museums. Offered on a satisfactory-fail basis only.

ARTID 460. Interior Design Internship.

Cr. 3. SS. Prereq: ARTID 350, 360, and 365

Professional interior design off-campus experience.

ARTID 461. Interior Design Professional Practices.

(3-0) Cr. 3-4. S. Prereq: ARTID 460

Organization and general management of the interior design office: agreements, business procedures, and professional ethics. Professional interior design issues and concerns.

ARTID 461H. Interior Design Professional Practices: Honors.

(3-0) Cr. 3-4. S. Prereq: ARTID 460

Organization and general management of the interior design office: agreements, business procedures, and professional ethics. Professional interior design issues and concerns.

ARTID 463. Environments for the Aging.

(Dual-listed with ARTID 563). (Cross-listed with GERON, HD FS). (3-0) Cr. 3. S. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies or permission of instructor*

Emphasis on independent living within residential settings including specialized shelter, supportive services and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities. (on-line course offering via Distance Education). Meets U.S. Diversity Requirement

ARTID 465. Interior Design Studio V.

(Dual-listed with ARTID 565). (1-6) Cr. 4. F. *Prereq: ARTID 460, or permission of instructor, and enrollment in ARTID 459*

Design research and refined problem solving methods including functional analysis, programming and detailing.

ARTID 467. Interior Design Studio VI.

(Dual-listed with ARTID 567). (1-6) Cr. 4. S. *Prereq: ARTID 465*

Refinement of technical, analytical and theoretical problem-solving methods and comprehensive design documentation. In-depth development of interior design projects. Current issues in interior design.

ARTID 468. Interior Design in an Urban Setting.

(1-4) Cr. 3. S. *Prereq: Enrollment or credit in third year studio courses*

Study of selected interior design projects and designers practicing in an urban setting. Studio project examining issues related to interior design in an urban context.

ARTID 468H. Interior Design in an Urban Setting: Honors.

(1-4) Cr. 3-4. S. *Prereq: Enrollment or credit in third year studio courses*

Study of selected interior design projects and designers practicing in an urban setting. Studio project examining issues related to interior design in an urban context.

ARTID 469. Advanced Studies in Interior Design.

Cr. 3. Repeatable, maximum of 6 credits. *Prereq: 12 credits in interior design related courses or permission of instructor*

Examination of special issues with emphasis on their translation into design application.

ARTID 469A. Advanced Studies in Interior Design: Design Theory.

(Dual-listed with ARTID 569A). Cr. 3. Repeatable, maximum of 6 credits. *Prereq: Graduate classification or permission of instructor*

Examination of special issues with emphasis on their translation into design application.

ARTID 469B. Advanced Studies in Interior Design: Advanced Color.

(Dual-listed with ARTID 569B). Cr. 3. Repeatable, maximum of 6 credits. *Prereq: 12 credits in interior design related courses or permission of instructor*

Examination of special issues with emphasis on their translation into design application.

ARTID 469C. Advanced Studies in Interior Design: Sustainable Design.

(Dual-listed with ARTID 569C). Cr. 3. Repeatable, maximum of 6 credits. *Prereq: 12 credits in interior design related courses or permission of instructor*

Examination of special issues with emphasis on their translation into design application.

ARTID 469D. Advanced Studies in Interior Design: Variable Topics.

(Dual-listed with ARTID 569D). Cr. 3. Repeatable, maximum of 6 credits. *Prereq: 12 credits in interior design related courses or permission of instructor*

Examination of special issues with emphasis on their translation into design application.

ARTID 490. Independent Study.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*

Student must have completed related interior design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTID 490H. Independent Study, Honors.

Cr. 1-6. Repeatable. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment*

Student must have completed related interior design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

ARTID 493. Workshop.

Cr. 1-3. Repeatable, maximum of 3 credits. F.S.SS. *Prereq: Evidence of satisfactory experience in area of specialization*

Intensive 2 to 4 week studio exploration. Topics vary each time offered.

Courses primarily for graduate students, open to qualified undergraduates:

ARTID 551. Design Humanics.

(3-0) Cr. 3. Repeatable, maximum of 15 credits. F.S. *Prereq: Instructor permission* An exploration of human nature as broadly defined and as applied to design of the built environment. Consideration of human characteristics, responses and performance, at varying scales, as sources of design insight. Topics vary each time offered.

ARTID 551A. Design Humanics: Micro-Scale Humanics.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: Instructor permission* Issues related to the nature, performance and accommodation of the individual organism, including sensation and perception, physical requirement, individual anthropometrics, personal safety and other issues connecting human needs and built environmental responses.

ARTID 551B. Design Humanics: Meso-Scale Humanics.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: Instructor permission* Issues related to human performance in small to moderate scale settings, including psychological and behavioral dimensions, social factors, interpersonal safety, etc.

ARTID 551C. Design Humanics: Macro-Scale Humanics.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: Instructor permission* Cultural and societal influences on human performance and well being in the moderate to large scale built environment, including the impact of political, economic, cultural, geographic, design cultural and other societal factors.

ARTID 552. Design Methods: Design Methods.

(2-0) Cr. 2. Repeatable, maximum of 10 credits. F.S. *Prereq: Permission of instructor*

Survey of methodologies and methodological tools for varied end uses and drawn from wide ranging sources. Emphasis on their organization and application to design of the human environment. Topics vary each time offered.

ARTID 552A. Design Methods: Investigation Analysis.

(2-0) Cr. 2. Repeatable, maximum of 10 credits. F.S. *Prereq: Permission of instructor*

Methods of design research, analysis, programming and theory formulation.

ARTID 552B. Design Methods: Synthesis.

(2-0) Cr. 2. Repeatable, maximum of 10 credits. F.S. *Prereq: Permission of instructor*

Methods of synthesizing design concepts and solutions.

ARTID 552C. Design Methods: Communication.

(2-0) Cr. 2. Repeatable, maximum of 10 credits. F.S. *Prereq: Permission of instructor*

Methods of managing, translating, communicating and otherwise utilizing text, image, abstract and other forms of information.

ARTID 552D. Design Methods: Procedural Alternatives.

(2-0) Cr. 2. Repeatable, maximum of 10 credits. F.S. *Prereq: Permission of instructor*

New and specialized methodological trends, including subject or setting-specific methods.

ARTID 554. Interior Design Teaching Practicum.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: ARTID 668 and permission of instructor*

Supervised practical application of interior design theory, materials, and practice to the educational process.

ARTID 559. Graduate Interior Design Field Study.

Cr. R. Repeatable. *Prereq: Graduate enrollment or permission of instructor*

Study and tours of places of interior design-related interest such as manufacturers, design studios, related professional offices, showrooms, museums, and historical sites.

ARTID 560. Interior Design Internship.

Cr. 3. F.S.SS. *Prereq: Permission of instructor.*

Professional interior design off-campus experience.

ARTID 563. Environments for the Aging.

(Dual-listed with ARTID 463). (Cross-listed with GERON, HD FS). (3-0) Cr.

3. S. *Prereq: HD FS 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies or permission of instructor*

Emphasis on independent living within residential settings including specialized shelter, supportive services and housing management. Application of criteria appropriate for accessibility and functional performance of activities; universal design principles. Creative project provides service learning opportunities. (on-line course offering via Distance Education).

Meets U.S. Diversity Requirement

ARTID 565. Interior Design Studio V.

(Dual-listed with ARTID 465). (1-6) Cr. 4. F. *Prereq: ARTID 460, or permission of instructor, and enrollment in ARTID 459*

Design research and refined problem solving methods including functional analysis, programming and detailing.

ARTID 567. Interior Design Studio VI.

(Dual-listed with ARTID 467). (1-6) Cr. 4. S. *Prereq: ARTID 465*

Refinement of technical, analytical and theoretical problem-solving methods and comprehensive design documentation. In-depth development of interior design projects. Current issues in interior design.

ARTID 568. Experimental Interior Design.

(0-8) Cr. 4. Repeatable, maximum of 16 credits. F.S. *Prereq: Graduate classification and permission of instructor*

Application of alternative design methods and sources of insight to the solution of human environmental design problems. Focus on the identification, formulation, refinement and application of theory to the design process. Emphasis on the pursuit of new discovery and innovative problem solving. Approaches, settings and scales vary each time offered.

ARTID 569. Advanced Studies in Interior Design.

Cr. 3. Repeatable, maximum of 6 credits. *Prereq: Graduate classification or permission of instructor*

Examination of special issues with emphasis on their translation into design application.

ARTID 569A. Advanced Studies in Interior Design: Design Theory.

(Dual-listed with ARTID 469A). Cr. 3. Repeatable, maximum of 6 credits. *Prereq: Graduate classification or permission of instructor*

Examination of special issues with emphasis on their translation into design application.

ARTID 569B. Advanced Studies in Interior Design: Advanced Color.

(Dual-listed with ARTID 469B). Cr. 3. Repeatable, maximum of 6 credits. *Prereq: Graduate classification or permission of instructor*

Examination of special issues with emphasis on their translation into design application.

ARTID 569C. Advanced Studies in Interior Design: Sustainable Design.

(Dual-listed with ARTID 469C). Cr. 3. Repeatable, maximum of 6 credits. *Prereq: Graduate classification or permission of instructor*

Examination of special issues with emphasis on their translation into design application.

ARTID 569D. Advanced Studies in Interior Design: Variable Topics.

(Dual-listed with ARTID 469D). Cr. 3. Repeatable, maximum of 6 credits. *Prereq: Graduate classification or permission of instructor*

Examination of special issues with emphasis on their translation into design application.

ARTID 590. Special Topics.

Cr. arr. *Prereq: Bachelor's degree in interior design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment*

ARTID 593. Workshop.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification; evidence of satisfactory experience in area of specialization*

Intensive 2 to 4 week studio exploration. Topics vary each time offered.

ARTID 598. Research Forum.

(1-0) Cr. 1-3. Repeatable, maximum of 9 times. F.S. *Prereq: Concurrent enrollment in ARTID 565, ARTID 567, ARTID 568, ARTID ARTID 665, or ARTID 668, and permission of instructor*

Presentation and discussion of cross-disciplinary design research theory, methods, and application. Focus on the investigation, application, and communication of types of design research.

ARTID 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:**ARTID 660. Research Methods.**

(3-0) Cr. 3. S. *Prereq: Permission of instructor*

Research strategies related to design. Application of selected methods to specific issues. Open to non-majors.

ARTID 668. Advanced Experimental Interior Design.

(0-8) Cr. 4. Repeatable, maximum of 16 credits. F.S. *Prereq: Graduate classification and permission of instructor.*

Application of alternative design methods and sources of insight to the solution of human environmental design problems. Focus on the identification, formulation, refinement and application of theory to the design process. Emphasis on the pursuit of new discovery and innovative problem solving. Approaches, settings and scales vary each time offered.

ARTID 690. Advanced Topics.

Cr. arr. Repeatable. *Prereq: M.F.A classification, permission of instructor*

ARTID 697. Design Practicum.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Approval of POS committee*

Applied, off campus, professional interior design-related experience.

ARTID 699. Research.

Cr. arr. Repeatable.

ARTID 699A. Thesis.

Cr. arr. Repeatable.

ARTID 699B. Thesis-Exhibition.

Cr. arr. Repeatable.

International Studies (INTST)

Courses primarily for undergraduates:

INTST 235. Introduction to International Studies.

(3-0) Cr. 3. F.SS.

Overview of international studies, emphasizing cultural, geographic, economic, and political characteristics of major world areas and nations.

Meets International Perspectives Requirement.

INTST 295. International Experience Abroad.

Cr. 1-8. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 12 college-level credits*

Supervised instruction in an international setting, augmented by practical living experience.

Meets International Perspectives Requirement.

INTST 350. Topics in International Studies.

Cr. 2-4.

Meets International Perspectives Requirement.

INTST 395. Interdisciplinary Study Abroad.

Cr. 1-4. Repeatable.

Multi-faceted exploration of a selected world region directed at developing a comprehensive understanding of a selected culture's role in contemporary society.

INTST 395A. Interdisciplinary Study Abroad: Pre-Departure Seminar.

Cr. 1-4. Repeatable.

Multi-faceted exploration of a selected world region directed at developing a comprehensive understanding of a selected culture's role in contemporary society.

INTST 395B. Interdisciplinary Study Abroad: Humanities.

Cr. 1-4. Repeatable.

Multi-faceted exploration of a selected world region directed at developing a comprehensive understanding of a selected culture's role in contemporary society.

INTST 395C. Interdisciplinary Study Abroad: Communications.

Cr. 1-4. Repeatable.

Multi-faceted exploration of a selected world region directed at developing a comprehensive understanding of a selected culture's role in contemporary society.

INTST 395D. Interdisciplinary Study Abroad: Mathematics and Natural Science.

Cr. 1-4. Repeatable.

Multi-faceted exploration of a selected world region directed at developing a comprehensive understanding of a selected culture's role in contemporary society.

INTST 395E. Interdisciplinary Study Abroad: Social Sciences.

Cr. 1-4. Repeatable.

Multi-faceted exploration of a selected world region directed at developing a comprehensive understanding of a selected culture's role in contemporary society.

INTST 430. Seminar in International Studies.

(3-0) Cr. 3. S. *Prereq: INTST 235, junior classification or higher*

Capstone seminar in international studies focused on economic development, women's issues, war and ethnic conflict, population, the environment, globalization, human rights, international trade and business and other issues.

Students develop a project on a subject linked to their area of professional interest or academic specialization.

Meets International Perspectives Requirement.

INTST 446. International Issues and Challenges in Sustainable Development.

(Cross-listed with AGRON, GLOBE). Cr. 4. S. *Prereq: 3-credit biology course, Sophomore or higher classification, permission of Instructor*

Interdisciplinary study and analysis of agricultural, biophysical, environmental, sociological, economical, political, and historical factors affecting sustainable development of communities and countries from art and science perspectives. International field experience with foreign language training required. A program fee is charged to students for international study abroad.

Meets International Perspectives Requirement.

INTST 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: Permission of International Studies director and faculty supervisor*

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered or to integrate areas of study appropriate to special problems with international foci. No more than 3 credits of IntSt 490 may be used in the International Studies major or minor.

INTST 491. Experiences Abroad: Learning to Think Globally.

(Cross-listed with WLC). (1-0) Cr. 1. Repeatable, maximum of 2 credits. *Prereq: Minimum of 3 cr. study abroad and/or internship abroad*

Students returning from study abroad gain perspective on the personal, academic, and professional impact of their time spent abroad through readings and discussions. Students will be expected to make one presentation about the culture they experienced to an audience outside ISU. Offered on a satisfactory-fail basis only.

Iowa Lakeside Laboratory (IA LL)

Courses primarily for undergraduates:

IA LL 293. Natural History Workshop.

Cr. 1-2. SS.

Offered as demand warrants. Five-day-long, nontechnical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 293G. Prairies.

Cr. 1-2. SS.

Offered as demand warrants. Five-day-long, nontechnical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 302. Plant-Animal Interactions.

Cr. 4. Alt. SS., offered odd-numbered years. *Prereq: One course in the biological sciences*

Introduction to ecology and co-evolution of plants and animals; emphasis on dispersal, pollination, and plant-herbivore interactions; field and laboratory work, reading, discussion.

IA LL 303I. Undergraduate Internships.

(Cross-listed with NREM). Cr. 1-5. SS. *Prereq: Permission of instructor and sophomore standing*

Placement with county conservation boards, camps, parks, etc. for experience as interpreters, rangers, and technicians.

IA LL 312I. Ecology.

(Cross-listed with A ECL, ENSCI). Cr. 4. SS.

An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

IA LL 326I. Ornithology.

(Cross-listed with A ECL). Cr. 4. SS.

The biology, ecology, and behavior of birds with emphasis on field studies of local avifauna. Group projects stress techniques of population analysis and methodology for population studies.

IA LL 333. Animals and Their Ecosystems.

(4-0) Cr. 4. *Prereq: Introductory biology*

Vertebrate and invertebrate animals of the Midwest are observed in nature either through passive observational techniques or active trapping exercises. Once identified, animals are placed in their proper taxonomic position (e.e., put onto the "Tree of Life"). They also are put into ecological perspective, including habitat preferences (i.e., wetland, lake, prairie, forest, river, edge), trophic position, and activity patterns. Conservation status is discussed.

IA LL 364. Biology of Aquatic Plants.

Cr. 4. Alt. SS., offered even-numbered years.

A field-oriented introduction to the taxonomy and ecology of aquatic plants in lakes, wetlands and rivers. Individual or group projects.

IA LL 367. Plant Taxonomy.

Cr. 4. SS.

Principles of classification and evolution of vascular plants; taxonomic tools and collection techniques; use of keys. Field and laboratory studies emphasizing identification of local flowering plants and recognition of major plant families.

IA LL 371I. Introduction to Insect Ecology.

(Cross-listed with ENT). (3-3) Cr. 4. Alt. SS., offered odd-numbered years.

Field and laboratory study of insects, their diversity, life history; emphasis on ecology and behavior.

IA LL 402I. Watershed Hydrology and Surficial Processes.

(Cross-listed with AGRON, ENSCI). Cr. 4. SS. *Prereq: Four courses in physical or biological sciences or engineering*

Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminants) in watersheds. Fieldwork will emphasize investigations of the Iowa Great Lakes watershed.

IA LL 403. Evolution.

Cr. 4. SS.

Mechanisms and patterns in microevolution and macroevolution. Field exercises will emphasize studies of natural selection, adaptation, genetic variation, and population genetics of local plant and animal populations.

IA LL 404I. Behavioral Ecology.

(Cross-listed with A ECL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: Two semesters of biology*

Animal coloniality, courtship, territoriality, predator defense, habitat selection, foraging, mating systems, and parental care will be examined in the field in order to evaluate various ecological and evolutionary theories of animal behavior.

IA LL 415. Freshwater Invertebrates.

Cr. 4. SS. *Prereq: One or more ecology courses*

Field-oriented introduction to the identification, life-history, and ecology of common, free-living freshwater invertebrates of north-temperate lakes, rivers, and wetlands. Emphasis on the role of invertebrates in aquatic food chains and litter processing.

IA LL 419I. Vertebrate Ecology and Evolution.

(Cross-listed with A ECL). Cr. 4. SS.

Field and laboratory study of representative vertebrates of northwestern Iowa. Observations and experimentation emphasize ecological histories by integrating concepts of functional morphology, behavioral ecology, and evolutionary biology.

IA LL 420I. Amphibians and Reptiles.

(Cross-listed with A ECL). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: Two semesters of biology*

Ecology, behavior, and conservation biology of amphibians and reptiles with emphasis on their anatomy and morphology; temperature and water regulation; locomotion; life history; reproduction; population and community ecology; and conservation.

IA LL 422I. Prairie Ecology.

(Cross-listed with ENSCI). Cr. 4. SS. *Prereq: Familiarity with basic principles in biological sciences and ecology*

Basic patterns and underlying physical and biotic causes of both regional and local distributions of plants and animals of North American prairies; field and laboratory analyses and projects.

IA LL 425I. Aquatic Toxicology and Wetland Dynamics in Freshwater Systems.

Cr. 4. SS. *Prereq: Introductory biology course and general chemistry course*

Fundamental knowledge and understanding of the scientific concepts related to the physio-chemical and biological environment. Problems and issues (global, national, regional, and local) associated with freshwater systems and how wetland restoration can be used to ameliorate problems. Discussion and application of basic tools used to assess aquatic toxicological problems.

IA LL 427I. Field Archaeology.

(Cross-listed with ANTHR). Cr. 4. SS.

Nature of cultural and environmental evidence in archaeology and how they are used to model past human behavior and land use; emphasis on Iowa prehistory; basic reconnaissance surveying and excavation techniques.

IA LL 435I. Illustrating Nature I Sketching.

(Cross-listed with BPM I). Cr. 2. SS.

Sketching plants, animals and terrain. Visual communication, development of a personal style, and integration of typographic and visual elements on a page will be emphasized.

IA LL 436I. Illustrating Nature II Photography.

(Cross-listed with BPM I). Cr. 2. SS.

Beginning to intermediate technical and compositional aspects of color photography of natural areas and their plants and animals.

IA LL 461I. Introduction to GIS.

(Cross-listed with ENSCI, ENV S, L A). Cr. 4. SS.

Descriptive and predictive GIS modeling techniques, spatial statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management.

IA LL 463I. Soil Formation and Landscape Relationships.

(Dual-listed with IA LL 563I). (Cross-listed with AGRON, ENSCI). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: AGRON 154 or AGRON 260*

Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only Agron 563 or 563I may be applied for graduation.

IA LL 484. Plant Ecology.

Cr. 4. SS.

Principles of plant population, community, and ecosystem ecology illustrated through studies of native vegetation in local prairies, wetlands and forests. Group or individual projects.

IA LL 490I. Iowa Lakeside Laboratory.

(Cross-listed with ANTHR, NREM). Cr. 1-6. Repeatable, maximum of 9 credits.

Prereq: 8 credits in biology and permission of instructor

Research opportunities for undergraduate students in the biological sciences. No more than 9 credits in Biol 490 may be counted toward graduation and of those, only 6 credits may be applied to the major.

IA LL 493. Natural History Workshop.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493A. Amphibians and Reptiles.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493B. Birds and Birding.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493C. Nature Photography.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493D. Mushrooms and Other Fungi.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493E. Iowa's Trees and Forests.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493F. Fish Biology.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493G. Prairies.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493I. Common Insects.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493J. Aquatic Plants.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493K. Life in Rivers.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493L. Life in Lakes.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493M. Mosses and Liverworts.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493N. Natural History of Iowa Great Lakes Region.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493P. Field Archaeology.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493Q. Common Algae.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493S. Scuba Diving.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493T. Astronomy.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 493U. Sketching Nature.

Cr. 1-2. SS.

Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

IA LL 494. Ecosystems of North America.

Cr. 2-4. SS. *Prereq: A general ecology course and permission of the instructor*

An extended field trip to study a particular type of ecosystem (prairie, coastal wetland, forest, alpine, coral reefs, etc.) or the ecosystems of a specific region (Rocky Mountains, Gulf Coast, Appalachian Mountains, Deserts of the Southwest, Central America, etc.). Prior to the field trip, there will be an orientation period and after each field trip a review and synthesis period. A field trip fee will be assessed to cover travel expenses.

IA LL 499. Undergraduate Research.

Cr. 1-4. *Prereq: Junior or senior classification and permission of instructor*

Courses primarily for graduate students, open to qualified undergraduates:

IA LL 501. Freshwater Algae.

Cr. 4. SS.

Structure and taxonomy of freshwater algae based on field collected material; emphasis on genus-level identifications, habitats visited include lakes, fens, streams, and rivers; algal ecology.

IA LL 503. Graduate Internships.

Cr. 1-5. SS. *Prereq: Permission of instructor and graduate standing*

Placement with county conservation boards, camps, parks, schools, etc. for experience as interpreters, rangers, technicians, and teachers.

IA LL 508I. Aquatic Ecology.

(Cross-listed with ENSCI, NREM). Cr. 4. SS. *Prereq: Courses in ecology, chemistry, and physics*

Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

IA LL 523I. Fish Ecology.

(Cross-listed with A ECL). Cr. 4. Alt. SS., offered even-numbered years.

Basic principles of fish interaction with the biotic and abiotic environment. Field methods, taxonomy, and biology of fish with emphasis on the fish fauna of northwestern Iowa.

IA LL 526I. Advanced Field Ornithology.

(Cross-listed with A ECL). Cr. 2. SS. *Prereq: Concurrent registration in IA LL 326I*

Field study of birds of the upper Midwest; extended field trip to Minnesota and Wisconsin; individual or group project.

IA LL 531I. Conservation Biology.

(Cross-listed with A ECL, EEOB). Cr. 4. Alt. SS., offered even-numbered years. *Prereq: IA LL 312I*

Population-and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

IA LL 532. Analysis of Environmental Data.

(2-0) Cr. 2. SS. *Prereq:* An undergraduate course in statistics, understanding of basic concepts such as correlation and regression, and familiarity with PC-based software for data analysis

Analysis of Environmental Data will provide students with training in the theory and application of a range of statistical techniques useful for the analysis of ecological and paleoecological data. Topics will include data management, exploratory data analysis, regression analysis, direct and indirect ordination methods, classification techniques, transfer functions and the analysis of temporal data. Practical classes will provide hands-on training in the use of statistical and graphical software including R, CANOCO, C2, and TWINSPAN. The course will be directed towards advanced undergraduate, graduate and working professionals in ecology and paleoecology.

IA LL 535I. Restoration Ecology.

(Cross-listed with A ECL, EEOB, ENSCI). Cr. 4. Alt. SS., offered even-numbered years. *Prereq:* A course in ecology

Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

IA LL 563I. Soil Formation and Landscape Relationships.

(Dual-listed with IA LL 463I). (Cross-listed with AGRON, ENSCI). Cr. 4. Alt. SS., offered even-numbered years. *Prereq:* AGRON 154 or AGRON 260

Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only Agron 563 or 563I may be applied for graduation.

IA LL 564I. Wetland Ecology.

(Cross-listed with EEOB, ENSCI). Cr. 4. SS. *Prereq:* IA LL 312I

Ecology, classification, creation, restoration, and management of wetlands. Field studies will examine the composition, structure and functions of local natural wetlands and restored prairie pothole wetlands. Individual or group projects.

IA LL 573. Techniques for Biology Teaching.

(Cross-listed with A ECL, EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573A. Techniques for Biology Teaching : Animal Biology.

(Cross-listed with A ECL, EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573B. Techniques for Biology Teaching: Plant Biology.

(Cross-listed with EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573C. Techniques for Biology Teaching: Fungi and Lichens.

(Cross-listed with EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573D. Techniques for Biology Teaching: Aquatic Ecology.

(Cross-listed with EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573E. Techniques for Biology Teaching: Prairie Ecology.

(Cross-listed with EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573F. Techniques for Biology Teaching: Wetland Ecology.

(Cross-listed with EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573G. Techniques for Biology Teaching: Limnology.

(Cross-listed with A ECL, EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573H. Techniques for Biology Teaching: Animal Behavior.

(Cross-listed with EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573I. Techniques for Biology Teaching: Insect Ecology.

(Cross-listed with A ECL, EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573J. Techniques for Biology Teaching: Biology of Invertebrates.

(Cross-listed with EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573K. Techniques for Biology Teaching: Non-invasive Use of Living Organisms.

(Cross-listed with EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 573W. Techniques for Biology Teaching: Project WET.

(Cross-listed with A ECL, EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

IA LL 575I. Field Mycology.

(Cross-listed with EEOB). Cr. 4. Alt. SS., offered even-numbered years.

Identification and classification of the common fungi; techniques for identification, preservation, and culture practiced with members of the various fungi groups.

IA LL 580I. Ecology and Systematics of Diatoms.

(Cross-listed with EEOB). Cr. 4. SS.

Field and laboratory study of freshwater diatoms; techniques in collection, preparation, and identification of diatom samples; study of environmental factors affecting growth, distribution, taxonomic characters; project design and execution including construction of reference and voucher collections and data organization and analysis.

IA LL 590. Graduate Independent Study.

(Cross-listed with A ECL, ANTHR, EEOB). Cr. 1-4. Repeatable. SS. *Prereq:* Graduate classification and permission of instructor

IA LL 590I. Special Topics: Graduate Independent Study.

(Cross-listed with A ECL, ANTHR, EEOB). Cr. 1-4. Repeatable. SS. *Prereq:* Graduate classification and permission of instructor

IA LL 593. Natural History Workshop.

Cr. 1-3. *Prereq:* Permission of instructor

Graduate workshop on some aspect of the natural history of the Upper Midwest or on techniques for studying natural history.

Courses for graduate students:**IA LL 699I. Research.**

(Cross-listed with A ECL, ANTHR, EEOB, GDCB). Cr. 1-4. Repeatable.

Journalism and Mass Communication (JL MC)

Courses primarily for undergraduates:

JL MC 101. Mass Media and Society.

(3-0) Cr. 3. F.S.SS.

Communication theory models and their application to the mass media; the mass communication process; organization, characteristics and responsibilities of the mass media; media literacy process.

JL MC 110. Orientation to Journalism and Communication.

(1-0) Cr. 1. F.S.Alt. SS., offered irregularly.

Orientation to professional and pre-professional opportunities, writing for the mass media and curriculum requirements in the Greenlee School. Basic media writing preparation. Offered on a satisfactory-fail basis only.

JL MC 201. Reporting and Writing for the Mass Media.

(1-4) Cr. 3. F.S.SS. *Prereq: ENGL 250 (or testout) and JL MC 110.*

Generating story ideas, exercising news judgment and gathering information via interviews, observation and documentary sources to produce news and informational material for the mass media. Emphasis on analyzing and organizing information, as well as accuracy and principles of good writing. Use of AP Style.

JL MC 202. Intermediate Reporting and Writing for the Mass Media.

(2-2) Cr. 3. F.S. *Prereq: Minimum of C+ in JL MC 201*

Writing for newspapers, magazines and online media. Enhancing and refining skills in developing sources and generating story ideas. Information-gathering techniques, reporting and writing.

JL MC 206. Reporting and Writing for the Electronic Media.

(2-2) Cr. 3. F.S. *Prereq: Minimum of C+ in JL MC 201*

Researching, organizing, and writing for radio, television and online media. Basic principles of news programming and storytelling across electronic media platforms. An emphasis on development, content and structure.

JL MC 242. Visual Principles for Mass Communicators.

(3-0) Cr. 3. F.S.

Understanding and analysis of the visual message. Visual perception, visual communication theory, design syntax, design elements and how they are applied in journalism and mass communication.

JL MC 306. Electronic Media Production.

(2-2) Cr. 3. F.S. *Prereq: Minimum of C+ in JL MC 201*

Introduction to studio production using professional equipment. Course focus on visual concepts, maintenance and practical operation of studio equipment.

JL MC 308. Electronic News Gathering and Production.

(2-3) Cr. 3. *Prereq: Minimum of C+ in JL MC 201.*

Field techniques in single-camera video production used to shoot and edit visual stories. Introduction to electronic news gathering.

JL MC 310. Fundamentals of Photojournalism.

(2-2) Cr. 3. F.S. *Prereq: Minimum of C+ in JL MC 201*

Basic photojournalism techniques. Includes camera operation, lighting, composition and photo reproduction techniques for print or computer-mediated applications. Emphasis on using the camera as a reporting tool. Basic use of digital imaging and editing software. Ethical issues involving photojournalism. A digital SLR camera is required.

JL MC 312. Advanced Techniques in Photojournalism.

(2-2) Cr. 3. Alt. F., offered irregularly. Alt. S., offered irregularly. *Prereq: JL MC 310 or permission of instructor*

Advanced techniques and problem solving, both ethical and technical, for photographers who seek to be members of newsgathering teams. Photographic storytelling using a combination of audio and still photography techniques to report stories for print and web publications. Hands on experience with latest digital imaging technology. A digital SLR camera is required.

JL MC 315. Multimedia Production.

(2-2) Cr. 3. F.S. *Prereq: JL MC 308 or JL MC 310 or JL MC 316 or equivalent computer design proficiency*

Visual storytelling concepts and principles for evaluating, constructing and designing information for the Web and other electronic publication systems. Issues of ethics and ownership of work pertinent to the new media.

JL MC 316. Introduction to Digital Publishing.

(2-2) Cr. 3. F.S. *Prereq: Credit or enrollment in JL MC 242 and C+ or better in JL MC 201*

Digital publishing and beginning techniques in layout, photo editing and vector artwork. Application of visual principles to design simple print projects.

JL MC 317. Publishing for Mobile Devices.

(2-2) Cr. 3. S. *Prereq: JL MC 316 or equivalent computer design proficiency and JL MC 310 or 315.*

Creating, designing and publishing content for mobile devices (e.g., cell phones and tablets). Use of digital publishing tools (e.g., In Design). Exposure to animation and video editing software.

JL MC 341. Contemporary Magazine Publishing.

(Dual-listed with JL MC 541). (3-0) Cr. 3. F.S. *Prereq: Junior classification*

Analysis of magazine industry and specific audiences served by print and online magazines. Editorial procedures and policies, advertising, circulation, and history of the industry. Individual study of magazines.

JL MC 344. Feature Writing.

(2-2) Cr. 3. F. *Prereq: Minimum of C+ in JL MC 202 or JL MC 206 or P R 321*

Reporting and writing short- and long- form stories for magazines, newspapers, corporate communication and the Web. Focus on departmental stories, personal essays, trend or conflict articles and personality profiles. Emphasis on immersion reporting. Majors may not apply both 344 and Engl 303 toward graduation.

JL MC 346. Public Affairs Reporting.

(2-2) Cr. 3. S. *Prereq: Minimum of C+ in JL MC 202 or JL MC 206 or P R 321*

Reporting and writing about government, business, and other institutions; identification of and access to public records; investigative reporting techniques; developing major stories about government and nonprofit organizations; and ethical issues.

JL MC 347. Science Communication.

(Dual-listed with JL MC 547). (2-2) Cr. 3. S. *Prereq: ADVRT, JL MC, and P R majors: minimum of C+ in JL MC 201. Nonmajors and minors by permission of instructor.*

Reporting and writing about science and technology topics for general audiences. Outlets for stories include print, broadcast and online media. Story topics include reporting about basic, applied sciences and social sciences, as well as ethical, political and policy issues related to science and technology.

JL MC 349. News and Feature Editing.

(1-5) Cr. 3. S. *Prereq: Minimum of C+ in JL MC 202 or JL MC 206 or P R 321*

Editing content for multiple platforms, including websites, magazines, newspapers, and newsletters. Adapting material for audiences, including selection and organization of text and visuals, grammar, punctuation, usage, logic and accuracy. Designing print and online layouts. Using search engine optimization and social media to promote content.

JL MC 354. Advanced Electronic Media Production.

(2-3) Cr. 3. *Prereq: JL MC 206.*

Application of advanced television techniques: writing, producing, and managing live and recorded information programs.

JL MC 390. Professional Skills Development.

(Cross-listed with ADVRT, P R). Cr. 1-3. Repeatable, maximum of 6 credits. F.S. *Prereq: Minimum of C+ in JL MC 201; other vary by topic. Instructor permission for non-majors.*

Check with Greenlee School for course availability.

JL MC 401. Mass Communication Theory.

(3-0) Cr. 3. *Prereq: Junior classification*

Theory and research in mass communication processes and effects; the scientific process; methods of measuring, evaluating and reporting mass communication research.

JL MC 406. Media Management.

(Dual-listed with JL MC 506). (3-0) Cr. 3. *Prereq: Junior classification*

Decision-making functions of media. Basic media market analysis, media organization and management, circulation and audience development, technological developments affecting management decisions, and relationships with labor and regulatory agencies that affect media operations.

JL MC 449. Editorial Strategies.

(3-0) Cr. 3. S. *Prereq: JL MC 242, JL MC 316, JL MC 349 or concurrent enrollment; junior classification*

Skills and strategies for editorial decision-making and management, including short and long range issue planning. Developing proposals, business plans and prototypes for content, design and layouts of publications for multiple platforms and diverse audiences, including new and existing online and print magazines, newspapers, newsletters and websites. Editing complex manuscripts, with continued emphasis on grammar, punctuation, usage, syntax and logic.

JL MC 453. Electronic Media Technology and Public Policy.

(3-0) Cr. 3. *Prereq: Junior classification*
Issues and policies affecting historical, contemporary and future developments of electronic media and their technologies.

JL MC 454. Critical Analysis and History of the Moving Image.

(3-0) Cr. 3. *Prereq: Junior classification*
Evolution of motion picture and television content and other visual technologies. Theories and techniques for evaluating and critiquing film and video.

JL MC 460. Law of Mass Communication.

(3-0) Cr. 3. F.S. *Prereq: Minimum of C+ in JL MC 201; junior classification. Nonmajors by permission of instructor.*
First Amendment law, libel, privacy, obscenity, contempt, copyright, trademark, the Federal Communications Act; laws affecting advertising, legal publication, and other business activities of the media.

JL MC 461. History of American Journalism.

(3-0) Cr. 3. *Prereq: Junior classification*
Role of the mass media, including advertising and public relations, in shaping the social, economic and political history of America; impact of change in these areas on the development, traditions and philosophies of the media.

JL MC 462. Media Ethics, Freedom, Responsibility.

(3-0) Cr. 3. F. *Prereq: Junior classification*
Ethics and professionalism in the practice of journalism, public relations and advertising.

JL MC 464. Journalism and Literature.

(3-0) Cr. 3. *Prereq: Junior classification*
A study of journalism's impact on literary writing and literature's impact on journalism, as seen through the works of esteemed American author-journalists.

JL MC 474. Communication Technology and Social Change.

(Cross-listed with T SC). (3-0) Cr. 3. *Prereq: Junior classification*
Examination of historical and current communication technologies, including how they shape and are shaped by the cultural and social practices into which they are introduced.
Meets International Perspectives Requirement.

JL MC 476. World Communication Systems.

(Dual-listed with JL MC 576). (3-0) Cr. 3. *Prereq: Junior classification*
World communication systems and social, political, and economic factors determining flow, character, and volume of news. Impact of media information and entertainment content on nations and societies. Comparative analysis of role and impact of traditional modes of communication, the mass media, and computer-mediated systems.
Meets International Perspectives Requirement.

JL MC 477. Ethnicity, Gender, Class and the Media.

(3-0) Cr. 3. F.S.SS. *Prereq: Junior classification*
Portrayals of ethnic groups, gender, and social class in the media in news, advertising, information and entertainment; the effects of mass media on social issues and population groups.
Meets U.S. Diversity Requirement

JL MC 490. Independent Study in Communication.

Cr. arr. *Prereq: Junior classification and contract with supervising professor to register*
Independent studies are research-based. Students may study problems associated with a medium, a professional specialization, a philosophical or practical concern, a reportorial method or writing technique, or a special topic in their field. Credit is not given for working on student or professional media without an accompanying research component. No more than 3 credits of JL MC 490 may be used toward a degree in journalism and mass communication or advertising.

JL MC 497. Special Topics in Communication.

(Cross-listed with ADVRT, P R). Cr. 1-3. Repeatable, maximum of 6 credits. F.S. Seminars or one-time classes on topics of relevance to students in communication.

JL MC 499. Professional Media Internship.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: JL MC majors: minimum of C+ in JL MC 202 or JL MC 206 or P R 321; ADVRT majors: minimum of C+ in JL MC 201 and ADVRT 301; P R majors: minimum of C+ in P R 321. All students, formal faculty adviser approval.*
Required of all Greenlee School majors. A 400-hour (for 3 credits) internship in the student's journalism and mass communication or advertising or public relations specialization. Assessment based on employer evaluations, student reports and faculty reviews. Available only to Greenlee School majors. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

JL MC 501. Theories of Mass Communication.

(3-0) Cr. 3. F. *Prereq: 6 credits in social science or admission to the graduate program*
Historical overview of mass communication theories. Examination of major areas of research activity and theoretical development related to organization, functions, and effects of mass communication.

JL MC 502. Communication Research Methods.

(3-2) Cr. 4. S. *Prereq: JL MC 501 or equivalent communication theory course*
Research methods in journalism and mass communication, including problem selection, sampling, hypothesis formulation, research design, data collection and analysis. Designing a research strategy appropriate for a variety of communication-related questions and assessing the appropriateness, validity, and generalizability of research results.

JL MC 506. Media Management.

(Dual-listed with JL MC 406). (3-0) Cr. 3. S. *Prereq: 6 credits in social science (economics highly recommended) or admission to the graduate program*
Decision-making functions of media. Basic media market analysis, media organization and management, circulation and audience development, technological developments affecting management decisions, and relationships with labor and regulatory agencies that affect media operations.

JL MC 510. Strategies of Communication.

(3-0) Cr. 3. *Prereq: JL MC 501*
The process of developing professional communication and persuasion strategies, with emphasis on problem definition, behavioral objectives, situation analysis, strategy formulation, and justification through application of communication theories and research.

JL MC 520. Public Relations Theory and Methods.

(3-0) Cr. 3. *Prereq: 6 credits in social science.*
Theories and research methods applied to the study and practice of public relations.

JL MC 521. Theories of Visual Communication.

(3-0) Cr. 3. F.Alt. S., offered irregularly. *Prereq: 6 credits in social science*
Explores the theoretical frameworks in visual communication, including concepts of perception, visual language, visual persuasion, and the social, political and cultural implications of the use of images. Understanding of the function of images in changing knowledge, attitudes and behavior.

JL MC 541. Contemporary Magazine Publishing.

(Dual-listed with JL MC 341). (3-0) Cr. 3. F.S. *Prereq: Junior classification*
Analysis of magazine industry and specific audiences served by print and online magazines. Editorial procedures and policies, advertising, circulation, and history of the industry. Individual study of magazines.

JL MC 547. Science Communication.

(Dual-listed with JL MC 347). (2-2) Cr. 3. S. *Prereq: ADVRT, JL MC, and P R majors: minimum of C+ in JL MC 201. Nonmajors and minors by permission of instructor.*
Reporting and writing about science and technology topics for general audiences. Outlets for stories include print, broadcast and online media. Story topics include reporting about basic, applied sciences and social sciences, as well as ethical, political and policy issues related to science and technology.

JL MC 560. Risk Perception and Communication.

(3-0) Cr. 3. F. *Prereq: Graduate standing, 6 graduate social science credits.*
Study of risk communication principles, models and theories applicable to any risk communication situation. Emphasis on science, technology and risk issues encountered in e.g., food, agriculture and veterinary medicine. Examines roles of scientists and communicators in cultivating a public informed about scientific and technological issues.

JL MC 561. Media and Society: Interrelationships.

(3-0) Cr. 3. Alt. F., offered irregularly. S. *Prereq: 6 credits in social science*
Media roles and functions in society: Interplay and interrelationships between the media and a variety of social actors and forces: the mutual influence between social factors and mass media.

JL MC 574. Communication Technologies and Social Change.

(Cross-listed with T SC). (3-0) Cr. 3. *Prereq: 6 credits in social science*
Personal, organizational, and social implications of the use of communication technologies. Includes theories and empirical research across the continuum of perspectives, from techno-utopianism through an anti-technology stance.
Meets International Perspectives Requirement.

JL MC 576. World Communication Systems.

(Dual-listed with JL MC 476). (3-0) Cr. 3.

World communication systems and social, political, and economic factors determining flow, character, and volume of news. Impact of media information and entertainment content on nations and societies. Comparative analysis of role and impact of traditional modes of communication, the mass media and computer-mediated systems.

Meets International Perspectives Requirement.

JL MC 590. Special Topics.Cr. arr. Repeatable. *Prereq: Permission of instructor***JL MC 590A. Special Topics: Media Studies.**Cr. arr. Repeatable. *Prereq: Permission of instructor***JL MC 590B. Special Topics: Professional Specialization.**Cr. arr. Repeatable. *Prereq: Permission of instructor***JL MC 590C. Special Topics: Research Problems and Methods.**Cr. arr. Repeatable. *Prereq: Permission of instructor***JL MC 590D. Special Topics: Technique and Style.**Cr. arr. Repeatable. *Prereq: Permission of instructor***JL MC 590E. Special Topics: Specialized Communication.**Cr. arr. Repeatable. *Prereq: Permission of instructor***JL MC 591. Professional Internship.**Cr. 1-2. F.S.SS. *Prereq: Permission of instructor*

Supervised internship experience. Offered on a satisfactory-fail basis only.

JL MC 592. Introduction to Graduate Study in Journalism and Mass Communication.Cr. R. F. *Prereq: Graduate classification*

Overview of advanced study in journalism and mass communication with special emphasis on requirements for obtaining the master of science degree.

JL MC 598. Seminars in Mass Communication.

Cr. 1-3. Repeatable.

JL MC 598A. Seminars in Mass Communication: Audiences and Effects.

Cr. 1-3. Repeatable.

JL MC 598B. Seminars in Mass Communication: Communication Technology.

Cr. 1-3. Repeatable.

JL MC 598C. Seminars in Mass Communication: Professional Communication.

Cr. 1-3. Repeatable.

JL MC 598D. Seminars in Mass Communication: Development Communication.

Cr. 1-3. Repeatable.

JL MC 598E. Seminars in Mass Communication: Evaluation Methods.

Cr. 1-3. Repeatable.

JL MC 598F. Seminars in Mass Communication: International Communication.

Cr. 1-3. Repeatable.

JL MC 598G. Seminars in Mass Communication: Mass Communication History.

Cr. 1-3. Repeatable.

JL MC 598H. Seminars in Mass Communication: Mass Communication Law.

Cr. 1-3. Repeatable.

JL MC 598I. Seminars in Mass Communication: Media Management.

Cr. 1-3. Repeatable.

JL MC 598J. Seminars in Mass Communication: Research Methods.

Cr. 1-3. Repeatable.

JL MC 598K. Seminars in Mass Communication: Society and Mass Communication.

Cr. 1-3. Repeatable.

JL MC 598L. Seminars in Mass Communication: Journalism and Mass Communication Education.

Cr. 1-3. Repeatable.

JL MC 598M. Seminars in Mass Communication: Visual Communication.

Cr. 1-3. Repeatable.

JL MC 598N. Seminars in Mass Communication: Broadcast Communication.

Cr. 1-3. Repeatable.

JL MC 598O. Seminars in Mass Communication: Communication Theory.

Cr. 1-3. Repeatable.

JL MC 598P. Seminars in Mass Communication: Computer Mediated Communication.

Cr. 1-3. Repeatable.

JL MC 598Q. Seminars in Mass Communication: Science, Technology and Risk Communication..

Cr. 1-3. Repeatable.

JL MC 599. Creative Component.Cr. arr. *Prereq: Approved creative component proposal***Courses for graduate students:****JL MC 699. Thesis Research.**Cr. arr. Repeatable. *Prereq: Approved thesis proposal*

Kinesiology (KIN)

Courses primarily for undergraduates:

KIN 101. Swimming I.

(0-3) Cr. 1. F.S.SS.

Basic course for nonswimmers. Emphasis on two fundamental strokes and personal water safety skills. Offered on a satisfactory-fail basis only.

KIN 102. Swimming II.

(0-3) Cr. 1. F.S. *Prereq: KIN 101 or equivalent skill*

Intermediate course. Emphasis on learning and improving five basic strokes and personal water safety skills. Offered on a satisfactory-fail basis only.

KIN 108. Aquatic Fitness.

(0-3) Cr. 1. F.S. *Prereq: KIN 102 or equivalent skill*

Water related exercises, activities, and swimming workouts to improve physical fitness. Offered on a satisfactory-fail basis only.

KIN 122. Badminton.

(0-2) Cr. 1. F.S.SS.

Introduction to fundamental badminton skills and strategic game play. Offered on a satisfactory-fail basis only.

KIN 129. Bowling.

(0-2) Cr. 1. F.S.SS.

Introduction to bowling skills and strategic game play. Offered on a satisfactory-fail basis only.

KIN 135. Golf.

(0-2) Cr. 1. F.S.SS.

Introduction to fundamental golf skills and strategic game play. Offered on a satisfactory-fail basis only.

KIN 144. Racquetball.

(0-2) Cr. 1. F.S.SS.

Introduction to fundamental racquetball skills and strategic game play. Offered on a satisfactory-fail basis only.

KIN 153. Ice Skating.

(0-2) Cr. 1. F.S.SS.

Introduction to fundamental ice skating skills and strategic game play. Offered on a satisfactory-fail basis only.

KIN 158. Tennis.

(0-2) Cr. 1. F.S.SS.

Introduction to basic skills (forehand, backhand, service) and basic knowledge of game play. Offered on a satisfactory-fail basis only.

KIN 163. Physical Fitness.

(0-3) Cr. 1. F.S.SS.

Evaluation of fitness status. Exercises, activities, and programs to improve physical fitness. Improve physical fitness and weight control. Offered on a satisfactory-fail basis only. Credit for only KIN 163 or 258 may be applied toward graduation.

KIN 164. Walking for Fitness.

(0-3) Cr. 1. F.S.SS.

Fitness walking as an activity to improve health and fitness; values of this type of activity as a lifetime endeavor with knowledge and usage of pedometers. Offered on a satisfactory-fail basis only.

KIN 165. Running for Fitness.

(0-2) Cr. 1. F.S.SS.

Running as a physical activity to improve physical fitness and health. Promotion of this activity as a lifetime endeavor. Offered on a satisfactory-fail basis only.

KIN 166. Weight Training.

(0-3) Cr. 1. F.S.SS.

Introduction to fundamental skills of weight training and strategic game play. Offered on a satisfactory-fail basis only.

KIN 168. Judo.

(0-2) Cr. 1. F.S.

Fundamentals of self defense, focusing on throwing with the hands, hips and feet as well as applying pins, chokes and arm-bars. The physical skills will be taught focused on training through development of courtesy, integrity, perseverance, self control, & indomitable spirit. Emphasis on learning a way of life that promotes personal development, physical health and citizenship. Offered on a satisfactory-fail basis only.

KIN 170. Tae Kwon Do/Karate I.

(0-2) Cr. 1. F.S.

Teaches fundamentals of self-defense, focusing on hand and foot striking and blocking techniques. The physical skills will be taught focused on training through development of courtesy, integrity, perseverance, self-control and indomitable spirit. It will be emphasized that each student learns a way of life that promotes personal development, physical health and citizenship. Offered on a satisfactory-fail basis only.

KIN 171. Tae Kwon Do/Karate II.

(0-2) Cr. 1. F.S.

Teaches advanced application of self-defense focusing on hand and foot striking and blocking techniques. The physical skills will be taught focused on training through development of courtesy, integrity, perseverance, self-control and indomitable spirit. It will be emphasized that each student learns a way of life that promotes personal development, physical health and citizenship. Offered on a satisfactory-fail basis only.

KIN 173. Hap Ki Do/Martial Self-Defense.

(0-2) Cr. 1. F.S.

Teaches fundamentals of self-defense focusing on joint locks, pressure points and throwing techniques to escape from an attacker. The physical skills will be taught focused on training through development of courtesy, integrity, perseverance, self-control and indomitable spirit. It will be emphasized that each student learns a way of life that promotes personal development, physical health & citizenship. Offered on a satisfactory-fail basis only.

KIN 182. Volleyball.

(0-2) Cr. 1. F.S.SS.

Introduction to fundamental volleyball skills and strategic game play. Offered on a satisfactory-fail basis only.

KIN 185. Soccer.

(0-2) Cr. 1. F.S.SS.

Introduction to fundamental soccer skills and strategic game play. Offered on a satisfactory-fail basis only.

KIN 210. Concepts of Fitness and Wellness.

(2-0) Cr. 2. F.S.

Coverage of behavioral skills needed to adopt and maintain lifestyles conducive to fitness and wellness. Provides students with knowledge and skills needed to adopt and maintain healthy lifestyles. Includes self-assessments and content on physical activity, nutrition, weight control, stress management and other lifestyle behaviors related to health. For non-kinesiology majors.

KIN 231. Fundamentals of Tumbling and Gymnastics.

(0-3) Cr. 1. F. *Prereq: Eligibility for admission to KIN teacher education program*

Fundamentals of tumbling and gymnastics apparatus. Skill enhancement, analysis, understanding practice and the development of progressions.

KIN 232. Fundamentals of Team Sports.

(0-3) Cr. 1. S. *Prereq: Eligibility for admission to KIN teacher education program*

Fundamentals of indoor and outdoor team sports, for example basketball, volleyball, flag football, and soccer. Skill enhancement, analysis, understanding practice and the development of progressions.

KIN 236. Fundamentals of Individual Sports and Fitness.

(0-3) Cr. 1. F. *Prereq: Eligibility for admission to KIN teacher education program*

Fundamentals of individual sports and fitness, for example disc golf, bowling, badminton, and weight training. Skill enhancement, analysis, understanding practice and the development of progressions.

KIN 238. Fundamentals of Outdoor and Adventure Activities.

(0-3) Cr. 1. F. *Prereq: Eligibility for admission to KIN teacher education program*

Techniques of individual and group facilitation for initiatives involving outdoor adventure activity. Topics include ropes/challenge course events, activity presentation, and sequencing, safety techniques, preparation principles and new games philosophy. Participation is required in one weekend of fieldwork.

KIN 252. Disciplines and Professions in Kinesiology and Health.

(1-0) Cr. 1. F.S.

Overview of the various disciplines and professions that comprise the field of Kinesiology (the study of human movement) and help students determine the career option that best fits their interests.

KIN 253. Orientation in Kinesiology and Health.

(1-0) Cr. 1. F.S. *Prereq: Concurrent enrollment or credit in KIN 252*

Overview of ISU policies and procedures, academic advising operations, degree requirements, program of study planning, and campus resources. Kinesiology and Health majors only. Offered on a satisfactory-fail basis only.

KIN 254. Learning Communities in Kinesiology/Health.

(0.5-0) Cr. 0.5. F.S. *Prereq: Concurrent enrollment or credit in KIN 253*
Semester long course for new students in the Kinesiology Learning Community to be taken concurrently with the general orientation class for Kinesiology majors. Students will take field trips and work with faculty, staff and mentors to explore careers in kinesiology and complete assignments related to identification & development of their skills and interests. Kinesiology and health majors only. Offered on a satisfactory-fail basis only.

KIN 258. Physical Fitness and Conditioning.

(1-3) Cr. 2. F.S. *Prereq: Kinesiology and health majors only*
Development of personal fitness using a variety of conditioning and exercise techniques such as aerobics, weight training, and aquatic fitness. Introduction to acute and chronic responses to exercise, and the role of exercise in health promotion and weight management. Credit for only one of the following courses may be applied toward graduation: KIN 163, 258.

KIN 259. Leadership Techniques for Fitness Programs.

(1-3) Cr. 2. F.S. *Prereq: KIN 258*
Development of exercise leadership skills for a variety of activities. Includes planning, promotion, and teaching techniques for developing fitness in others using a variety of exercise modalities including aerobics, weight training, and aquatic fitness. Kinesiology and health majors only.

KIN 266. Advanced Strength Training and Conditioning.

(1-2) Cr. 2. F.S. *Prereq: KIN 258*
This course is designed to enhance the student's current level of knowledge and expertise to an advanced level in the area of strength training and conditioning. The course will prepare students interested in taking the National Strength and Conditioning Association Certified and Conditioning Specialist's exam. The course will focus on the assessment and implementation of training programs with strong emphasis on the areas of resistance training, metabolic training, flexibility, reaction time, speed, and agility. Kinesiology and health majors only and permission of instructor needed.

KIN 280. Directed Field Experience in Elementary Physical Education.

(0-3) Cr. 1. F.S.
Observing, planning, and facilitating movement experiences of children in an elementary school setting. Offered on a satisfactory-fail basis only.

KIN 281. Directed Field Experience in Secondary Physical Education.

(0-3) Cr. 1. F.S. *Prereq: Admission to Educator Preparation Program*
Observing, planning, and facilitating movement experiences of students in a public school setting. Offered on a satisfactory-fail basis only.

KIN 282. Field Experience with Educational Outreach.

(0-2) Cr. 1. F.S. *Prereq: Admission to Educator Preparation Program*
Planning and facilitating physical education experiences for children in a community outreach setting. Experiences take place on campus. Offered on a satisfactory-fail basis only.

KIN 284. Elementary and Pre-school Movement Education.

(2-3) Cr. 3. F.S.SS. *Prereq: 3 credits in human development and family studies*
Approaches to teaching movement skills, health-related fitness and school-based physical activities (in the classroom, in PE, during recess) to pre-school and elementary school age children are covered. Emphasis is placed on planning and conducting developmentally appropriate movement experiences for preschool and elementary aged children throughout the school day based upon educational psychology, exercise psychology and motor development research. Practical experience is provided. Credit in only one of the following courses may be applied toward graduation: KIN 284, 312.

KIN 285. Pre-Internship in Kinesiology and Health.

(Cross-listed with H S). Cr. 1-2. F.S.SS. *Prereq: Kinesiology and Health major and permission of internship coordinator*
Pre-internship experience with a health or fitness organization based on option. Offered on a satisfactory-fail basis only.

KIN 290. Independent Study.

Cr. 1. F.
Study under supervision of faculty.

KIN 312. Movement Education in Elementary School Physical Education.

(2-2) Cr. 3. F.
Planning for management and instruction of developmentally appropriate physical education for children pre-school through grade six. Laboratory experience required. Credit for only one in the following courses can be applied toward graduation: KIN 284, 312.

KIN 313. Teaching Secondary Physical Education.

(2-3) Cr. 3. S. *Prereq: Admission to Educator Preparation Program*
Current theory, practice and research on teaching focusing on management, instructional, and learning styles of students in secondary schools.

KIN 315. Coaching Theory and Administrative Issues.

(3-0) Cr. 3. F.S.SS.
Study in the theory, ethics, strategy, and mechanics of coaching various interscholastic and/or intercollegiate sports. Emphasis on formulating a philosophy, identifying goals and psychological aspects, teaching skills, and developing strategies.

KIN 345. Management of Health-Fitness Programs and Facilities.

(3-0) Cr. 3. F.S.
Application of management concepts to the fitness industry, e.g., understanding customers, marketing, program management, financial management, legal issues, and evaluation and planning.

KIN 355. Biomechanics.

(3-0) Cr. 3. F.S.SS. *Prereq: PHYS 111 or PHYS 115*
Mechanical basis of human performance; application of mechanical principles to exercise, sport and other physical activities.

KIN 358. Physiology of Exercise.

(3-0) Cr. 3. F.S.SS. *Prereq: BIOL 255, BIOL 255L, BIOL 256 and BIOL 256L*
Physiological basis of human performance; effects of physical activity on body functions.

KIN 360. Sociology of Sport and Exercise.

(3-0) Cr. 3. F.S. *Prereq: SOC 134 and one of STAT 101, STAT 104 or STAT 226/ STAT 326, or KIN 471*
Sport and exercise as social systems and as institutions related to other institutions such as the polity, the economy, mass media, and education.

KIN 363. Basic Electrocardiography.

(2-0) Cr. 2. Alt. F., offered even-numbered years.
Understanding of human electrocardiography, including normal and abnormal 12-lead ECGs and arrhythmia identification.

KIN 365. Sport Psychology.

(3-0) Cr. 3. F.S. *Prereq: PSYCH 101 or PSYCH 230*
Psychological factors that influence performance in sport settings. The influence of personality, anxiety, motivation, social factors, and psychological skills training.

KIN 366. Exercise Psychology.

(3-0) Cr. 3. F.S.SS. *Prereq: PSYCH 101 or PSYCH 230*
Psychological theories for understanding and predicting health-oriented exercise behavior. Psychological and psychobiological responses to exercise. Psychological interventions for increasing exercise participation and adherence rates.

KIN 372. Motor Control and Learning Across the Lifespan.

(3-0) Cr. 3. F.S.SS. *Prereq: PSYCH 101 or PSYCH 230, BIOL 255, BIOL 256*
Introduction to major concepts of neuromotor control, behavioral motor control and motor learning in the child, adult and older adult, with emphasis on the adult system.

KIN 385. Strategies for Professional School and Field Experience Opportunities.

(Cross-listed with H S). Cr. R. F.S. *Prereq: Junior classification; to be taken minimum of two semesters prior to graduation or field experience placement.*
Search techniques and preparation of relevant material for work and/or professional school admission. Information specifically related to health care and kinesiology fields. Field experience process and procedures will be reviewed.

KIN 391. Service Learning Leadership Experience.

Cr. 1-3. Repeatable. F.S.
Applied service learning experiences designed to provide students with opportunities to apply classroom knowledge to real world applications. Students will gain professional skills and programming experience while supporting health, education and wellness programming in school, work site or community settings. Offered on a satisfactory-fail basis only.

KIN 395. Adapted Physical Education.

(Dual-listed with KIN 595). (2-3) Cr. 3. F. *Prereq: KIN 312*
Specific disabling conditions in terms of etiology, characteristics, needs, and potential for movement experiences. Techniques of assessment, prescription, adaptation of activities, methods, and program planning. Laboratory experience required. KIN 595 may not be taken by students who have previously earned credit in KIN 395

KIN 399. Recreational Sport Management.

(3-0) Cr. 3. F. *Prereq: SOC 134*
The role of sport in developing fitness, recreational opportunities, and tourism, with special emphasis on issues related to youth sport, volunteerism, and the marketing of sport events and facilities.

KIN 417. Supervised Teaching in Physical Education in the Secondary School.

Cr. arr. F.S. Prereq: KIN 281, KIN 313, KIN 355, KIN 358, KIN 395, KIN 471, KIN 475; admission to Teacher Education; approval before enrolling in the course. Supervised teaching in the secondary schools.

KIN 418. Supervised Teaching in Physical Education in the Elementary School.

Cr. 8. F.S. Prereq: KIN 280, KIN 312, KIN 355, KIN 358, KIN 395, KIN 471, KIN 475. Students must be fully admitted to Teacher Education and must apply for approval to enroll at the beginning of the semester prior to registering. Supervised teaching in the elementary schools.

KIN 445. Legal Aspects of Sport.

(3-0) Cr. 3. S.

Students will understand legal concepts and terminology relevant to sport/activity, identify strategies for limiting liability in sport/fitness programs, and identify solutions for elimination of discriminatory practices in sport and physical activity.

KIN 455. Research Topics in Biomechanics.

(3-0) Cr. 3. Prereq: KIN 355 or permission of instructor

Examination of biomechanics and kinesiology research literature to evaluate the application of mechanical principles and analyses to human movement in exercise, sport, physical activity, and activities of daily living and to assess research outcomes and their implications for motor performance, movement energetic, musculoskeletal loading, and injury.

KIN 458. Principles of Fitness Assessment and Exercise Prescription.

(3-2) Cr. 4. F.S. Prereq: KIN 258, KIN 358

Principles of cardiac risk factor identification and modification; risk classification of potential exercise clients; fitness assessments; developing comprehensive exercise prescriptions for individuals.

KIN 459. Internship in Exercise Leadership.

(0-3) Cr. 1. F.S. Prereq: C- or better in KIN 259, CPR certification, concurrent enrollment in KIN 458

Observation and practice of exercise leadership techniques in an on-campus adult fitness program.

KIN 462. Medical Aspects of Exercise.

(3-0) Cr. 3. F.S. Prereq: KIN 358

The role of exercise in preventive medicine. Impact of exercise on various diseases, and the effect of various medical conditions on the ability to participate in vigorous exercise and competitive sports. Principles of exercise testing and prescription for individuals with these conditions. Environmental and nutritional aspects of exercise.

KIN 467. Exercise and Health: Behavior Change.

(Dual-listed with KIN 567). (3-0) Cr. 3. S. Prereq: Introductory course with emphasis on exercise psychology (i.e., KIN 366 or equivalent)

Advanced analysis of theoretical health behavior models and their application to physical activity behavior. Includes practical techniques, tools and interventions (e.g., counseling skills, motivational interviewing) to enhance exercise prescription and motivation, and considerations for working with special populations.

KIN 471. Measurement in Physical Education.

(Dual-listed with KIN 571). (3-0) Cr. 3. S.

Study of grading, assessment and evaluation in physical education with a focus on measuring cognitive and psycho-motor achievement.

KIN 472. Neural Basis of Human Movement.

(Dual-listed with KIN 572). (3-0) Cr. 3. S. Prereq: KIN 372 or PSYCH 310

Addresses the role of the central nervous system in the control of voluntary human movement, with the focus on the cerebral cortex, basal ganglia and cerebellum. Content organized around specific nervous system damage (such as stroke, apraxia, spasticity, or spinal cord damage) and functional movements (such as reaching and grasping, balance and gait). Converging evidence from human movement disorders, brain imaging, animal lesion and single cell studies provide the primary basis for the content.

KIN 475. Physical Education Curriculum Design and Program Organization.

(Dual-listed with KIN 575). (3-0) Cr. 3. F. Prereq: Admission to Educator Preparation Program

Current theory, practices and principles applied to curriculum development for programs in physical education, K-12. Organizing for teaching in a variety of school settings.

KIN 480. Functional Anatomy.

(3-0) Cr. 3. F.S. Prereq: KIN 355; BIOL 155 or BIOL 255 and BIOL 256

The structure and function of human muscular, skeletal and nervous systems. The relationship of these systems to efficient and safe human motion.

KIN 481. Biomechanics Lab.

(0-2) Cr. 1. Prereq: KIN 355

Learning lab techniques in Biomechanics and engaging in the experimental process.

KIN 482. Exercise Physiology Lab.

(0-2) Cr. 1. Prereq: KIN 358

Learning lab techniques in Exercise Physiology and engaging in the experimental process.

KIN 483. Exercise Psychology Lab.

(0-2) Cr. 1. Prereq: KIN 366

Learning lab techniques in Exercise Psychology and engaging in the experimental process.

KIN 484. Assessment and Control of Locomotion.

(0-2) Cr. 1. Prereq: KIN 372

Learning lab techniques in Motor Control and engaging in the experimental process.

KIN 485. Internship in Exercise Science.

Cr. 1-16. Prereq: Senior classification and advance registration

Observation and practice in fitness agencies. Offered on a satisfactory-fail basis only.

KIN 485A. Internship in Exercise Science: Health/Fitness Management..

Cr. 1-16. Prereq: Prereq: C- or better in KIN 458 and KIN 459, Kinesiology and Health majors only. Cumulative GPA 2.0.

Observation and practice in selected sport and exercise science agencies. Offered on a satisfactory-fail basis only.

KIN 485B. Internship in Exercise Science: Sport and Physical Activity..

Cr. 1-16. Prereq: Prereq: Kinesiology and Health majors only. Cumulative GPA 2.0.

Observation and practice in selected sport and exercise science agencies. Offered on a satisfactory-fail basis only.

KIN 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 6 credits. Prereq: 6 credits from KIN advanced core and permission of coordinator

Independent study of problems of areas of interest in exercise and sport science and related areas.

KIN 490A. Independent Study: Exercise and Sport Science.

Cr. 1-3. Repeatable, maximum of 6 credits. Prereq: 6 credits from KIN advanced core and permission of coordinator

Independent study of problems of areas of interest in exercise and sport science and related areas.

KIN 490H. Independent Study: Honors.

Cr. 1-2. Repeatable, maximum of 4 credits. Prereq: 6 credits from KIN advanced core and permission of coordinator

Independent study of problems of areas of interest in exercise and sport science and related areas.

KIN 495. Seminar in Exercise and Sport Science.

Cr. 0.5-1. Prereq: Senior classification

Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:**KIN 501. Research Methods in Physical Activity.**

(3-0) Cr. 3. Repeatable. Prereq: Graduate classification in kinesiology and health. Methods and techniques used in the design and interpretation of research involving physical activity. Emphasis on styles of writing, library use, and computer applications.

KIN 505. Research Laboratory Techniques in Exercise Physiology.

(0-4) Cr. 2. Prereq: KIN 358 or equivalent course with basic laboratory experience. Application and use of laboratory research equipment in exercise physiology, including operation, calibration, and use in selected situations.

KIN 510. Advanced Medical Aspects of Exercise.

(2-0) Cr. 2. Prereq: KIN 358

The role of exercise in preventive medicine. Impact of exercise on various diseases, and the effect of various medical conditions on the ability to participate in vigorous exercise and competitive sports. Principles of exercise testing and prescription for individuals with these conditions.

KIN 512. Movement Education in Elementary School Physical Education.

(2-2) Cr. 3. F.

Planning for management and instruction of developmentally appropriate physical education for children pre-school through grade six. Laboratory experience required. Emphasis on evaluating published research on physical education and school-wide physical activity.

KIN 515. Injury Biomechanics.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: Kin 355 or permission of instructor.*

Utilization of biomechanical principles to model injury mechanisms. Introduction to tissue mechanics of bone, articular cartilage, ligament, tendon, and muscle. Biomechanics of lower extremity, upper extremity, and head/neck/trunk injuries.

KIN 516. Quantitative Analysis of Human Movement.

(3-1) Cr. 3. *Prereq: KIN 355*

Application of the principles of mechanics to the analysis of human motion. Investigation of the effects of kinematics and kinetics on the human body with special emphasis on exercise and sport applications. Includes consideration of two-dimensional and three-dimensional imaging techniques and force measurements.

KIN 517. Musculoskeletal Modeling.

(3-1) Cr. 3. F. *Prereq: KIN 355 or permission from instructor*

Systematic problem-solving approaches and design of computer programs for biomechanical analyses. Estimation of anthropometric parameters and mechanical properties of muscles, bones, and joints. Integration of anthropometrics, kinematics, and muscle mechanics into simulations of human movement.

KIN 518. Student Teaching in Elementary Physical Education.

(0-8) Cr. 8. F.S. *Prereq: KIN 512, KIN 570, KIN 575*

Student teaching for 8 weeks in an elementary school.

KIN 519. Student Teaching in Secondary Physical Education.

(0-8) Cr. 8. F.S. *Prereq: KIN 512, KIN 570, KIN 575*

Student teaching for 8 weeks in a middle or high school.

KIN 520. The Social Analysis of Sport.

(3-0) Cr. 3. *Prereq: KIN 360; open to majors only or by permission of instructor*

Sociological analysis of sport with emphasis on sociological theory, sports structure, and function in modern industrialized society; the systems of sport in regard to their role structure; formal organization, and professionalization and its differentiation along social class, age, and sex.

KIN 521. Advanced Topics in Exercise and Sport Psychology.

(3-0) Cr. 3. *Prereq: KIN 365 or KIN 366, 3 courses in psychology; open to majors only or by permission of instructor*

Aspects of psychology which form a basis for understanding and explaining behavior in the context of exercise and sport. Emphasis on evaluating published research, particularly theory and research methodology. Student presentations.

KIN 549. Advanced Vertebrate Physiology I.

(Cross-listed with AN S, NUTRS). (4-0) Cr. 4. F. *Prereq: Biol 335; credit or enrollment in BBMB 404 or BBMB 420*

Overview of mammalian physiology. Cell biology, endocrinology, cardiovascular, respiratory, immune, digestive, skeletal muscle and reproductive systems.

KIN 550. Advanced Physiology of Exercise I.

(2-3) Cr. 3. *Prereq: KIN 505*

Concepts and methods of assessing neurological, muscular, cardiovascular, and respiratory adjustments to exercise.

KIN 551. Advanced Physiology of Exercise II.

(2-3) Cr. 3. *Prereq: KIN 505*

Analysis of factors affecting work capacity and performance. Human energy metabolism concepts and measurement.

KIN 552. Advanced Vertebrate Physiology II.

(Cross-listed with AN S, NUTRS). (3-0) Cr. 3. S. *Prereq: BIOL 335; credit or enrollment in BBMB 404 or BBMB 420*

Cardiovascular, renal, respiratory, and digestive physiology.

KIN 558. Physical Fitness - Principles, Programs and Evaluation.

(2-3) Cr. 3. *Prereq: KIN 358*

Physiological principles of physical fitness, design and administration of fitness programs; testing, evaluation, and prescription; electrocardiogram interpretation.

KIN 560. Principles of Motor Control and Learning.

(2-3) Cr. 3. *Prereq: KIN 372*

Theoretical perspectives of motor control and learning will be examined as well as factors that facilitate motor learning. Motor control and learning will also be addressed by studying functional tasks such as reach and grasp, posture and locomotor, handwriting, catching and/or speech.

KIN 561. Motor Development and Physical Activity.

(2-0) Cr. 2-3. *Prereq: PSYCH 230*

Addresses theories and underlying mechanisms of motor development and motor control applied to typically and atypically developing children. Developmental control of balance, locomotion, reach-to-grasp, and other functional skills will be discussed, as will the role of physical activity in a child's life.

KIN 567. Exercise and Health: Behavior Change.

(Dual-listed with KIN 467). (3-0) Cr. 3. S. *Prereq: Introductory course with emphasis on exercise psychology (i.e., KIN 366 or equivalent)*

Advanced analysis of theoretical health behavior models and their application to physical activity behavior. Includes practical techniques, tools and interventions (e.g., counseling skills, motivational interviewing) to enhance exercise prescription and motivation, and considerations for working with special populations.

KIN 570. Physical Activity Assessment for Health Related Research.

(2-2) Cr. 3.

This course will cover the broad scope of research in physical activity and public health. Emphasis will be placed on the application of physical activity assessment techniques since accurate measures are needed to more accurately assess the health benefits from physical activity and to evaluate the effectiveness of behavioral interventions designed to promote physical activity.

KIN 571. Measurement in Physical Education.

(Dual-listed with KIN 471). (3-0) Cr. 3. S.

Study of grading, assessment and evaluation in physical education with a focus on measuring cognitive and psycho-motor achievement.

KIN 572. Neural Basis of Human Movement.

(Dual-listed with KIN 472). (3-0) Cr. 3. S. *Prereq: KIN 372 or PSYCH 310*

Addresses the role of the central nervous system in the control of voluntary human movement, with the focus on the cerebral cortex, basal ganglia and cerebellum. Content organized around specific nervous system damage (such as stroke, apraxia, spasticity, or spinal cord damage) and functional movements (such as reaching and grasping, balance and gait). Converging evidence from human movement disorders, brain imaging, animal lesion and single cell studies provide the primary basis for the content.

KIN 575. Physical Education Curriculum Design and Program Organization.

(Dual-listed with KIN 475). (3-0) Cr. 3. F. *Prereq: Admission to Educator Preparation Program*

Current theory, practices and principles applied to curriculum development for programs in physical education, K-12. Organizing for teaching in a variety of school settings.

KIN 590. Special Topics.

Cr. 1-3. Repeatable.

KIN 590A. Special Topics: Physical Education.

Cr. 1-3. Repeatable.

KIN 590B. Special Topics: Health and Exercise Promotion.

Cr. 1-3. Repeatable.

KIN 590D. Special Topics: Exercise Physiology.

Cr. 1-3. Repeatable.

KIN 590E. Special Topics: Sport Sociology.

Cr. 1-3. Repeatable.

KIN 590F. Special Topics: Sport/Exercise Psychology.

Cr. 1-3. Repeatable.

KIN 590G. Special Topics: Motor Behavior.

Cr. 1-3. Repeatable.

KIN 590H. Special Topics: Biomechanics.

Cr. 1-3. Repeatable.

KIN 590I. Special Topics: Research Ethics.

Cr. 1-3. Repeatable.

KIN 591. Supervised Field Experience.

Cr. 1-6. *Prereq: 10 graduate credits in kinesiology and/or related areas*
Supervised on-the-job field experience in special areas.

KIN 591A. Supervised Field Experience: Physical Education.

Cr. 1-6. *Prereq: 10 graduate credits in kinesiology and/or related areas*
Supervised on-the-job field experience in special areas.

KIN 591B. Supervised Field Experience: Health and Exercise Promotion.

Cr. 1-6. *Prereq: 10 graduate credits in kinesiology and/or related areas*
Supervised on-the-job field experience in special areas.

KIN 591D. Supervised Field Experience: Exercise Physiology.

Cr. 1-6. *Prereq: 10 graduate credits in kinesiology and/or related areas*
Supervised on-the-job field experience in special areas.

KIN 592. Practicum in College Teaching.

Cr. 1-3. Repeatable, maximum of 3 credits. F.S.SS.
Supervised experience with teaching an upper division, classroom-based course. Offered on a satisfactory-fail basis only.

KIN 595. Adapted Physical Education.

(Dual-listed with KIN 395). (2-3) Cr. 3. F. *Prereq: KIN 312*

Specific disabling conditions in terms of etiology, characteristics, needs, and potential for movement experiences. Techniques of assessment, prescription, adaptation of activities, methods, and program planning. Laboratory experience required. KIN 595 may not be taken by students who have previously earned credit in KIN 395

KIN 599. Creative Component.

Cr. 1-3. Repeatable.

Courses for graduate students:

KIN 615. Seminar.

Cr. 1-3. Repeatable.

KIN 620. Advance Research Methods in Physical Activity.

(3-0) Cr. 3. S. *Prereq: KIN 501, STAT 401 and STAT 402. Doctoral students only*

Culminating seminar designed to synthesize statistical and design courses with practical research issues using data from physical activity.

KIN 699. Research.

Cr. 1-6. Repeatable.

Landscape Architecture

(L A)

Courses primarily for undergraduates:

L A 201. Studio: Landscape Interpretation and Representation.

(1-15) Cr. 6. F. *Prereq: Enrollment in the professional program*
Reading and representing varied landscapes; development of aesthetic sensitivity to the geomorphology, vegetation, and cultural influences on these landscapes. Small-scale interventions and exploration of landscape phenomena and change. Emphasis on a variety of documentation and drawing techniques.

L A 202. Studio: Site Design I.

(1-15) Cr. 6. S. *Prereq: L A 201*
Fundamental issues of landscape planning and design at a site scale. Projects introduce a variety of (objective and subjective) site inquiry methods, space and place making, and sensitive integration of architecture and landscape for specific land uses. User needs, precedent study, programming, site engineering, planting design, and outdoor space design expressed through a variety of three-dimensional modeling, graphic, and written media.

L A 221. Native Plants of the Savanna Ecotone.

(2-3) Cr. 3. F. *Prereq: Enrollment in the professional program*
Observation and study of the wetland, prairie, and woodland vegetation native to the savanna ecotone. Emphasis on plant communities, their distribution, structure, habitat and aesthetics. Plant identification and use in landscape design. Precedent and case studies of vegetation preservation, restoration and use in built works.

L A 222. Introduced Plants of the Midwest.

(2-3) Cr. 3. S. *Prereq: L A 221*
Identification, observation, and study of plants introduced to cultivation in the Midwest region. Plant cultural requirements, including adaptations to climate changes, solar exposure, and soil conditions. Investigation of history of plant introduction and use in designed landscape, including consequent impacts of plant introduction such as plant invasion. Introduction to planting design at the site scale, including matching plant cultural requirements to site conditions, functional uses of plants and expressive composition using plant form, texture and color.

L A 241. Developing Identity as a Landscape Architect.

(1-0) Cr. 1. F. *Prereq: Enrollment in the professional program*
Development of life skills for conflict resolution, effective interpersonal communication, and CPR/First Aid. Examination of personal values as they relate to the backgrounds, abilities, attitudes, and values of others; exploration of how these influence personal decision-making and group interaction. Reading, discussion, class activities, journal-keeping, writing. Offered on a satisfactory-fail basis only.

L A 270. Foundations in Natural Resource Policy and History.

(Cross-listed with ENV S, NREM). (3-0) Cr. 3. Alt. F., offered odd-numbered years.
The development of natural resource conservation philosophy and policy from the Colonial Era to the present. North American wildlife, forestry, and environmental policy; national parks and other protected lands; federal and state agencies. Relationship to cultural contexts, including urban reform and American planning movement. Discussion of common pool resources, public and private lands.

L A 272. Cultural Landscape Studies.

(3-0) Cr. 3. F. *Prereq: Enrollment in the professional program*
Exploration of cultural landscapes, from broad settlement patterns to individual sites, with an emphasis on the origins and evolution of landscapes. Investigation of relationships between vernacular and designed landscapes. Landscapes considered as modes of cultural production that shape and are shaped by social, political, and economic processes. Exploration of landscapes as persistent (yet ephemeral) repositories of culture. Lectures, reading, field studies, and writing. Meets U.S. Diversity Requirement

L A 274. The Social and Behavioral Landscape.

(3-0) Cr. 3. S.
Exploration of social and behavioral factors pertinent to design of the domestic, civic, and commercial landscape. Focus on working familiarity with design principles as they relate to the behavior and activities of people across a broad demographic and cultural spectrum; application of these principles to design of outdoor environments. Lectures and discussions, including group exercises and field trips. Meets U.S. Diversity Requirement

L A 281. Investigating Landscape Form, Process, and Detail.

(1-6) Cr. 3. F. *Prereq: Enrollment in professional program*
Exploration of the poetics and principles of landscape construction. Investigation and interpretation of landform and geomorphic processes such as the hydrologic cycle, erosion, and sedimentation. Close observation and representation of detail design, with an emphasis on material types, their connections, and weathering. Readings, field studies, and drawings in analog and digital media.

L A 282. Landscape Dynamics.

(2-2) Cr. 3. S. *Prereq: Sophomore standing*
Understand design implications presented by geotechnical and ecological processes in the landscape including ecology, vegetation, soils and water. Understand the influence of landforms, geology, plants, soils, and water on the creation of landscape designs. Course relates current issues including water quality impairment, erosion, and invasive species with design strategies such as stormwater management, soil quality management, and plant community restoration. Field trips.

L A 301. Site Design II.

(1-15) Cr. 6. F. *Prereq: L A 202*
Development of half-acre to hundred-acre landscape design and planning proposals, potentially in collaboration with students in other programs. Apply critical methodological frameworks to shape site systems while providing appropriate support for diverse user groups and creating culturally meaningful places. Assess and interpret a program of use, organize subjective and objective site inventory and analysis, develop functional and poetic design strategies for infrastructure and natural systems, and craft artistic and functionally explicit landscape architectural proposals. Development of appropriate technique and high level of craft in representations to support design thinking process and final scheme presentation.

L A 302. Ecological Design at the Regional Scale.

(1-15) Cr. 6. S. *Prereq: L A 282, L A 301, L A 381 and NREM 120*
Application of ecological theories and processes in design and planning at the hundred plus-acre scale specifically focusing on urban and urban fringe landscapes. Apply advanced landscape analysis of soil, water, and vegetation utilizing geographic information systems. Particular focus on stream and wetland restoration, mitigation, and regulations and developing design representations for public use.

L A 309. Field Travel.

Cr. 1. Repeatable, maximum of 2 times. F.S.SS. *Prereq: Enrollment in the professional program and permission of instructor*
Observation of and reflection on professional practice and landscapes in urban, rural, and wilderness areas. Offered on a satisfactory-fail basis only.

L A 322. Fundamentals of Planting Design.

(2-3) Cr. 3. *Prereq: L A 221*
The art and techniques of creating plant compositions in the landscape that respond to cultural and biophysical contexts. Investigation of soil properties and plant/soil relationships relevant to the built environment. Methods of site inventory and analysis, developing plant palettes and composing plant assemblages that address expressive and functional needs. Introduction to the techniques of preparing planting plans, including standards for plant selection, plant lists and plant specification.

L A 341. Contemporary Landscape Architecture.

(1-0) Cr. 1. S. *Prereq: L A 301*
Exploration of contemporary landscape architectural practice through individualized research into practicing firms. Preparation of paper and presentation outlining broad framework and specific parameters of a selected area of contemporary practice using specific projects as examples. Work may result in invitation of current practitioner(s) as a lecture series or event. Resume and portfolio preparation in advance of required off-campus semester (L A 444 A, B or C).

L A 371. History of Modern Landscapes, 1750 to Present.

(3-0) Cr. 3. S.
Investigation of landscape design concepts and trends as observed over time, from approximately 1750 to the present, with emphasis on the United States and Europe. Examination of significant figures and outstanding works (sites, gardens, landscapes, monuments, subdivisions, city plans, etc.) of varied geographic regions. Analysis of the social, economic, political, and technical forces contributing to the development of landscape design styles, vocabulary, and literature. Lectures, readings, projects, research papers.

L A 373. Gardens and Landscapes from Antiquity to 1750.

(3-0) Cr. 3. F.

Investigation of international landscape design concepts and trends as observed over time, from pre-history to the mid 18th century. Examination of significant figures and outstanding works (sites, gardens, landscapes, monuments, subdivisions, city plans, etc.) of varied geographic regions. Analysis of the social, economic, political, and technical forces contributing to the development of landscape design styles, vocabulary, and literature. Lectures, readings, projects, research papers.

Meets International Perspectives Requirement.

L A 381. Shaping the Land.(3-0) Cr. 3. F. *Prereq:* L A 282 and MATH 141

Design of landforms to achieve aesthetic, functional, and safety goals. Landform changes to accommodate human uses and activities. Impacts and implications of landform transformation on the surrounding environment. Surface and subsurface drainage design, storm water runoff best management practices, contour manipulation to incorporate slopes, swales, culverts, pads, retaining walls, walks, steps, terraces, buildings, and other structures in the landscape. Road layout and alignment, parking lot design, and earthwork volume estimates. Design communication using CAD, perspectives, cross-sections, contour maps, landform models, and narratives. Class exercises, case study precedents, and preliminary construction documents.

L A 401. Community Design.(1-15) Cr. 6. F. *Prereq:* L A 402

Physical planning and design of places utilizing community-based methods. Projects address social and cultural dimensions of placemaking such as reuse of abandoned sites, in-fill development, and community visioning. Emphasis on development of user-client relationship skills and design research. Integrated seminar component.

L A 401H. Community Design: Honors.(1-15) Cr. 7. F. *Prereq:* L A 402

Physical planning and design of places utilizing community-based methods. Projects address social and cultural dimensions of placemaking such as reuse of abandoned sites, in-fill development, and community visioning. Emphasis on development of user-client relationship skills and design research. Integrated seminar component.

L A 402. Urban Design.(1-15) Cr. 6. F. *Prereq:* L A 302

Comprehensive planning and design for urban sites or for sites within urban contexts. Projects typically include planning for a variety of integrated land uses, and cover the full range of design scales from master planning to proposals for site details. Emphasis on written and verbal as well as graphic communications. Integrated seminar component.

L A 402H. Urban Design: Honors.(1-15) Cr. 7. F. *Prereq:* L A 302

Comprehensive planning and design for urban sites or for sites within urban contexts. Projects typically include planning for a variety of integrated land uses, and cover the full range of design scales from master planning to proposals for site details. Emphasis on written and verbal as well as graphic communications. Integrated seminar component.

L A 403H. Senior Thesis Preparation Tutorial.

Cr. 2. F. *Prereq:* L A 402, *permission of thesis advisor, enrollment in Honors program*

Preparation for senior thesis.

L A 404. Advanced Landscape Architectural Design.(1-15) Cr. 6. Repeatable, maximum of 2 times. S. *Prereq:* L A 401

Advanced forum for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are encouraged.

L A 404H. Advanced Landscape Architectural Design: Honors.(1-15) Cr. 6-7. Repeatable, maximum of 2 times. S. *Prereq:* L A 401

Advanced forum for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are encouraged.

L A 405H. Senior Thesis.

(0-15) Cr. 6. S. *Prereq:* L A 401, L A 402, L A 403, *enrollment in Honors program and permission of adviser, chair and thesis adviser*

Individual advanced forum for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are expected.

L A 417. Urban and Peri-urban Watershed Assessment.(2-3) Cr. 3. F. *Prereq:* *Junior classification and 6 credits of natural science*

Assessment and reduction of impacts in urban and peri-urban watershed areas. Course prepares students to work with various analysis methods for vegetation, topography, stormwater and stream condition as well as work with data from other disciplines. Emphasis on communicating with the public. Introductory GIS and GPS technologies are utilized. Learning is largely field-based.

L A 421. Advanced Planting Design.(Dual-listed with L A 521). (2-3) Cr. 3. S. *Prereq:* L A 322 or *permission of instructor*

Theory and practice of planting design, with emphasis on the ecological, cultural, and aesthetic factors affecting planting design and vegetation management in the built environment. Research, case studies, and design projects.

L A 441. Professional Practice.(2-0) Cr. 2. S. *Prereq:* L A 481

Studies of conventional and developing forms of public and private practice. Explore relationships between professional life and the culture of the professional design firm; investigate firm identities and structures; understand design projects, their delivery process, and contractual agreements. Lecture and class discussion.

L A 444. Landscape Architecture Independent Educational Enrichment.

Cr. R. Repeatable, maximum of 3 times. F.S.SS. *Prereq:* L A 341 or *permission of adviser and chair*

Independent educational enrichment through exploration of landscape architectural practice in a professional internship, international studies, or out-of-region national study experience.

L A 444A. Landscape Architecture Independent Educational Enrichment: Professional Internship.

Cr. R. Repeatable, maximum of 3 times. F.S.SS. *Prereq:* L A 341 or *permission of adviser and chair*

Independent educational enrichment through exploration of landscape architectural practice in a professional internship, international studies, or out-of-region national study experience.

L A 444B. Landscape Architecture Independent Educational Enrichment: Study Abroad.

Cr. R. Repeatable, maximum of 3 times. F.S.SS. *Prereq:* L A 341 or *permission of adviser and chair*

Independent educational enrichment through exploration of landscape architectural practice in a professional internship, international studies, or out-of-region national study experience.

L A 444C. Landscape Architecture Independent Educational Enrichment: National Student Exchange.

Cr. R. Repeatable, maximum of 3 times. F.S.SS. *Prereq:* L A 341 or *permission of adviser and chair*

Independent educational enrichment through exploration of landscape architectural practice in a professional internship, international studies, or out-of-region national study experience.

L A 461I. Introduction to GIS.

(Cross-listed with ENSCI, ENV S, IA LL). Cr. 4. SS.

Descriptive and predictive GIS modeling techniques, spatial statistics, and map algebra. Application of GIS modeling techniques to environmental planning and resource management.

L A 478. Topical Studies in Landscape Architecture.(Dual-listed with L A 578). Cr. 2-3. Repeatable. F.S.SS. *Prereq:* *Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 478D. Landscape Architecture: History/Theory/Criticism.(Dual-listed with L A 578D). Cr. 2-3. Repeatable. F.S.SS. *Prereq:* *Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 478E. Landscape Architecture: Landscape Planning.(Dual-listed with L A 578E). Cr. 2-3. Repeatable. F.S.SS. *Prereq:* *Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 478F. Landscape Architecture: Urban Design.

(Dual-listed with L A 578F). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*
Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 478G. Landscape Architecture: Graphics.

(Dual-listed with L A 578G). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*
Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 478I. Landscape Architecture: Interdisciplinary Studies.

(Dual-listed with L A 578I). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*
Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 478J. Landscape Architecture: International Studies.

(Dual-listed with L A 578J). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*
Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 478K. Landscape Architecture: Computer Applications.

(Dual-listed with L A 578K). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*
Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 478L. Landscape Architecture: Ecological Design.

(Dual-listed with L A 578L). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*
Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 478M. Landscape Architecture: Social/Behavioral.

(Dual-listed with L A 578M). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*
Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 478N. Landscape Architecture: Natural Resources.

(Dual-listed with L A 578N). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*
Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 481. Landscape Construction.

(3-0) Cr. 3. F. *Prereq: L A 381*

Development of construction details with emphasis on materials and their aesthetic and functional uses as building materials. Explore characteristics and uses of construction materials and application of wood systems, paving systems, retaining walls, masonry and concrete systems, and metals; investigate structural theory of wood systems. Preliminary preparation of construction documents.

L A 482. Advanced Landscape Construction.

(3-0) Cr. 3. S. *Prereq: L A 481*

Advanced site construction issues, with emphasis on water and irrigation systems, mechanical and electrical systems, site lighting, proposal preparation, project scheduling, project costing and estimating, and master specification editing.

L A 490. Independent Study.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490A. Independent Study: Landscape Design.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490B. Independent Study: Planting Design.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490C. Independent Study: Construction.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490D. Independent Study: History/Theory/Criticism.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490E. Independent Study: Landscape Planning.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490F. Independent Study: Urban Design.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490G. Independent Study: Graphics.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490H. Independent Study: Honors.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490I. Independent Study: Interdisciplinary Studies.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490J. Independent Study: International Studies.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490K. Independent Study: Computer Applications.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490L. Independent Study: Ecological Design.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490M. Independent Study: Social/Behavioral.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 490N. Independent Study: Natural Resources.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Written approval of instructor and department chair on required form*
Investigation of a topic of special interest to the student.

L A 491. Environmental Law and Planning.

(Dual-listed with L A 591). (Cross-listed with C R P, ENV S). (3-0) Cr. 3. S. *Prereq: 6 credits in natural sciences*

Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

Courses primarily for graduate students, open to qualified undergraduates:

L A 504. Landworks: Advanced Landscape Architecture.

(1-15) Cr. 6. *Prereq: Graduate classification*

Graduate studio in landscape architectural design working on complex sites involving multiple scales of design. Course emphasizes advanced skills in design research and representation and application of theory, as well as technical competency and teamwork. Development of original ideas, experimentation, and innovation.

L A 517. Urban and Peri-urban Watershed Assessment.

(Dual-listed with L A 417). (2-3) Cr. 3. F. *Prereq: Junior classification and 6 credits of natural science*

Assessment and reduction of impacts in urban and peri-urban watershed areas. Course prepares students to work with various analysis methods for vegetation, topography, stormwater and stream condition as well as work with data from other disciplines. Emphasis on communicating with the public. Introductory GIS and GPS technologies are utilized. Learning is largely field-based.

L A 521. Advanced Planting Design.

(Dual-listed with L A 421). (2-3) Cr. 3. S. *Prereq: L A 322 or permission of instructor*

Theory and practice of planting design, with emphasis on the ecological, cultural, and aesthetic factors affecting planting design and vegetation management in the built environment. Research, case studies, and design projects.

L A 522. Advanced Plant Technology.

(1-4) Cr. 3. F. *Prereq: LA 301 or graduate standing*

Planting design and emergent technologies for design performance in the urban built environment. Emphasis on innovative strategies for planting design and plant technology in building design, sustainable streetscapes, and urban systems integrating storm water and urban "hardscape" design. Interviews with practitioners, technical experts and agency program leaders will complement readings, lecture and site visits to exemplary project sites.

L A 541. Principles of Research for Landscape Architects.

(3-0) Cr. 3. F. *Prereq: Graduate standing*

Examination of design inquiry and research methods appropriate to landscape architectural projects, including bibliographical, historical, numerical, statistical, survey, and geographical methods. Readings, discussions, and application problems. Preparation of a research proposal.

L A 567. Advanced GIS Landscape Modeling.

(0-6) Cr. 3. *Prereq: L A 302 or C R P 451/C R P 551*

Application of Geographic Information Systems (GIS) modeling techniques to landscape planning and management issues. Selection, acquisition, and conversion of digital landscape data. Modeling applications for studio projects, outreach projects, and research projects.

L A 571. Landscape Architectural Theory I.

(3-0) Cr. 3. F. *Prereq: graduate classification or permission of instructor*

Examination of the development of ideas in landscape architecture in their historical context of social practices and knowledge systems. Emphasis on exposure to key modern and contemporary texts and projects in landscape architecture, architecture, art, and related fields. Readings, discussions, and writings.

L A 573. Landscape Architectural Theory II.

(3-0) Cr. 3. S. *Prereq: Graduate standing or permission of instructor*

Exploration of major theories and emerging practices of landscape architectural design and their relationships to broader, cultural and theoretical perspectives. Emphasis on developing critical ways of analyzing ideas. Lectures, readings, discussion, and writings.

L A 578. Topical Studies in Landscape Architecture.

(Dual-listed with L A 478). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 578D. Landscape Architecture: History/Theory/Criticism.

(Dual-listed with L A 478D). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 578E. Landscape Architecture: Landscape Planning.

(Dual-listed with L A 478E). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 578F. Landscape Architecture: Urban Design.

(Dual-listed with L A 478F). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 578G. Landscape Architecture: Graphics.

(Dual-listed with L A 478G). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 578I. Landscape Architecture: Interdisciplinary Studies.

(Dual-listed with L A 478I). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 578J. Landscape Architecture: International Studies.

(Dual-listed with L A 478J). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 578K. Landscape Architecture: Computer Applications.

(Dual-listed with L A 478K). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 578L. Landscape Architecture: Ecological Design.

(Dual-listed with L A 478L). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 578M. Landscape Architecture: Social/Behavioral.

(Dual-listed with L A 478M). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 578N. Landscape Architecture: Natural Resources.

(Dual-listed with L A 478N). Cr. 2-3. Repeatable. F.S.SS. *Prereq: Senior classification or graduate standing*

Offerings vary with each term; check with department for available sections. Course contact hours can range from (2-0) to (3-0) depending on number of credits.

L A 580. Thesis, Creative Component Tutorial.

Cr. 1-4. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Permission of major professor*

Hands-on participation in a creative or research activity in the student's area of specialization. Development of a detailed prospectus that defines the thesis or creative component.

L A 590. Special Topics.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590A. Special Topics: Landscape Design.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590B. Special Topics: Planting Design.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590C. Special Topics: Construction.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590D. Special Topics: History/Theory/Criticism.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590E. Special Topics: Landscape Planning.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590F. Special Topics: Urban Design.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590G. Special Topics: Graphics.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590I. Special Topics: Interdisciplinary Studies.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590J. Special Topics: International Studies.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590K. Special Topics: Computer Applications.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590L. Special Topics: Ecological Design.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590M. Special Topics: Social/Behavioral.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 590N. Special Topics: Natural Resources.

Cr. 1-6. Repeatable, maximum of 3 times. F.S.SS. *Prereq: graduate standing.*

L A 591. Environmental Law and Planning.

(Dual-listed with L A 491). (Cross-listed with C R P). (3-0) Cr. 3. S. *Prereq: 6 credits in natural sciences*

Environmental law and policy as applied in planning at the local and state levels. Brownfields, environmental justice, water quality, air quality, wetland and floodplain management, and local government involvement in ecological protection through land use planning and other programs.

L A 599. Creative Component.

Cr. 1-8. Repeatable, maximum of 8 credits. F.S.SS. *Prereq: Permission of major professor*

Comprehensive study and original development of a project selected by the student and approved by the major professor. Completed project must be submitted to and approved by a graduate faculty committee as evidence of mastery of the principles of landscape architecture.

Courses for graduate students:**L A 699. Thesis Research.**

Cr. 1-8. Repeatable, maximum of 8 credits. F.S.SS. *Prereq: Permission of major professor*

Latin (LATIN)

Courses primarily for undergraduates:

LATIN 101. Elementary Latin I.

(4-0) Cr. 4. F.

Grammar and vocabulary of classical Latin, within the context of Roman culture; reading knowledge through texts adapted from classical authors.

LATIN 102. Elementary Latin II.

(4-0) Cr. 4. S. *Prereq:* LATIN 101

Grammar and vocabulary of classical Latin, within the context of Roman culture; reading knowledge through texts adapted from classical authors.

Meets International Perspectives Requirement.

LATIN 201. Intermediate Latin.

Cr. arr. F. *Prereq:* LATIN 102

Emphasis on grammatical principles, composition and reading Latin texts.

Meets International Perspectives Requirement.

LATIN 332. Introduction to Latin Literature.

Cr. arr. S. *Prereq:* LATIN 201

Readings in Latin Literature with emphasis on critical analysis of style, structure or thought.

Meets International Perspectives Requirement.

LATIN 490. Independent Study.

Cr. 1-6. Repeatable, maximum of 9 credits. *Prereq:* 6 credits in Latin and permission of department chair

Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits in Latin 490 may be counted toward graduation.

Liberal Arts and Sciences Cross-Disciplinary Studies (LAS)

Courses primarily for undergraduates:

LAS 101. Orientation for Open Option and Preprofessional Students.

(1-0) Cr. 1. F.S.

Introduction to all undergraduate colleges. Provides information about university resources and services, assists with a successful academic transition to the university, and helps initiate the process of identifying academic major(s) and eventual career paths. Required of all first-year students in Open Option and Preprofessional Programs. Offered on a satisfactory-fail basis only.

LAS 103. Frontiers of the Discipline.

(1-0) Cr. 1. Repeatable. S.

Learning Community/ Seminar focusing entirely on the "cutting edge" research activities of faculty members. Offered on a satisfactory-fail basis only. A maximum of three total credits of LAS 103A, 103B, 103C, 103D, 103E can count for graduation.

LAS 103A. Frontiers of the Discipline: General.

(1-0) Cr. 1. Repeatable. S.

Learning Community/ Seminar focusing entirely on the "cutting edge" research activities of faculty members. Offered on a satisfactory-fail basis only. A maximum of three total credits of LAS 103A, 103B, 103C, 103D, 103E can count for graduation.

LAS 103B. Frontiers of the Discipline: Humanities.

(1-0) Cr. 1. Repeatable. S.

Learning Community/ Seminar focusing entirely on the "cutting edge" research activities of faculty members. Offered on a satisfactory-fail basis only. A maximum of three total credits of LAS 103A, 103B, 103C, 103D, 103E can count for graduation.

LAS 103C. Frontiers of the Discipline: Communication.

(1-0) Cr. 1. Repeatable. S.

Learning Community/ Seminar focusing entirely on the "cutting edge" research activities of faculty members. Offered on a satisfactory-fail basis only. A maximum of three total credits of LAS 103A, 103B, 103C, 103D, 103E can count for graduation.

LAS 103D. Frontiers of the Discipline: Mathematics and Natural Sciences.

(1-0) Cr. 1. Repeatable. S.

Learning Community/ Seminar focusing entirely on the "cutting edge" research activities of faculty members. Offered on a satisfactory-fail basis only. A maximum of three total credits of LAS 103A, 103B, 103C, 103D, 103E can count for graduation.

LAS 103E. Frontiers of the Discipline: Social Sciences.

(1-0) Cr. 1. Repeatable. S.

Learning Community/ Seminar focusing entirely on the "cutting edge" research activities of faculty members. Offered on a satisfactory-fail basis only. A maximum of three total credits of LAS 103A, 103B, 103C, 103D, 103E can count for graduation.

LAS 125. Connections.

(1-0) Cr. 1. F. Prereq: First year student

Links a large lecture class with a small learning community / seminar. In each case the professor teaching the large lecture facilitates a small weekly seminar. Informal discussions about critical issues of the day connected to lecture topics through films, public lectures and other events which students and the faculty leader attend. Offered on a satisfactory-fail basis only.

LAS 125A. Connections: General.

(1-0) Cr. 1. F. Prereq: First year student

Links a large lecture class with a small learning community / seminar. In each case the professor teaching the large lecture facilitates a small weekly seminar. Informal discussions about critical issues of the day connected to lecture topics through films, public lectures and other events which students and the faculty leader attend. Offered on a satisfactory-fail basis only.

LAS 125B. Connections: Humanities.

(1-0) Cr. 1. F. Prereq: First year student

Links a large lecture class with a small learning community / seminar. In each case the professor teaching the large lecture facilitates a small weekly seminar. Informal discussions about critical issues of the day connected to lecture topics through films, public lectures and other events which students and the faculty leader attend. Offered on a satisfactory-fail basis only.

LAS 125C. Connections: Communication.

(1-0) Cr. 1. F. Prereq: First year student

Links a large lecture class with a small learning community / seminar. In each case the professor teaching the large lecture facilitates a small weekly seminar. Informal discussions about critical issues of the day connected to lecture topics through films, public lectures and other events which students and the faculty leader attend. Offered on a satisfactory-fail basis only.

LAS 125D. Connections: Mathematics and Natural Sciences.

(1-0) Cr. 1. F. Prereq: First year student

Links a large lecture class with a small learning community / seminar. In each case the professor teaching the large lecture facilitates a small weekly seminar. Informal discussions about critical issues of the day connected to lecture topics through films, public lectures and other events which students and the faculty leader attend. Offered on a satisfactory-fail basis only.

LAS 125E. Connections: Social Sciences.

(1-0) Cr. 1. F. Prereq: First year student

Links a large lecture class with a small learning community / seminar. In each case the professor teaching the large lecture facilitates a small weekly seminar. Informal discussions about critical issues of the day connected to lecture topics through films, public lectures and other events which students and the faculty leader attend. Offered on a satisfactory-fail basis only.

LAS 151. Dean's Leadership Seminar I.

(1-0) Cr. 1. F. Prereq: Selection based on application.

Beginning to study leadership through applied examples, including the importance of community, communication, trust, shared responsibility, modeling the way, and inspiring a shared vision. Students will be introduced to campus leadership opportunities.

LAS 152. Dean's Leadership Seminar II.

(1-0) Cr. 1. S. Prereq: Selection based on application.

Continuing to study leadership through applied examples, including the importance of challenging the process, enabling others to act, and encouraging the heart. Students will engage more deeply in campus leadership opportunities.

LAS 201. Professional Employment Preparation.

(1-0) Cr. 1. Prereq: 2nd semester freshman or transfer student within the College of Liberal Arts and Sciences.

Exploration, development, and practice of techniques utilized to develop and implement a comprehensive career plan and conduct a professional internship or employment search with emphasis on preparing resumes, cover letters, application materials, interviewing techniques, and overall professional behaviors throughout the recruiting process. Offered on a satisfactory-fail basis only.

LAS 225. Introduction to Asian American Studies.

(3-0) Cr. 3.

An interdisciplinary and chronological examination of Asian American immigration experiences from the early 19th century to the 21st century. Focus on how these immigration histories are accompanied by changing racial constructions. Discussion of racial stereotyping, the model minority myth, identity development, and efforts for social justice.

Meets U.S. Diversity Requirement

LAS 290. Special Projects.

Cr. 1-3. Repeatable. F.S.SS. Prereq: Freshman or sophomore classification; Permission of the director of the Catt Center for LAS 290G.; other topics need: permission of the dean of the College of Liberal Arts and Sciences.

LAS 290A. Special Projects: LAS Ambassadors..

Cr. 1-3. Repeatable. F.S.SS. Prereq: Freshman or sophomore classification; Permission of the director of the Catt Center for LAS 290G.; other topics need: permission of the dean of the College of Liberal Arts and Sciences.

LAS 290B. Special Projects: Advising Project.

Cr. 1-3. Repeatable. F.S.SS. Prereq: Freshman or sophomore classification; Permission of the director of the Catt Center for LAS 290G.; other topics need: permission of the dean of the College of Liberal Arts and Sciences.

LAS 290C. Special Projects: Pre-Law Project.

Cr. 1-3. Repeatable. F.S.SS. Prereq: Freshman or sophomore classification; Permission of the director of the Catt Center for LAS 290G.; other topics need: permission of the dean of the College of Liberal Arts and Sciences.

LAS 290D. Special Projects: General.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Freshman or sophomore classification; Permission of the director of the Catt Center for LAS 290G.; other topics need: permission of the dean of the College of Liberal Arts and Sciences.*

LAS 290G. Special Projects: Catt Center Project.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Freshman or sophomore classification; Permission of the director of the Catt Center for LAS 290G.; other topics need: permission of the dean of the College of Liberal Arts and Sciences.*

LAS 291. Service Learning.

Cr. 1-4. Repeatable, maximum of 6 credits. *Prereq: Permission of the dean of the College of Liberal Arts and Sciences*

Service work as appropriate to the student's degree program. Academic work under faculty supervision may include written project, report, and guided reading. Offered on a satisfactory-fail basis only.

LAS 291A. Service Learning: General.

Cr. 1-4. Repeatable, maximum of 6 credits. *Prereq: Permission of the dean of the College of Liberal Arts and Sciences*

Service work as appropriate to the student's degree program. Academic work under faculty supervision may include written project, report, and guided reading. Offered on a satisfactory-fail basis only.

LAS 291B. Service Learning: U.S. Diversity Project.

Cr. 1-4. Repeatable, maximum of 6 credits. *Prereq: Permission of the dean of the College of Liberal Arts and Sciences*

Service work as appropriate to the student's degree program. Academic work under faculty supervision may include written project, report, and guided reading. Offered on a satisfactory-fail basis only.

LAS 291C. Service Learning: International Perspectives Project.

Cr. 1-4. Repeatable, maximum of 6 credits. *Prereq: Permission of the dean of the College of Liberal Arts and Sciences*

Service work as appropriate to the student's degree program. Academic work under faculty supervision may include written project, report, and guided reading. Offered on a satisfactory-fail basis only.

LAS 298. Internship/Co-op.

Cr. R. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services; sophomore classification*

Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student status. Offered on a satisfactory-fail basis only.

LAS 350. Topics in Interdisciplinary Studies.

(3-0) Cr. 1-4. Repeatable, maximum of 8 credits.

LAS 350A. Topics in Interdisciplinary Studies: Interdisciplinary.

(3-0) Cr. 1-4. Repeatable, maximum of 8 credits.

LAS 350B. Topics in Interdisciplinary Studies: Humanities.

(3-0) Cr. 1-4. Repeatable, maximum of 8 credits.

LAS 350C. Topics in Interdisciplinary Studies: Mathematics and Nature Science.

(3-0) Cr. 1-4. Repeatable, maximum of 8 credits.

LAS 350D. Topics in Interdisciplinary Studies: Social Sciences.

(3-0) Cr. 1-4. Repeatable, maximum of 8 credits.

LAS 385. The Holocaust.

(3-0) Cr. 3. F.S.SS.

An examination of the religious, social, scientific, and historical contexts for the Nazi destruction of European Jewry. Topics covered include anti-Semitism, German folkish philosophy, eugenics, World War II, the Final Solution, rescuers, and contemporary issues.

Meets International Perspectives Requirement.

LAS 398. Internship/Co-op.

Cr. R. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services; junior classification*

Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student status.

LAS 490. Independent Study.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Permission of the instructor for LAS 490G; other topics need: permission of the dean of the College of Liberal Arts and Sciences*

No more than 9 credits of LAS 490 may be applied toward graduation.

LAS 490A. Independent Study: General.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Permission of the instructor for LAS 490G; other topics need: permission of the dean of the College of Liberal Arts and Sciences*

No more than 9 credits of LAS 490 may be applied toward graduation.

LAS 490E. Independent Study: Entrepreneurial Studies.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Permission of the instructor for LAS 490G; other topics need: permission of the dean of the College of Liberal Arts and Sciences*

No more than 9 credits of LAS 490 may be applied toward graduation.

LAS 490G. Independent Study: Catt Center Project.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Permission of the instructor for LAS 490G; other topics need: permission of the dean of the College of Liberal Arts and Sciences*

No more than 9 credits of LAS 490 may be applied toward graduation.

LAS 491. Service Learning.

Cr. 1-4. F.S.SS. *Prereq: Permission of the dean of the College of Liberal Arts and Sciences*

Service work as appropriate to the student's degree program. Academic work under faculty supervision may include written project, report, and guided reading.

LAS 491A. Service Learning: General.

Cr. 1-4. F.S.SS. *Prereq: Permission of the dean of the College of Liberal Arts and Sciences*

Service work as appropriate to the student's degree program. Academic work under faculty supervision may include written project, report, and guided reading.

LAS 491B. Service Learning: U.S. Diversity Project.

Cr. 1-4. F.S.SS. *Prereq: Permission of the dean of the College of Liberal Arts and Sciences*

Service work as appropriate to the student's degree program. Academic work under faculty supervision may include written project, report, and guided reading. Meets U.S. Diversity Requirement

LAS 491C. Service Learning: International Perspectives Project.

Cr. 1-4. F.S.SS. *Prereq: Permission of the dean of the College of Liberal Arts and Sciences*

Service work as appropriate to the student's degree program. Academic work under faculty supervision may include written project, report, and guided reading. Meets International Perspectives Requirement.

LAS 498. Internship/Co-op.

Cr. R. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services; senior classification*

Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student status.

LAS 499. Internship.

Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of Liberal Arts and Sciences Career Services*

Work experience in professional setting appropriate to the student's degree program. Academic work under faculty supervision may include written projects, reports, and guided reading.

Library (LIB)

Courses primarily for undergraduates:

LIB 160. Information Literacy.

(1-0) Cr. 1. F.S.SS. *Prereq:* For students whose native language is not English: Completion of ENGL 101 requirement.

Eight-week course required for undergraduate degree. Provides a solid understanding of information literacy and the research process with emphases on finding, evaluating, and using scholarly information; the ethical and legal framework related to information use; and utilization of library discovery tools. To be taken as early as possible in the student's undergraduate career. See course descriptions of ENGL 150 and ENGL 250 for requirements related to LIB 160. Offered on a satisfactory-fail basis only.

Linguistics (LING)

Courses primarily for undergraduates:

LING 101. Introduction to the Study of Linguistics.

(1-0) Cr. 1. S.

Cross-disciplinary perspectives on the study of linguistics. Applications of linguistics to real world problems. Careers in linguistics.

LING 119. Introduction to World Languages.

(Cross-listed with WLC). (3-0) Cr. 3.

Study of language diversity and the personal, social and political effects of diversity. Language families, attitudes toward language and language use, language and culture, multilingualism, foreign language learning, written codes, official languages, and language policy.

Meets International Perspectives Requirement.

LING 120. Computers and Language.

(Cross-listed with ENGL). (3-0) Cr. 3.

Introduction to the use of linguistic knowledge in computer applications today and the basic computational techniques used in such applications. The development of these techniques throughout the history of computational linguistics. How the study of language has contributed to the advancement of technology and how certain computational problems have influenced the way linguists study language.

LING 207. Introduction to Symbolic Logic.

(Cross-listed with PHIL). (3-0) Cr. 3. S.

Introduction to fundamental logical concepts and logical symbolism. Development of natural deduction through first order predicate logic with identity. Applications to arguments in ordinary English and to philosophical issues. Linguistics majors should take LING/PHIL 207 as early as possible.

LING 219. Introduction to Linguistics.

(Cross-listed with ENGL). (3-0) Cr. 3. F.S. *Prereq: Sophomore classification*

Introduction to linguistic concepts and principles of linguistic analysis with English as the primary source of data. Sound and writing systems, sentence structure, vocabulary, and meaning. Issues in the study of usage, regional and social dialects, language acquisition, and language change.

LING 220. Descriptive English Grammar.

(Cross-listed with ENGL). (3-0) Cr. 3. F.S. *Prereq: ENGL 250*

Overview of grammatical structures and functions. Parts of speech; phrase, clause, and sentence structure; sentence types and sentence analysis; rhetorical grammar and sentence style; terminology. Not a remedial, English composition, or ESL course.

LING 275. Introduction to Communication Disorders.

(Cross-listed with CMDIS). (3-0) Cr. 3.

Survey of nature, causes, and types of major communication disorders including phonological, adult and child language, voice, cleft palate, fluency, and hearing disorders.

LING 286. Communicating with the Deaf.

(Cross-listed with CMDIS). (3-0) Cr. 3.

Learn to communicate with the deaf using Signed English and Signed Pidgin English. Other topics covered include types, causes, and consequences of hearing loss, hearing technology (hearing aids, assistive listening devices, and cochlear implants), education of hearing-impaired children, Deaf culture, and the history of manual communication.

Meets U.S. Diversity Requirement

LING 305. Language, Thought and Action.

(Cross-listed with SP CM). (3-0) Cr. 3. *Prereq: ENGL 250*

The study of symbolic processes and how meaning is conveyed in words, sentences, and utterances; discussion of modern theories of meaning; and an exploration of relationships among language, thought and action.

LING 309. Introduction to Culture and Language.

(Cross-listed with ANTHR). (3-0) Cr. 3. *Prereq: ANTHR 201 recommended*

Introduction to study of language, culture and society from an anthropological perspective. Focus on language and thought, ethnography of speaking, discourse and narrative, writing and literacy, and media communication. Discussion of key theories and methods of linguistic anthropology.

Meets International Perspectives Requirement.

LING 331. Theory of Computing.

(Cross-listed with COM S). (3-1) Cr. 3. F.S. *Prereq: Minimum of C- in COM S 228, MATH 166, and in COM S 330 or CPR E 310; ENGL 250*

Models of computation: finite state automata, pushdown automata and Turing machines. Study of grammars and their relation to automata. Limits of digital computation, unsolvability and Church-Turing thesis. Chomsky hierarchy and relations between classes of languages.

LING 352. Introduction to Spanish Phonology.

(Cross-listed with SPAN). (3-0) Cr. 3. F.S. *Prereq: SPAN 301, SPAN 303 or SPAN 304*

An introductory study of the articulation, classification, distribution, and regional variations of the sounds of the Spanish language. Taught in Spanish.

Meets International Perspectives Requirement.

LING 354. Introduction to Spanish-English Interpretation.

(Dual-listed with LING 554). (Cross-listed with SPAN). (3-0) Cr. 3. F.S. *Prereq: SPAN 351*

Introduction to the theory, methods, techniques, and problems of consecutive and simultaneous interpretation. Consideration of material from business, agriculture, law, design, medicine, literature, advertisement, and sports. Taught in Spanish.

Meets International Perspectives Requirement.

LING 371. Phonetics and Phonology.

(Cross-listed with CMDIS). (3-0) Cr. 3. *Prereq: ENGL 219*

Analysis of speech through study of individual sounds, their variations, and relationships in context; English phonology; practice in auditory discrimination and transcription of sounds of American English; description of speech sounds in terms of their production, transmission, and perception.

LING 413. Psychology of Language.

(Cross-listed with PSYCH). (3-0) Cr. 3. *Prereq: PSYCH 101*

Introduction to psycholinguistics. Topics may include origin of language, speech perception, language comprehension, reading, bilingualism, brain bases of language, and computational modeling of language processes.

LING 420. History of the English Language.

(Cross-listed with ENGL). (3-0) Cr. 3. F.S. *Prereq: ENGL 219 or LING 219, ENGL 220 or LING 220*

Comparison of English to other languages by family background and by type. Analysis of representative Old, Middle, Early Modern and present-day English texts, including both literary works and non-literary documents.

LING 422. Women, Men, and the English Language.

(Cross-listed with ENGL, W S). (3-0) Cr. 3. S. *Prereq: ENGL 219 or LING 219*

The ways men and women differ in using language in varied settings and the ways in which language both creates and reflects gender divisions.

Meets U.S. Diversity Requirement

LING 425. Second Language Learning and Teaching.

(Cross-listed with ENGL). (3-0) Cr. 3. S. *Prereq: ENGL 219 or LING 219; junior classification*

The process of second language learning and principles and techniques of teaching second languages. Learning and teaching in specific situations and for particular purposes. Current applications of technology in teaching and assessment.

LING 437. Grammatical Analysis.

(Cross-listed with ENGL). (3-0) Cr. 3. F. *Prereq: ENGL 220 or LING 220; ENGL 219 or LING 219 or introductory course in linguistics; junior classification*

Theories and methods for analysis of syntax and morphology.

LING 462. Contrastive Analysis of Spanish/ English for Translators.

(Cross-listed with SPAN). (3-0) Cr. 3. *Prereq: SPAN 351*

Linguistic study of the major differences between the Spanish and English grammatical systems and their applications in the translation of Spanish to English. Taught in Spanish.

LING 463. Hispanic Dialectology.

(Cross-listed with SPAN). (3-0) Cr. 3. *Prereq: SPAN 352*

Intensive study of the phonology, morphosyntax and lexicon of the Hispanic dialects of Spain and Latin America in their historical context. Taught in Spanish.

Meets International Perspectives Requirement.

LING 471. Language and Reading Development in Children.

(Cross-listed with CMDIS). (3-0) Cr. 3. *Prereq: CMDIS 275 or PSYCH 230 or ENGL 219 or LING 219*

Theories and developmental processes related to the components of language (semantics, syntax, morphology, phonology, and pragmatics); the development of metalinguistic knowledge; theories and developmental processes of reading.

LING 480A. Topics in Communication Disorders: Anatomy and Physiology of Speech and Hearing.

(Cross-listed with CMDIS). (3-0) Cr. 3. F.S. *Prereq: CMDIS/LING 275, CMDIS/LING 371, and BIOL 255; permission of instructor.*

Guided examination of topics in preparation for graduate work in Speech-Language Pathology or Audiology. Primary course delivery by WWW.

LING 480B. Topics in Communication Disorders: Articulation and Phonological Disorders.

(Cross-listed with CMDIS). (3-0) Cr. 3. F.S. *Prereq: CMDIS/LING 275, CMDIS/LING 371, and BIOL 255; permission of instructor.*

Guided examination of topics in preparation for graduate work in Speech-Language Pathology or Audiology. Primary course delivery by WWW.

LING 480C. Topics in Communication Disorders: Evaluation and diagnosis of communication disorders.

(Cross-listed with CMDIS). (3-0) Cr. 3. F.S. *Prereq: CMDIS/LING 275, CMDIS/LING 371, and BIOL 255; permission of instructor.*

Guided examination of topics in preparation for graduate work in Speech-Language Pathology or Audiology. Primary course delivery by WWW.

LING 486. Methods in Elementary School World Language Instruction.

(Cross-listed with C I, WLC). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language* Planning, implementation, and assessment of standards-based, student-centered, and thematic instruction in the elementary (K-8) classroom. Special emphasis on K-8 students' communicative skills, cultural knowledge, and content learning.

LING 489. Undergraduate Seminar.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable. F. *Prereq: 9 credits in English beyond ENGL 250*

Intensive study of a selected topic in literature, criticism, rhetoric, writing, or language. Cross-listing with linguistics acceptable only when offered as a course in linguistics.

LING 490B. Independent Study: Linguistics.

(Cross-listed with ENGL). Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq: 9 credits in English beyond ENGL 250 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee or Linguistics Adviser*

Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits of ENGL 490 may be used toward graduation.

LING 490D. Independent Study: Linguistic Anthropology.

(Cross-listed with ANTHR). Cr. 1-5. Repeatable, maximum of 9 credits. *Prereq: 9 credits in anthropology.*

No more than 9 credits of Anthr 490 may be counted toward graduation.

Courses primarily for graduate students, open to qualified undergraduates:**LING 510. Introduction to Computers in Applied Linguistics.**

(Cross-listed with ENGL). (3-0) Cr. 3. F. *Prereq: Graduate classification* Use of software and web applications for language teaching, linguistic analysis, and statistical analysis. Issues and problems in applied linguistics related to computer methods.

LING 511. Introduction to Linguistic Analysis.

(Cross-listed with ENGL). (3-0) Cr. 3. F. *Prereq: Graduate classification* Principles and methods of linguistic analysis with emphasis on phonology, morphology, and syntax. Description of linguistic variation and current theoretical approaches to linguistics.

LING 512. Second Language Acquisition.

(Cross-listed with ENGL). (3-0) Cr. 3. F. *Prereq: ENGL 511 or LING 511 or an introductory course in linguistics*

Theory, methods, and results of second language acquisition research with emphasis on approaches relevant to second language teaching.

LING 513. Language Assessment Practicum.

(Cross-listed with ENGL). (3-0) Cr. 3. F.S.SS. *Prereq: ENGL 519 or LING 519* Advanced practicum in language assessment.

LING 514. Sociolinguistics.

(Cross-listed with ENGL). (3-0) Cr. 3. S. *Prereq: ENGL 511 or LING 511 or an introductory course in linguistics*

Theories and methods of examining language in its social setting. Analysis of individual characteristics (e.g., age, gender, ethnicity, social class, region), interactional factors (e.g., situation, topic, purpose) and national policies affecting language use.

LING 515. Statistical Natural Language Processing.

(Cross-listed with ENGL, HCI). (3-0) Cr. 3. F. *Prereq: STAT 330 or equivalent, recommended ENGL 219 or LING 219, or ENGL 511 or LING 511*

Introduction to computational techniques involving human language and speech in applications such as information retrieval and extraction, automatic text categorization, word prediction, intelligent Web searching, spelling and grammar checking, speech recognition and synthesis, statistical machine translation, n-grams, POS-tagging, word-sense disambiguation, on-line lexicons and thesauri, markup languages, corpus analysis, and Python programming language.

LING 518. Teaching English as a Second Language Methods and Materials.

(Cross-listed with ENGL). (3-0) Cr. 3. F. *Prereq: ENGL 511 or LING 511 or an introductory course in linguistics*

Introduction to approaches, methods, techniques, materials, curricular design, and assessment for various levels of ESL instruction. Attention to issues related to the teaching of listening, speaking, reading, writing, vocabulary, pronunciation, and culture.

LING 519. Second Language Assessment.

(Cross-listed with ENGL). (3-0) Cr. 3. S. *Prereq: ENGL 511 or LING 511*

Principles of second language assessment including reliability, validity, authenticity and practicality. Constructing, scoring, interpreting, and evaluating second language tests for a variety of situations.

LING 520. Computational Analysis of English.

(Cross-listed with ENGL, HCI). (3-0) Cr. 3. S. *Prereq: ENGL 510 or LING 510, and ENGL 511 or LING 511*

Concepts and practices for analysis of English by computer with emphasis on the applications of computational analysis to problems in applied linguistics such as corpus analysis and recognition of learner language in computer-assisted learning and language assessment.

LING 524. Literacy: Issues and Methods for Nonnative Speakers of English.

(Cross-listed with ENGL). (3-0) Cr. 3. F. *Prereq: ENGL 511 or LING 511 or an introductory course in linguistics*

Theoretical and practical issues and techniques in the teaching of literacy in a variety of contexts, involving children and adults at basic skill levels and teens and adults in academic and vocational programs.

LING 525. Methods in Teaching Listening and Speaking Skills to Nonnative Speakers of English.

(Cross-listed with ENGL). (3-0) Cr. 3. S. *Prereq: ENGL 511 or LING 511 or an introductory course in linguistics*

Theoretical and practical issues and techniques in the teaching of second language pronunciation, listening, and speaking skills. Topics will be relevant to those intending to teach in various contexts involving both K-12 and adult learners.

LING 526. Computer-Assisted Language Learning.

(Cross-listed with ENGL). (3-0) Cr. 3. S. *Prereq: ENGL 511 or LING 511 or equivalent*

Theory, research, and practice in computer use for teaching nonnative speakers of English. Methods for planning and evaluating computer-based learning activities.

LING 527. Discourse Analysis.

(Cross-listed with ENGL). (3-0) Cr. 3. S. *Prereq: ENGL 511 or LING 511 or an introductory course in linguistics*

Methods and theoretical foundations for linguistic approaches to discourse analysis. Applications of discourse analysis to the study of texts in a variety of settings, including academic and research contexts.

LING 528. English for Specific Purposes.

(Cross-listed with ENGL). (3-0) Cr. 3. *Prereq: ENGL 511 or LING 511 or an introductory course in linguistics*

Issues and techniques in analyzing, teaching, and assessing English for specific purposes. Topics include theories of specific purpose language use, analysis of learner needs in target language contexts, and corpus-informed syllabus and materials development for teaching and assessment.

LING 537. Corpus Approaches to Grammatical Analysis.

(Cross-listed with ENGL). (3-0) Cr. 3. F. *Prereq: ENGL 220 or LING 220; ENGL 219, LING 219, ENGL 511, LING 511, or introductory course in linguistics; graduate classification*

Corpus-informed analysis of syntax in authentic writing and speech, with emphasis on approaches used in applied linguistics: rationalist, empirical, functional, cognitive, and pedagogical.

LING 554. Introduction to Spanish-English Interpretation.

(Dual-listed with LING 354). (Cross-listed with SPAN). (3-0) Cr. 3. F.S. *Prereq:* SPAN 351

Introduction to the theory, methods, techniques, and problems of consecutive and simultaneous interpretation. Consideration of material from business, agriculture, law, design, medicine, literature, advertisement, and sports. Taught in Spanish. Meets International Perspectives Requirement.

LING 588. Supervised Practice Teaching in Teaching English as a Second Language.

(Cross-listed with ENGL). (1-5) Cr. 3. F.S.SS. *Prereq:* 9 credits toward the TESL/TEFL Certificate, 15 credits toward the TESL/AL master's degree, or 18 credits completed toward the ESL Endorsement option.

Intensive observation of ESL instruction and supervised practice in teaching learners of English in a context appropriate to the student teacher's goals. ENGL 588 cannot be used for teacher licensure and cannot be taken during student teaching.

LING 590. Special Topics.

(Cross-listed with ENGL). Cr. arr. Repeatable. *Prereq:* Permission of the English Department Graduate Studies Committee according to guidelines available in the department office

LING 590B. Special Topics: Teaching English as a Second Language (TESL)/Applied Linguistics.

(Cross-listed with ENGL). Cr. arr. Repeatable. *Prereq:* Permission of the Director of Graduate Education according to guidelines available online

LING 590G. Special Topics: Applied Linguistics and Technology.

(Cross-listed with ENGL). Cr. arr. Repeatable. *Prereq:* Permission of the Director of Graduate Education according to guidelines available online

LING 591. Studies in Applied Linguistics.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq:* 6 credits in TESL/Applied Linguistics

Intensive study of applied linguistic theory as it relates to specific issues in language acquisition, teaching, or use.

LING 591B. Directed Readings: Teaching English as a Second Language (TESL)/Applied Linguistics.

(Cross-listed with ENGL). Cr. arr. Repeatable.

LING 591G. Directed Readings: Applied Linguistics and Technology.

(Cross-listed with ENGL). Cr. arr. Repeatable.

Courses for graduate students:**LING 623. Research Methods in Applied Linguistics.**

(Cross-listed with ENGL). (3-0) Cr. 3. F. *Prereq:* ENGL 511 or LING 511, ENGL 517 or LING 517, ENGL 519 or LING 519

Survey of research traditions in applied linguistics. Focus on theoretical and practical aspects of quantitative and qualitative approaches to applied linguistic study, including experimental and quasiexperimental methods, classroom observation and research, introspective methods, elicitation techniques, case studies, interactional analysis, ethnography, and program evaluation. Computational tools and resources for linguistic research will be highlighted.

LING 626. Computer-Assisted Language Testing.

(Cross-listed with ENGL). (3-0) Cr. 3. F. *Prereq:* ENGL 510 or LING 510, ENGL 511 or LING 511, ENGL 519 or LING 519

Principles and practice for the use and study of computers and the Internet in second language assessment.

LING 630. Seminar in Technology and Applied Linguistics.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable. *Prereq:* ENGL 510 or LING 510, ENGL 511 or LING 511

Topic changes each semester. Topics include advanced methods in natural language processing, technology and literacy in a global context, feedback in CALL programs, technology and pronunciation, and advances in language assessment.

LING 688. Practicum in Technology and Applied Linguistics.

(Cross-listed with ENGL). (1-5) Cr. 3. F.S.SS. *Prereq:* ENGL 510 or LING 510, ENGL 626 or LING 626, or equivalent; at least 2nd year PhD student in Applied Linguistics and Technology

Focus on integrating theoretical knowledge with practical expertise. Assess client needs; develop, integrate, and evaluate solutions. Practical understanding of computer applications used in multimedia development. Create web-based or CD-ROM-based multimedia materials. Work with advanced authoring applications.

Management (MGMT)

Courses primarily for undergraduates:

MGMT 310. Entrepreneurship and Innovation.

(3-0) Cr. 3. F.S. *Prereq: Sophomore classification*

Review of the entrepreneurial process with emphasis on starting a new business. How to analyze opportunities, develop an innovative product, organize, finance, market, launch, and manage a new venture. Deals with the role of the entrepreneur and the importance of a business plan. Speakers and field project.

MGMT 313. Feasibility Analysis and Business Planning.

(3-0) Cr. 3. F.S. *Prereq: MGMT 310*

Developing an idea for a new business venture, conducting a feasibility study, researching the potential market, analyzing the competition, and writing a formal business plan. Basic business functions are discussed in terms of their application to conducting feasibility analysis and writing a business plan for an entrepreneurial venture.

MGMT 367. International Entrepreneurship.

(3-0) Cr. 3. *Prereq: junior standing*

The essentials of operating an entrepreneurial firm in an international environment. Topics include understanding the role of entrepreneurship in economic development, starting and developing a business in an international market, financing international ventures, international management issues and exchange rates.

Meets International Perspectives Requirement.

MGMT 370. Management of Organizations.

(3-0) Cr. 3. F.S.SS. *Prereq: ECON 101 or ECON 102 or equivalent*

A management functions approach is used to explain what managers do in organizations; how they deal with external constituents, how they structure their companies, and how they deal with employees. A contingency approach is used as a framework for understanding how to increase the effectiveness and efficiency of organizations in today's dynamic, highly competitive business environment.

MGMT 371. Organizational Behavior.

(3-0) Cr. 3. F.S. *Prereq: MGMT 370*

The study of individual attributes, interpersonal relations, and employee attitudes in organizations. Instructional emphasis is placed on how management concepts such as reward systems, job design, leadership, teams, etc., can be used to manage employee attitudes and behavior.

MGMT 377. Competitive Strategy.

(3-0) Cr. 3. F. *Prereq: MGMT 370*

Developing competitive strategy and achieving competitive advantage in firms, including: industry analysis, generic strategies, hypercompetition, competing against time, and building distinctive capabilities.

MGMT 410. Social Entrepreneurship.

(3-0) Cr. 3. F.S. *Prereq: Sophomore classification*

This course will introduce students to issues related to the role of social entrepreneurship in helping to solve social problems, including innovation, opportunity recognition, planning and the launch of new non-profit organizations.

MGMT 414. International Management.

(3-0) Cr. 3. F.S.

The nature and economic role of the multinational firm and entrepreneurial ventures, including the impact of legal, political, and cultural variables upon firm performance and managerial activity; case studies illustrate interdependent nature of functional areas of business projected across national boundaries.

MGMT 415. Managing New Ventures.

(3-0) Cr. 3. F.S. *Prereq: MGMT 370; MKT 340; FIN 301; SCM 301*

Examination of business problems and issues in new and growing firms. Emphasis is on analyzing existing businesses. Includes a field project.

MGMT 419. Social Responsibility of Business.

(3-0) Cr. 3. S.

A consideration of the role of business in society. Critical analysis of ethical, managerial, and public issues as they affect the corporation.

MGMT 471. Personnel and Human Resource Management.

(3-0) Cr. 3. F.S. *Prereq: Junior standing*

Recruitment and selection, utilization, and development of people in organizations. Examination of each personnel function; interrelationships among the functions.

MGMT 472. Management of Diversity.

(3-0) Cr. 3. F.S. *Prereq: Junior classification*

One of the most crucial problems in organizations today is the management of diversity. Attempts to define the difference between equal employment opportunity/affirmative action, which has a legal basis, and diversity which has an educational basis. Organized around the concepts of: (1) cultural diversity and cultural unity; (2) development of skills and tools to manage diversity; and (3) structure of diversity development programs in organizations. Meets U.S. Diversity Requirement

MGMT 478. Strategic Management.

(3-0) Cr. 3. F.S.SS. *Prereq: MGMT 370; ACCT 285; FIN 301; MKT 340; SCM 301; graduating senior*

Strategy formulation, implementation, and evaluation and control in today's organizations. Emphasis is on strategic planning and decision making using the case method and/or projects.

MGMT 490. Independent Study.

Cr. 1-3. Repeatable. *Prereq: MGMT 370, senior classification, permission of instructor*

Courses primarily for graduate students, open to qualified undergraduates:

MGMT 502. Organizational Behavior.

(3-0) Cr. 3. F. *Prereq: Enrollment in MBA program or departmental permission*

Understanding human behavior in organizations and the nature of sustainable organizations from a managerial perspective. Special emphasis is placed on how individual differences, such as perceptions, personality, and motivation, influence individual and group behavior in organizations and on how behavior can be influenced by job design, leadership, groups, and the structure of organizations.

MGMT 503. Professional Responsibility in Business and Society.

(3-0) Cr. 3. *Prereq: Enrollment in MBA program or department permission, ACCT 501, FIN 501, MGMT 502, MKT 501*

Ethical and social responsibilities of top managers in corporations. Topics include stakeholder management, corporate social responsibilities, strategies for sustainable development, pursuit of societal and corporate goals, board and chief executive leadership roles, governance reform and ethics, and executive leadership style and values. The presentation of course concepts is facilitated by the use of cases, discussion scenarios, and ethical dilemmas.

MGMT 504. Strategic Management.

(3-0) Cr. 3. *Prereq: Enrollment in MBA program or departmental permission, ACCT 501, FIN 501, MGMT 502, MKT 501*

Critical analysis of case studies in strategic management with an emphasis on integrative decision making. Strategy implementation in light of the global, legal, economic, cultural, and political contexts of business.

MGMT 565. Early Stage Entrepreneurship - Mind to Market.

(3-0) Cr. 3. *Prereq: Graduate classification*

Commercialization of new technology. Topics covered include market analysis, intellectual property, product development, feasibility analysis, and new business evaluation.

MGMT 566. Entrepreneurship and New Business Creation.

(3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor.*

The essentials of starting and operating a new business. Topics include current research on entrepreneurial perspective, starting and developing a new business, financing the venture, managing the growing firm, and special issues.

MGMT 567. International Entrepreneurship.

(3-0) Cr. 3.

Essentials of operating an entrepreneurial firm in an international environment. Topics include international entrepreneurship, starting and developing a business in an international market, financing international ventures, international management issues, exchange rates, and culture.

MGMT 569. Technology Entrepreneurship.

(3-0) Cr. 3. *Prereq: Graduate standing or instructor's permission*

Identification of high-potential, technology-intensive commercial opportunities, resources? gathering, and risk management under environmental uncertainty. Focus on technology ventures and firms that use technology strategically across several industries. Topics include key success factors and forecasting analysis across main value-chain activities.

MGMT 570. Managing Employee Attitudes and Behaviors.

(3-0) Cr. 3. F.SS. *Prereq: MGMT 371 or MGMT 502 or PSYCH 450*

Advanced topics germane to the management of individuals and groups over their work lives; sustained work commitment, motivation and job/career satisfaction, absenteeism, turnover, stress, leadership and career development (e.g., career ladders, mentoring).

MGMT 571. Seminar in Personnel and Human Resources Management.

(3-0) Cr. 3. S. *Prereq: MGMT 371 or MGMT 502 or SOC 420*
Topics and issues in personnel management with a focus on the management of human resources in organizations. Current personnel practices, philosophies, and behavioral science research.

MGMT 572. Personality and Management.

(3-0) Cr. 3. *Prereq: Graduate standing or permission of instructor*
Personality and individual differences have significant implications for human resource management, organizational behavior and strategic management. Research has shown that these characteristics affect many core management topics including motivation, leadership, and decision making. Surveys the literature relating personality and individual differences to management and organizations. Students will complete a wide variety of personality assessments and get their results, and reflect on how personality and individual differences can be practically relevant in the modern work environment.

MGMT 581. Contemporary Topics in Strategy.

(3-0) Cr. 3. F. *Prereq: MGMT 504 or permission of instructor*
Discussion of concepts and techniques used in long range strategic planning. Examination of planning practices in business and not-for-profit organizations. Topics include environmental scanning, industry analysis, forecasting, corporate and competitive strategies, and tactics.

MGMT 582. Corporate Governance and Top Management.

(Cross-listed with ACCT). (3-0) Cr. 3. *Prereq: MGMT 503 or permission*
Duties, structure, and functioning of top management teams and corporate boards of directors. CEO/board tenure and succession planning, top management compensation, board committee composition, assessment of CEO and board performance, theories of corporate governance, management of the corporate strategic agenda, governance codes, international governance, and chairman/CEO duality. Case studies and contemporary issues discussed.

MGMT 583. Strategic Management of Innovation.

(3-0) Cr. 3. *Prereq: MGMT 504 or permission of instructor*
Critical analysis and discussion of cases focused on strategic management of innovation. Assessment of a firm's innovative capabilities and competitive dynamics to manage innovative processes. Practical applications through emphasis on implementation including internal corporate venturing, management of the corporate R&D function, and institutionalization of innovation.

MGMT 584. Management Consulting.

(3-0) Cr. 3. *Prereq: MGMT 504 or permission of instructor*
Provides the opportunity for students to understand the role of the professional consultant, the issues facing the management consulting industry, the competencies of various management consulting firms, the nature and form of strategic consulting engagement, and the nature and scope of strategic change in business firms. Students will learn about management consulting functions and will practice the consultant role through cases and field studies.

MGMT 590. Special Topics.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*
For students wishing to do individual research in a particular area of management.

Courses for graduate students:**MGMT 601. Philosophy of Science.**

(3-0) Cr. 3. *Prereq: enrollment in the PhD program*
This course provides a philosophical introduction to the theoretical and empirical development of scientific knowledge. It focuses on a variety of basic problems common to the social sciences: the nature of explanation, the structure of theories, forms of knowledge, scientific laws, nature of theory and ethics. The purpose of the course is to help doctoral students define a research context by addressing the purposes, assumptions and primary components of scientific inquiry.

MGMT 602. Organizational Theory.

(3-0) Cr. 3. *Prereq: enrollment in the PhD program*
This seminar involves the examination of the core theories and perspectives in organizational theory, as well as their applications and extensions. This material addresses the fundamental rationale for organizations in modern society, basic processes of organizing and organizational structure, a consideration of inter-organizational relationships and the external environment, and a variety of factors that help determine organizational effectiveness.

MGMT 603. Strategic Management of Technology and Innovation.

(3-0) Cr. 3. *Prereq: MGMT 601*
This course will offer a critical review of organizational decision making with respect to technology and innovation. Students will learn how technological change can alter the basis of competition; how competitive strategy drives technology investment decisions; how market-orientation should be the other backbone of technological innovation; and best practices of organizing and managing the new product development process to achieve strategic goals.

MGMT 604. Seminar in Organizational Behavior.

(3-0) Cr. 3. *Prereq: enrollment in the PhD program*
The purpose of this seminar is to introduce behavioral science literature relevant to the study of behavior in organizational settings. The course will focus on the individual's role within organizations and cover topics such as individual differences, motivation, leadership, decision-making. Learning, risk taking, interpersonal relations, etc. Both theoretical and empirical contributions will be examined, with emphasis on integration of diverse theoretical perspectives.

MGMT 650. Research Practicum I.

(1-0) Cr. 1. *Prereq: enrollment in the PhD program*
Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

MGMT 651. Research Practicum.

(1-0) Cr. 1. *Prereq: enrollment in the PhD program*
Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

MGMT 699. Dissertation.

Cr. 1-12. *Prereq: Graduate classification, permission of dissertation supervisor*
Research.

Management Information Systems (MIS)

Courses primarily for undergraduates:

MIS 207. Fundamentals of Computer Programming.

(Cross-listed with COM S). (3-1) Cr. 3. F.S. Prereq: MATH 150 or placement into MATH 140/MATH 141/MATH 142 or higher

An introduction to computer programming using an object-oriented programming language. Emphasis on the basics of good programming techniques and style. Extensive practice in designing, implementing, and debugging small programs. Use of abstract data types. Interactive and file I/O. Exceptions/error-handling. This course is not designed for computer science, software engineering, and computer engineering majors. Credit may not be applied toward graduation for both Com S 207/MIS 207 and Com S 227.

MIS 301. Management Information Systems.

(3-0) Cr. 3. Prereq: COM S 113 or BUSAD 150

The role of information technology in organizations. Overview of methodologies for design and development of systems including decision support systems, expert systems, data bases, end-user computing, etc. Computer applications relate concepts to practice. Lecture and laboratory work emphasizes the enabling role of IT in contemporary organizations.

MIS 307. Intermediate Business Programming.

(3-0) Cr. 3. Prereq: MIS 207/COM S 207 or COM S 227; credit or enrollment in MIS 301

Introduction to the concepts and use of data structures, file accesses and object oriented programming methodologies in contemporary business environments. Application development environments will be covered.

MIS 310. Information Systems Analysis.

(3-0) Cr. 3. Prereq: credit or enrollment in MIS 301

Critical analysis of business processes, data and process modeling, feasibility studies, CASE tools, and developing system design specifications.

MIS 320. Database Management Systems.

(3-0) Cr. 3. Prereq: Credit or enrollment in MIS 301

Database design, development, and implementation. Focus on data models, both classical and object oriented. Uses relational and/or object oriented database management systems.

MIS 340. Project Management.

(Cross-listed with SCM). (3-0) Cr. 3. Prereq: credit or enrollment in MIS 301

Equips students to support team activities in the general project management environment and better manage their careers. Practical experience using project management techniques and tools. Course topics include project initiation and execution, risk assessment, estimating and contracts, planning, human factors, and standard methods.

MIS 407. Advanced Business Programming.

(3-0) Cr. 3. Prereq: MIS 307

Advanced software development and topics in contemporary programming languages. Topics include basic syntax, advanced programming techniques, file structures and management, database access, algorithm design, web forms and graphical user interfaces.

MIS 434. Electronic Commerce Strategy.

(3-0) Cr. 3. Prereq: MIS 301, MKT 340, SCM 301

Overview of business strategies and technologies used for electronic commerce. Emphasis is on the strategic, operational, and technical issues associated with global electronic commerce using class lecture/discussion and case studies.

MIS 435. Information Systems Infrastructure.

(3-0) Cr. 3. Prereq: MIS 301

Overview of Internet and telecommunications technology used in business applications. Understand Internet and network protocols, network and application architectures, design, and implementation.

MIS 436. Introduction to Business Analytics.

(3-0) Cr. 3. Prereq: STAT 226 and MIS 320 or permission of the instructor

Introduction to the field of business analytics (BA). Students will examine BA processes and techniques used in transforming data to knowledge and creating value for organizations. Business cases, presentations by business professionals, class lectures and discussions on data analysis, design and modeling, and extensive hands-on analytical exercises.

MIS 439. Topics in Management of Information Systems.

(3-0) Cr. 3. Repeatable. Prereq: MIS 301, permission of instructor

A variety of topics will be covered and topics may vary between semesters. Some of the topics are information resources management, electronic commerce, decision support systems, and expert systems.

MIS 440. Supply Chain Information Systems.

(Cross-listed with SCM). (3-0) Cr. 3. Prereq: MIS 301, SCM 301

Internal and inter-organizational information systems necessary for a supply chain to achieve competitive advantage. Topics include: design, development, implementation, and maintenance of supply chain information systems; enterprise resource planning; advanced planning and scheduling, manufacturing execution systems; and the interface between manufacturing planning and control processes, logistics processes, and the information system.

MIS 445. Enterprise Systems and Architecture.

(3-0) Cr. 3. Prereq: MIS 435

Contemporary theories, concepts, and practices in network infrastructure, network design, and information security. Design, install, and administer a complex network infrastructure. Study security threats and attacks and countermeasures. Investigate exposure to attacks, firewalls, and development of intrusion detection systems. Other security topics such as risk management, IT audit, and security regulations will also be addressed.

MIS 446. Advanced Business Analytics.

(3-0) Cr. 3. Prereq: MIS 436

Projects-based course which provides an in-depth understanding of BA methods of visualization, data mining, text mining, web-mining, and predictions through the use of specific BA tools. For students who are interested in understanding advanced techniques and applications of data analytics and acquiring hands-on skills for making intelligent business decisions in data-rich organizations.

MIS 447. Information Systems Development.

(3-0) Cr. 3. Prereq: MIS 407

Design of business systems using contemporary tools and methods such as SQL, CASE tools, OOD tools, etc. Focuses on synthesizing concepts from earlier MIS courses.

MIS 450. Enterprise Resource Planning Systems in Supply Chain.

(Cross-listed with SCM). (3-0) Cr. 3. Prereq: SCM 301, MIS 301 or IE 148, IE 341

Examination of the role of enterprise resource planning systems (ERP) in the supply chain. Hands-on experience with a major software application in use by many corporations to manage and improve the efficiency of their supply chains and operations. Students will develop a more process-centric perspective about how a supply chain operates and how ERP enables and supports such operations.

MIS 490. Independent Study.

Cr. 1-3. Repeatable. Prereq: MIS 301, senior classification, permission of instructor

Courses primarily for graduate students, open to qualified undergraduates:

MIS 501. Management Information Systems.

(3-0) Cr. 3. Prereq: Enrollment in MBA program or departmental permission.

This course exposes the student to current theories and practices appropriate for understanding the role and application of information systems for individuals, organizations, and society within a globally competitive context. The course focuses on information technology and its uses in improving work practices, products, and tools for individuals and organizations. The course also addresses issues pertaining to current and emerging topics in the development and use of technology, the role of technology in and its alignment with organizational strategy and sustainable business practices, information system planning and the development of enterprise architectures, and human interface and personal characteristics in the design and use of technology.

MIS 532. Advanced Business Software Development.

(3-0) Cr. 3. Prereq: MIS 531 or equivalent

A survey of business-oriented programming languages with emphasis on state-of-the-art development techniques for business software. Topics include object-oriented and Internet programming issues and methods.

MIS 533. Data Management for Decision Makers.

(3-0) Cr. 3. Prereq: MIS 501

Addresses data needs of functions such as marketing, finance, and production. Advanced skills needed to design, develop and use database, data warehousing and data mining systems for effective decision support. Emphasis on importance of contemporary technologies.

MIS 534. Electronic Commerce.(3-0) Cr. 3. *Prereq: MIS 501*

Overview of how modern communication technologies including the internet and world wide web have revolutionized the way we do business. Provides an understanding of various internet technologies and how companies are using the internet for commercial purposes. Explores future scenarios on the use of these technologies and their impact on various industries and the society.

MIS 535. Telecommunications Management.(3-0) Cr. 3. *Prereq: MIS 501*

Issues involved in the management of telecommunications function. Overview of communications technology used in various business applications, local area network, wide area network, broad band network, wireless and voice networks. Internet technologies and protocols. Analyzing the strategic impact of these technologies on organizations. Strategic planning for telecommunications, including network planning and analysis.

MIS 537. Project Management.(3-0) Cr. 3. *Prereq: MIS 501*

Prepares students to support team activities in the general project management environment and provides them with a working understanding of the full scope of project management activities. Students will also have practical experience using project management techniques and tools. Course topics include project initiation and execution, risk assessment, estimating and contracts, planning, human factors, and standard methods. The course follows the recommended content areas of the Project Management Institute, and provides students with a recognized foundational training in project management.

MIS 538. Business Process Systems.(3-0) Cr. 3. *Prereq: MIS 501*

Examine current and historical perspectives on business process management. Topics include process identification, mapping, and improvement. Additional topics will address business process automation and integration, business process outsourcing. Investigate current and potential tools and methods for business process management. Include process management projects.

MIS 539. Topics in Management of Information Systems.(3-0) Cr. 3. Repeatable. *Prereq: MIS 501*

A variety of topics may be offered in different semesters. Topics may include electronic commerce, information resources management, decision support systems, and expert systems.

MIS 590. Special Topics.Cr. 1-3. Repeatable. *Prereq: Permission of instructor*

For students wishing to do individual research in a particular area of MIS.

MIS 598. Research Seminar in Management Information Systems.(3-0) Cr. 3. *Prereq: Graduate classification*

Examines issues such as the nature and content of information systems research; aspects of starting and pursuing research topics in information systems; exploring and understanding relevant research methods and tools. Develop preliminary research proposals.

MIS 599. Creative Component.Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair*
Preparation and writing of creative component.**Courses for graduate students:****MIS 601. Behavioral Issues in IS Research.**(3-0) Cr. 3. *Prereq: MIS 501 or equivalent, enrollment in PhD program*

The state of behavioral research in the IS function. MIS activities in an organization span the following three major areas: design and implementation of the MIS, use of the MIS, and management of the MIS function. Each of these processes is carried out at several levels: individual, group, organizational and inter-organizational. Identify behavioral issues of relevance for the cells defined by the process and level dimensions. Reading and discussion of the research literature surrounding the development, use, and implications of information technology.

MIS 602. Current Issues in IS Research.(3-0) Cr. 3. *Prereq: MIS 501 or equivalent, enrollment in PhD program*

Three fundamental areas of Information Systems, namely, infrastructure, management, and processes. Infrastructure studies examine the IT architecture including computing, communication, data, and application. Management focuses on addressing the value added notion of IT. Finally processing addresses topics related to enabling role of IT in myriad of areas.

MIS 603. Seminar on IT Strategy and Structure.(3-0) Cr. 3. *Prereq: MIS 601*

Strategic issues in IT management. Address issues such as aligning IT strategy with corporate strategy and functional strategies, IT structure, valuation, governance and control, and related topics. Provide students with research skills related to the boundary between IT and the firm's external environment.

MIS 604. Collaboration, Knowledge, and Intelligence in Organizations.(3-0) Cr. 3. *Prereq: MIS 601*

Research issues in the emerging areas of collaboration, knowledge management, and enterprise intelligence. Topics will include emerging and contemporary technologies of Data Mining, Knowledge Discovery from Databases, Web Mining, organizational memory, and knowledge management.

MIS 650. Research Practicum I.(1-0) Cr. 1. *Prereq: enrollment in the PhD program*

Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

MIS 651. Research Practicum II.(1-0) Cr. 1. *Prereq: enrollment in the PhD program*

Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

MIS 655. Organizational and Social Implications of Human Computer Interaction.(Cross-listed with HCI). (3-0) Cr. 3. *Prereq: Graduate classification*

Examine opportunities and implications of information technologies and human computer interaction on social and organizational systems. Explore ethical and social issues appurtenant to human computer interaction, both from a proscriptive and prescriptive perspective. Develop informed perspective on human computer interaction. Implications on research and development programs.

MIS 699. Research.Cr. 3-6. Repeatable. *Prereq: Graduate classification, permission of dissertation supervisor*
Research.

Marketing (MKT)

Courses primarily for undergraduates:

MKT 340. Principles of Marketing.

(3-0) Cr. 3. F.S.SS. *Prereq: credit or current enrollment in ECON 101*

The role of marketing in society. Markets, marketing institutions, and marketing functions with emphases on product, price, marketing communication, and marketing channel decisions.

MKT 343. Personal Sales.

(3-0) Cr. 3. *Prereq: MKT 340*

Analysis of the theory and practice of personal selling with the context of relationship marketing and salesforce automation. Topics include: goal setting, prospecting, time/territory management, questioning, presentations, objections, commitment and customer service; simulations of selling situations.

MKT 410. Promotional Strategy.

(3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in MKT 447*

Principles, concepts, and problems involved in the development and implementation of promotional strategies. Coordination of a variety of promotional elements: advertising, sales promotion, direct marketing, public relations and publicity of web communications, and personal selling.

MKT 442. Sales Management.

(3-0) Cr. 3. F.S. *Prereq: MKT 340*

Functional aspects of sales force management; personal selling methods; procedures for recruiting, selecting, and training new salespeople; compensation and expense control systems; problems of sales force motivation and supervision; methods of territorial and quota assignment; sales department budgets; distributor-dealer relations; other selected topics.

MKT 443. Strategic Marketing Management.

(3-0) Cr. 3. F.S.SS. *Prereq: MKT 444, MKT 447*

Analysis of major elements of strategic marketing management. May include case studies or business simulations involving decision making using marketing tools from previous courses. (For marketing majors only.).

MKT 444. Marketing Research.

(3-0) Cr. 3. F.S. *Prereq: MKT 340, STAT 226*

Marketing research techniques: problem formulation, research design, questionnaire construction, sampling, data collection procedures, and analysis and interpretation of data related to marketing decisions.

MKT 445. Customer Relationship Management.

(3-0) Cr. 3. F.S. *Prereq: MKT 340*

Examines how customer data can be used to enhance decisions relating to acquisition, development and retention. Topics include customer lifetime value, customer as assets, customer loyalty programs and customization.

MKT 446. Retailing.

(3-0) Cr. 3. F.S. *Prereq: MKT 340*

Basic areas of retail management: buying, merchandising, retail promotion, store location, store layout, credit management, and inventory control. Emphasis on practical application of retail management principles.

MKT 447. Consumer Behavior.

(3-0) Cr. 3. F.S. *Prereq: MKT 340*

Study of how consumers select, purchase, use, and dispose of goods and services. Includes analyses of how markets and others influence these processes. Application of concepts and methods of the behavioral sciences to marketing management decision making.

MKT 448. Global Marketing.

(3-0) Cr. 3. F.S. *Prereq: MKT 340*

Introduction to terms used in international marketing and sources of information on international markets. Development of sensitivity toward foreign business environment and familiarity with operations of multinational corporations.

MKT 449. Marketing Seminar.

(3-0) Cr. 3. *Prereq: MKT 340*

Analysis of current issues and problems in marketing with emphasis on new theoretical and methodological developments. Additional seminars may be offered.

MKT 451. Marketing Channels.

(3-0) Cr. 3. F.S. *Prereq: MKT 340*

Focuses on marketing channels, the downstream part of a value chain, companies that come together to bring products and services from their point of origin to the point of consumption. Topics include channel institutions, channel design, channel coordination and implementation. Highlights international and technological aspects of marketing channels so that students can successfully develop and manage marketing channels in a contemporary business environment.

MKT 453. Brand Management.

(3-0) Cr. 3. F.S. *Prereq: MKT 447*

Examines the role of brands and branding in market environments characterized by intense competition and consumer power. Covers issues relating to why branding is important to firms, what brands represent to consumers, and what should be done to manage them effectively.

MKT 490. Independent Study.

Cr. 1-3. Repeatable. *Prereq: MKT 340, senior classification; permission of instructor*

MKT 492. Comparative Marketing.

(3-0) Cr. 3. SS. *Prereq: MKT 340*

Provides experience to students in culture, social, economic, and political environment of marketing in a foreign country. Students complete a term project (e.g., a marketing plan) based on information collected in the foreign country. Students attend briefings by experts/officials of private and public organizations.

Courses primarily for graduate students, open to qualified undergraduates:

MKT 501. Marketing.

(3-0) Cr. 3. *Prereq: Enrollment in MBA program or departmental permission*

An analytical approach to the study of marketing issues and challenges of business firms and nonprofit organizations. Emphasis on the influence of the global marketplace and the marketing environment on marketing decision making; the determination of the organization's products, prices, channels and communication strategies; an orientation that ensures sustainability of marketing operations; and the organization's system for planning and controlling its marketing effort.

MKT 540. Advanced Marketing Management.

(3-0) Cr. 3. F.S. *Prereq: MKT 501*

Strategic marketing and decision making, with emphasis on cases utilizing qualitative and quantitative techniques and marketing models.

MKT 541. International Marketing.

(3-0) Cr. 3. F. *Prereq: MKT 501, MKT 509*

Scope and nature of global marketing operation; the context of international environment in which firms operate. Recent developments of international business activities, and a framework for better understanding of the basic forces driving international business and marketing operations. Development of market entry strategies and global marketing mix policies, as well as export operations. Organizational issues related to the globalization of the firm.

MKT 542. New Product Development and Marketing.

(3-0) Cr. 3. S. *Prereq: MKT 501*

Principles and concepts of new product development and introduction; decision areas include market definition and structure, idea generation, concept evaluation, test marketing, launch tracking, and global product planning; models and techniques of new product evaluation used by consumer product companies.

MKT 543. Services Marketing.

(3-0) Cr. 3. *Prereq: MKT 501 and instructor permission*

In-depth appreciation and understanding of the unique challenges inherent in managing and delivering quality services. Students will be introduced to and have the opportunity to work with tools and strategies that address these challenges.

MKT 544. Marketing Research.

(3-0) Cr. 3. S. *Prereq: MKT 501, BUSAD 502 or STAT 401*

Marketing research methods are examined with emphasis on the use of advanced research methods in business research. Application of advanced sampling, measurement, and data analysis methods in research on market segmentation, market structure, consumers' perceptions and decision processes, marketing communication, new product development, and pricing.

MKT 545. Integrated Marketing Communication.

(3-0) Cr. 3. *Prereq: MKT 501*

Introduces the student to the field of marketing communications. Covers a number of topics and areas essential for understanding how to design and evaluate communication strategies necessary for the successful marketing of products and services. An integrated marketing communications (IMC) perspective is employed in covering material, with a corresponding focus on various elements of an IMC strategy, including advertising, promotions, point-of-purchase communications, direct marketing techniques, and other topics.

MKT 546. Customer Relationship and Business-To-Business Marketing.(3-0) Cr. 3. *Prereq: MKT 501*

Core concepts and issues involved in customer relationship strategy and management in consumer and business-to-business markets. Emphasis on customer opportunity analyses, customer relationship management tools and strategies.

MKT 547. Consumer Behavior.(3-0) Cr. 3. S. *Prereq: MKT 501*

The behavior of consumers. Intensive review of literature from relevant disciplines. Applications of concepts and methods of the behavioral sciences to marketing management decision making.

MKT 549. Global Marketing Planning and Execution.(3-0) Cr. 3. *Prereq: MKT 501*

Allows students to develop the ability to plan and execute a B2B business by integrating aspects of marketing with other business functions in the international context. Product strategy, innovation, foreign market entry, supply strategies for foreign markets, pricing strategy, market research, customer service, international payments, managing international subsidiaries, licensing, distribution strategy, and responding to changing international environmental conditions. Involves a simulation-based instruction in planning and managing an international B2B business.

MKT 551. Marketing Channels.(3-0) Cr. 3. *Prereq: MKT 501*

Design of marketing channels, developing and managing relationships with resellers, and evaluating channel performance. Emphasis on international and technological aspects of marketing channels.

MKT 590. Special Topics.Cr. 1-3. Repeatable. *Prereq: Permission of instructor*

For students wishing to do individual research in a particular area of marketing.

Courses for graduate students:**MKT 601. Seminar in Consumer Behavior.**(3-0) Cr. 3. *Prereq: MGMT 601*

A rigorous foundation of the major conceptual and methodological paradigms in the consumer-behavior literature. Seeks to aid students in understanding the psychological, sociological, and anthropological roots of consumer behavior research. Read the latest research in the area reported in leading consumer behavior/psychology journals.

MKT 602. Marketing Strategy.(3-0) Cr. 3. *Prereq: MGMT 601*

Review major contributions and recent developments in marketing strategy research and practice. Review commonly used modeling approaches and research methods to study strategic interaction between firms seeking to build competitive advantages. Provide an overview of empirical research regarding measurement, level and persistence of business success and implications of findings for theory and strategy development.

MKT 603. Customer Management Strategy and Implementation.(3-0) Cr. 3. *Prereq: Mkt 601*

Addresses key strategy and implementation issues behind customer management. Topics such as typology of CM strategies, antecedents and outcomes; environmental and managerial influences on strategy formation; technology and impact on CM strategy; and value of CM strategy. Examine theories and concepts behind important CM issues such as customer satisfaction, customer loyalty and customer profitability.

MKT 604. Marketing Issues in Inter-Organizational Relations.(3-0) Cr. 3. *Prereq: MGMT 602*

Inter-firm and network competition; relationship among suppliers, distributors, alliance partners, external employees, and internal employees. Theories including agency theory, network theory, relationship marketing, channels of distribution theories on cooperation versus competition, IOS theories.

MKT 644. Research Methods.(3-0) Cr. 3. *Prereq: Knowledge of introductory statistics, Stat 401, enrollment in the PhD program*

Introduction to methodological issues that arise when addressing a wide variety of research questions in organizational and consumer studies. Address measurement issues (scales, reliability and construct validity), design (for experiments, surveys, or qualitative studies), sampling, and analysis (univariate and multivariate statistical procedures). Measurement issues in cross-cultural and international research will also be covered. It is assumed that students entering the course have knowledge of introductory statistics.

MKT 650. Research Practicum I.(1-0) Cr. 1. *Prereq: enrollment in the PhD program*

Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

MKT 651. Research Practicum II.(1-0) Cr. 1. *Prereq: enrollment in the PhD program*

Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

MKT 699. Dissertation.Cr. 12. *Prereq: Graduate classification, permission of dissertation supervisor Research.*

Materials Engineering (MAT E)

Courses primarily for undergraduates:

MAT E 214. Structural Characterization of Materials.

(2-2) Cr. 3. F.S. *Prereq: MAT E 215, credit or enrollment in PHYS 221*
Structural characterization of ceramic, electronic, polymeric and metallic materials. Techniques include optical and electron microscopy, x-ray diffraction, and thermal analysis. Identification of materials type, microstructure, and crystal structure.

MAT E 215. Introduction to Materials Science and Engineering I.

(3-0) Cr. 3. F.S. *Prereq: Math 165 AND (CHEM 177 or CHEM 167)*
Materials Engineering majors only. Structure and properties of ceramic, electronic, polymeric and metallic materials, emphasizing differences based on structure and bonding. Phase equilibria and phase transformations. Only one of Mat E 215, 273, or 392 may count toward graduation.

MAT E 215L. Introduction to Materials Science and Engineering I - Lab.

(0-3) Cr. 1. F.S. *Prereq: Credit or enrollment in MAT E 215 or MAT E 273 or MAT E 392*

Materials Engineering majors only. Laboratory exercise in materials.

MAT E 216. Introduction to Materials Science and Engineering II.

(3-0) Cr. 3. F.S. *Prereq: MAT E 215, Chem 178, Credit or enrollment in PHYS 222*
Materials Engineering majors only. Fundamentals of ceramic, polymeric, and composite materials; degradation, electronic, thermal, magnetic, and optical properties of materials. Materials for energy, biomaterials, and nanomaterials.

MAT E 216L. Introduction to Materials Science and Engineering II - Lab.

(0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 216*

Materials Engineering majors only. Laboratory exercise in materials.

MAT E 220. Global Sustainability.

(Cross-listed with ANTHR, ENV S, GLOBE, M E, SOC, T SC). (3-0) Cr. 3. F.S.
An introduction to the key global issues in sustainability. Focuses on interconnected roles of energy, materials, human resources, economics, and technology in building and maintaining sustainable systems. Applications discussed will include challenges in both the developed and developing world and will examine the role of technology in a resource-constrained world. Cannot be used for technical elective credit in any engineering department. Meets International Perspectives Requirement.

MAT E 273. Principles of Materials Science and Engineering.

(3-0) Cr. 3. F.S.SS. *Prereq: Sophomore classification; CHEM 167 or CHEM 177; MATH 165*

Introduction to the structure and properties of engineering materials. Structure of crystalline solids and imperfections. Atomic diffusion. Mechanical properties and failure of ductile and brittle materials. Dislocations and strengthening mechanisms. Phase equilibria, phase transformations, microstructure development, and heat treatment principles of common metallurgical systems including steels and aluminum alloys. Structure and mechanical properties of ceramic, polymeric and composite materials. Thermal properties of materials. Corrosion and degradation. Basic electronic properties of materials. Engineering applications. Only one of Mat E 215, 272, 273, or 392 may count toward graduation

MAT E 298. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services*

First professional work period in the cooperative education program. Students must register for this course before commencing work.

MAT E 311. Thermodynamics in Materials Engineering.

(3-0) Cr. 3. F. *Prereq: CHEM 178, credit or enrollment in MAT E 216, PHYS 222, and MATH 267*

Basic laws of the thermodynamics applied to phase equilibria, transformations, and reactions in multicomponent multiphase materials systems; Thermodynamic descriptions of heterogeneous systems; Binary and ternary phase diagrams; interfaces, surfaces, and defects.

MAT E 314. Kinetics and Phase Equilibria in Materials.

(3-0) Cr. 3. S. *Prereq: MAT E 216, MAT E 311*

Kinetic phenomena and phase equilibria relevant to the origins and stability of microstructure in metallic, ceramic and polymeric systems. Application of thermodynamics to the understanding of stable and metastable phase equilibria, interfaces and their effects on stability: defects and diffusion, empirical rate equations for transformation kinetics, driving forces and kinetics of nucleation, diffusional and diffusionless phase transformations.

MAT E 316. Computational Methods in Materials.

(3-0) Cr. 3. S.SS. *Prereq: MAT E 215*

Use of mathematical and statistical computer tools for materials design and analysis. Applications of statistical principles to problems concerned with materials. Computer-assisted design of experiments.

MAT E 317. Introduction to Electronic Properties of Ceramic, Metallic, and Polymeric Materials.

(3-0) Cr. 3. F. *Prereq: MAT E 216 and PHYS 222*

Materials Engineering majors only. Introduction to electronic properties of materials and their practical applications. Classical conduction models and electronic properties of metallic and ceramic materials. Elementary quantum mechanics and band theory of electron states in solids. Quantum theory of metallic conduction. Elementary semiconductor theory and devices. Polarization and dielectric properties of materials. Electron conduction in polymeric systems. Magnetic properties and applications of metals and ceramics.

MAT E 321. Introduction to Ceramic Science.

(3-0) Cr. 3. F. *Prereq: MAT E 216*

Ceramic crystal structures, defects, diffusion and transport. Phase equilibria and microstructures. Powder packing. Thermal, electronic, optical and magnetic properties of ceramics.

MAT E 322. Introduction to Ceramic Processing.

(2-3) Cr. 3. S. *Prereq: MAT E 216*

Synthesis and characterization of ceramic powders. Colloidal phenomena, rheology of suspensions, ceramic forming methods, and drying. High temperature ceramic reactions, liquid and solid-state sintering, grain growth, microstructure development. Processing/microstructure/property relationships.

MAT E 332. Semiconductor Materials and Devices.

(Cross-listed with E E). (3-0) Cr. 3. S. *Prereq: PHYS 222; MAT E majors: MAT E 317; CPR E and E E majors: E E 230*

Introduction to semiconductor material and device physics. Quantum mechanics and band theory of semiconductors. Charge carrier distributions, generation/recombination, transport properties. Physical and electrical properties and fabrication of semiconductor devices such as MOSFETs, bipolar transistors, laser diodes and LED's.

MAT E 334. Electronic & Magnetic Properties of Metallic Materials.

(3-0) Cr. 3. S. *Prereq: MAT E 317*

Electronic conduction in metals and the properties of conducting materials. Quantum mechanical behavior of free electrons and electrons in potentials wells, bonds and lattices. Development of the band theory of electron states in solids and the Free and Nearly Free Electron models. Density-of-states in energy bands and the Fermi-Dirac statistics of state occupancy. Quantum mechanical model of metallic conduction; Brillouin zones and Fermi surfaces. Additional topics include the thermal properties of metals, electron phase transitions in metallic alloys and the BCS theory of superconductivity. Classical and quantum mechanical treatment of the origins of magnetism in materials; orbital and spin angular momentum. Theory of magnetic behavior in dia-, para-magnetic, ferromagnetic materials.

MAT E 341. Metals Processing.

(2-2) Cr. 3. F. *Prereq: 215 or 273 or 392, Mat E majors only*

Theory and practice of metal processing, including casting; powder metallurgy; additive manufacturing; rolling; forging; extrusion; drawing; material removal; joining; surface modification; and heat treatment. Use of processing software.

MAT E 343. Physical Metallurgy of Ferrous Alloys.

(3-0) Cr. 3. S. *Prereq: 214, 215 or 273 or 392, credit or enrollment in 311*

Production and processing of ferrous metals. Extraction of pig iron from ore. Steelmaking processes. Equilibrium and nonequilibrium phases in the Fe-C system. Properties and processing of cast irons, plain carbon and alloy steels, stainless and specialty steels. Transformation diagrams, hardenability, and surface treatments. Continuous casting, forging, hot rolling, quenching, and tempering as they apply to ferrous materials. Cost and mechanical performance considerations in cast iron and steel selection and heat treatment.

MAT E 348. Solidification Processes.

(Cross-listed with I E). (2-2) Cr. 3. S. *Prereq: I E 248 and MAT E 273, or MAT E 215*

Theory and applications related to metal casting, welding, polymer processing, powder metallurgy, and composites manufacturing.

MAT E 351. Introduction to Polymeric Materials.

(3-0) Cr. 3. S. *Prereq: MAT E 216, CHEM 331*

Introduction to polymeric materials, synthesis, structure and properties. Relationship between polymer composition, processing and properties.

MAT E 362. Principles of Nondestructive Testing.

(Cross-listed with E M). (3-0) Cr. 3. S. *Prereq: PHYS 112 or PHYS 222*
Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other techniques. Physical bases of tests; materials to which applicable; types of defects detectable; calibration standards, and reliability safety precautions.

MAT E 362L. Nondestructive Testing Laboratory.

(Cross-listed with E M). (0-3) Cr. 1. S. *Prereq: Credit or enrollment in MAT E 362*
Application of nondestructive testing techniques to the detection and sizing of flaws in materials and to the characterization of material's microstructure. Included are experiments in hardness, dye penetrant, magnetic particle, x-ray, ultrasonic and eddy current testing. Field trips to industrial laboratories.

MAT E 370. Toying with Technology.

(Cross-listed with CPR E). (2-2) Cr. 3. F.S. *Prereq: C I 201 or C I 202*
A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on laboratory experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Future K-12 teachers will leave the course with complete lesson plans for use in their upcoming careers.

MAT E 391. Introduction to US Women's roles in Industry and Preparation for Summer Study.

(3-0) Cr. 3. S.
Introduction to the historical role of women as related to US industry, family and community with emphasis on the years 1830 - 1945, but also related to the current climate. Topics completed in 392 with arranged lectures at Brunel University. Orientation for Brunel summer study program. Offered on a satisfactory-fail basis only. Credit for graduation allowable only upon completion of Mat E 392. Meets U.S. Diversity Requirement

MAT E 392. Principles of Materials Science and Engineering.

(3-0) Cr. 3. SS. *Prereq: MAT E 391, CHEM 167 or CHEM 177*
Structure and properties of ceramic, electronic, polymeric and metallic materials, emphasizing differences based on structure and bonding. Phase equilibria and phase transformations. Taught on Brunel University campus. Offered on a satisfactory-fail basis only. Only one of Mat E 215, 273, or 392 may count toward graduation. Meets International Perspectives Requirement.

MAT E 394. Topics in Sustainable Engineering in Italy.

(3-0) Cr. 3. S. *Prereq: Chem 167 or Chem 177*
Fundamentals of sustainable engineering related to biofuels. Basics of food and biofuel chemistry and fluid dynamics. Preparation course for Italy as a case study for food and sustainable engineering. Orientation for summer study abroad program in Torino, Italy. Credit for graduation allowable only upon completion of the following summer's offering of Mat E 316 taught in Italy, along with additional sustainability lessons/tours.

MAT E 396. Summer Internship.

Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services*
Summer professional work period.

MAT E 397. Engineering Internship.

Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services; junior classification*
Professional work period, one semester maximum per academic year.

MAT E 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq: MAT E 298, permission of department and Engineering Career Services*
Second professional work period in the cooperative education program. Students must register for this course before commencing work.

MAT E 401. Materials Engineering Professional Planning.

Cr. R. F. *Prereq: Senior classification in materials engineering*
Preparation for a career in materials engineering or graduate school; experiential learning, resumes, interviewing, Myers-Briggs Type Indicator, leadership, international opportunities, professional ethics, graduate school preparation and opportunities, and alternative career paths (med school, law school, etc.). Offered on a satisfactory-fail basis only.

MAT E 413. Materials Design and Professional Practice I.

(2-2) Cr. 3. F. *Prereq: Senior status in Mat E*
Fundamentals of materials engineering design, information sources, team behavior, professional preparation, quantitative design including finite-element analysis and computer aided design, materials selection, informatics and combinatorial methods. Analysis of design problems, development of solutions, selected case studies. Oral presentation skills. Preparations for spring project.

MAT E 414. Materials Design and Professional Practice II.

(2-2) Cr. 3. S. *Prereq: Senior status in Mat E*
Integration of materials processing, structure/composition, properties and performance principles in materials engineering problems. Multi-scale design of materials, materials processing, case studies including cost analysis, ethics, risk and safety. Team projects specified by either industry or academic partners. Written and oral final project reports.

MAT E 418. Mechanical Behavior of Materials.

(3-0) Cr. 3. S. *Prereq: MAT E 216 and credit or enrollment in E M 324*
Mechanical behavior of ceramics, metals, polymers, and composites. Relationships between materials processing and atomic aspects of elasticity, plasticity, fracture, and fatigue. Life prediction, stress-and failure analysis.

MAT E 425. Glass Science and Engineering.

(2-3) Cr. 3. F. *Prereq: MAT E 216*
Composition, structure, properties manufacturing, and applications of inorganic glasses. Mechanical, structural, thermal, optical, ionic, electronic, and biological applications of inorganic glasses, especially silicate glasses. Contemporary topics in glass science and engineering such as glass optical fiber communication and flat panel display technologies. Laboratory exercises in the preparation and characterization of silicate glasses. Nonmajor graduate credit.

MAT E 432. Microelectronics Fabrication Techniques.

(Dual-listed with M S E 532). (Cross-listed with E E). (2-4) Cr. 4. *Prereq: PHYS 222, MATH 267. E E 332 or MAT E 317 recommended*
Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS ICs and micro-electro-mechanical systems (MEMS).

MAT E 433. Advanced Electronic Materials.

(2-3) Cr. 3. S. *Prereq: MAT E 317*
Charged point defects and formation equations. Non-stoichiometric conductors, dielectric, ferroelectric, and piezoelectric materials and applications. Optical properties, optical spectra of materials, optoelectronic devices. Magnetic and superconducting materials. Contemporary topics in advanced ceramics.

MAT E 442. Structure/Property Relations in Nonferrous Metals.

(3-0) Cr. 3. F. *Prereq: MAT E 215 or 273 or 392*
Processing of metals and alloys to obtain desired mechanical properties by manipulation of their microstructure and composition of constituent phase(s). Relevance of defects to mechanical properties, plastic flow. Strengthening mechanisms in metals and alloys. Microstructure, heat treatment and mechanical properties of engineering alloys. Metal-matrix composites.

MAT E 444. Corrosion and Failure Analysis.

(2-2) Cr. 3. S. *Prereq: MAT E 215 or 273 or 392 and credit or enrollment in MAT E 418*
Corrosion and corrosion control of metallic systems. Corrosion fundamentals, classification of different types of metallic corrosion, corrosion properties of various engineering alloys, corrosion control. Failure analysis. Characteristics of common types of metallic failures, case studies of failures, designing to reduce failure risk.

MAT E 449. Structural Health Monitoring.

(Dual-listed with M S E 549). (Cross-listed with C E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Senior classification in Engineering or permission of instructor*
Every third semester. Introductory and advanced topics in structural health monitoring (SHM) of aeronautical, civil, and mechanical systems. Topics include sensors, signal processing in time and frequency domains, data acquisition and transmission systems, design of integrated SHM solutions, nondestructive evaluation techniques, feature extraction methods, and cutting edge research in the field of SHM. Graduate students will have a supervisory role to assist students in 449 and an additional design project or more in-depth analysis and design.

MAT E 453. Physical and Mechanical Properties of Polymers.

(2-3) Cr. 3. F. *Prereq: MAT E 351*
Overview of polymer chemical composition, microstructure, thermal and mechanical properties, rheology, and principles of polymer materials selection. Intensive laboratory experiments include chemical composition studies, microstructural characterization, thermal analysis, and mechanical testing.

MAT E 454. Polymer Composites and Processing.

(Dual-listed with M S E 554). (3-0) Cr. 3. S. *Prereq: MAT E 351*

Basic concepts in polymer composites, blends, and block copolymers. Phase separation and miscibility, microstructures and mechanical behavior. Fiber reinforced and laminated composites. Viscosity, rheology, viscoelasticity of polymers. Polymer melt processing methods such as injection molding and extrusion; selection of suitable processing methods and their applications.

MAT E 456. Biomaterials.

(Dual-listed with M S E 556). (Cross-listed with B M E). (3-0) Cr. 3. F. *Prereq: MAT E 216 or MAT E 273 or MAT E 392*

Presentation of the basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

MAT E 457. Chemical and Physical Metallurgy of Rare Earth Metals.

(Dual-listed with M S E 557). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: MAT E 311 or CHEM 325 AND CHEM 324 or PHYS 322

Electronic configuration, valence states, minerals, ores, beneficiation, extraction, separation, metal preparation and purification. Crystal structures, phase transformations and polymorphism, and thermochemical properties of rare earth metals. Chemical properties: inorganic and organometallic compounds, alloy chemistry, nature of the chemical bonding. Physical properties: mechanical and elastic properties, magnetic properties, resistivity, and superconductivity.

MAT E 466. Multidisciplinary Engineering Design.

(Cross-listed with A B E, AER E, CPR E, E E, ENGR, I E, M E). (1-4) Cr. 3.

Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and permission of instructor.*

Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

MAT E 467. Multidisciplinary Engineering Design II.

(Cross-listed with AER E, CPR E, E E, ENGR, I E, M E). (1-4) Cr. 3. Repeatable, maximum of 2 times. F.S. *Prereq: Student must be within two semesters of graduation or receive permission of instructor.*

Build and test of a conceptual design. Detail design, manufacturability, test criteria and procedures. Application of design tools such as CAD and CAM and manufacturing techniques such as rapid prototyping. Development and testing of a full-scale prototype with appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

MAT E 481. Computational Modeling of Materials.

(Dual-listed with M S E 581). (3-0) Cr. 3. F. *Prereq: Math 265 and (MatE 311 or ChE 381 or Chem 325 or Phys 304)*

Introduction to the basic methods used in the computational modeling and simulation of materials, from atomistic simulations to methods at the mesoscale. Students will be expected to develop and run sample programs. Topics to be covered include, for example, electronic structure calculations, molecular dynamics, Monte Carlo, phase-field methods, etc.

MAT E 488. Eddy Current Nondestructive Evaluation.

(Dual-listed with M S E 588). (Cross-listed with E E). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: MATH 265 and (MAT E 216 or MAT E 272 or E E 311 or PHYS 364)*

Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

MAT E 490. Independent Study.

Cr. arr. Repeatable.

Investigation of individual research or special topics.

MAT E 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. *Prereq: MAT E 398, permission of department and Engineering Career Services*

Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Materials Science and Engineering (M S E)

Courses primarily for graduate students, open to qualified undergraduates:

M S E 510. Fundamentals of Structure and Chemistry of Materials.

(3-0) Cr. 3. F. *Prereq:* MATH 165, PHYS 221, and CHEM 167

Geometric and algebraic representations of symmetry. Pair distribution function. Structure, chemistry, and basic properties of covalent, ionic, and metallic solids, glasses and liquids, and polymers. Interactions of materials with particles and waves. Relationships between direct and reciprocal spaces. The kinematical theory of diffraction, with an introduction to the dynamical theory.

M S E 519. Magnetism and Magnetic Materials.

(Cross-listed with E E). (3-0) Cr. 3. F. *Prereq:* E E 311 or MAT E 317 or PHYS 364

Magnetic fields, flux density and magnetization. Magnetic materials, magnetic measurements. Magnetic properties of materials. Domains, domain walls, domain processes, magnetization curves and hysteresis. Types of magnetic order, magnetic phases and critical phenomena. Magnetic moments of electrons, theory of electron magnetism. Technological application, soft magnetic materials for electromagnets, hard magnetic materials, permanent magnets, magnetic recording technology, magnetic measurements of properties for materials evaluation.

M S E 520. Thermodynamics and Kinetics in Multicomponent Materials.

(3-0) Cr. 3. F. *Prereq:* MAT E 311 or CHEM 321, MATH 266 or MATH 267

A review of the fundamental principles of heat, work, basic thermodynamic relations, and criteria for equilibrium. Analytical treatments for the thermodynamic description of multicomponent chemical solutions and reacting systems are developed and employed to predict phase equilibria in materials systems. Builds on the thermodynamic construction to treat the kinetics of chemical reactions and phase transformations. Topics include general first order and second order transitions, along with chemical diffusion. Detailed examples involving nucleation and diffusion limited growth, spinodal decomposition, martensitic transformations, magnetic and electric transitions, and glass formation will be considered.

M S E 521. Mechanical Behavior and Manufacturing of Polymers and Composites.

(Cross-listed with M E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* M E 324 or MAT E 272 and E M 324

Effect of chemical structure and morphology on properties. Linear viscoelasticity, damping and stress relaxation phenomena. Structure and mechanics of filler and fiber reinforced composites. Mechanical properties and failure mechanisms. Material selection and designing with polymers. Processing of polymer and composite parts.

M S E 530. Solid State Science.

(3-0) Cr. 3. S. *Prereq:* MAT E 334 or E E 332 or PHYS 322

Development of a quantitative description of the electronic structure of solids starting with fundamentals of atoms, atomic bonding, basic crystallography, and band theory of solids. Continuum properties of solids in response to electromagnetic fields and thermal gradients. Quantitative description of the atomistic properties of solids through electron-electron interactions, electron-phonon interactions, and dipole interactions.

M S E 532. Microelectronics Fabrication Techniques.

(Dual-listed with MAT E 432). (2-4) Cr. 4. *Prereq:* PHYS 222, MATH 267. E E 332 or MAT E 334 recommended

Techniques used in modern integrated circuit fabrication, including diffusion, oxidation, ion implantation, lithography, evaporation, sputtering, chemical-vapor deposition, and etching. Process integration. Process evaluation and final device testing. Extensive laboratory exercises utilizing fabrication methods to build electronic devices. Use of computer simulation tools for predicting processing outcomes. Recent advances in processing CMOS ICs and micro-electro-mechanical systems (MEMS).

M S E 539. Electronic Properties of Materials.

(Cross-listed with E E). (3-0) Cr. 3. *Prereq:* E E 332 or MAT E 334 or PHYS 322

Review of classical and quantum mechanical descriptions of electrons in solids, band theory, metallic conduction, lattice vibrations, semiconductors, semiconductor devices, dielectrics, polarization, dielectric relaxation, crystal anisotropy, ferroelectricity, piezoelectricity, superconductivity, magnetism, device applications.

M S E 540. Mechanical Behavior of Materials.

(3-0) Cr. 3. F. *Prereq:* MAT E 418, MATH 266 or MATH 267

Mechanical behavior of materials with emphasis on micromechanics of deformation in three generic regimes: elasticity, plasticity, and fracture. A materials science approach is followed to understand and model the mechanical behavior that combines continuum mechanics, thermodynamics, kinetics, and microstructure. Some topics include elastic properties of materials, permanent deformation mechanisms at different temperatures (e.g., via dislocation motion and creep), and fracture in ductile and brittle materials. Specific classes of materials that are studied: metals, ceramics, polymers, glasses and composites.

M S E 549. Structural Health Monitoring.

(Dual-listed with MAT E 449). (Cross-listed with C E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* Senior classification in Engineering or permission of instructor

Every third semester. Introductory and advanced topics in structural health monitoring (SHM) of aeronautical, civil, and mechanical systems. Topics include sensors, signal processing in time and frequency domains, data acquisition and transmission systems, design of integrated SHM solutions, nondestructive evaluation techniques, feature extraction methods, and cutting edge research in the field of SHM. Graduate students will have a supervisory role to assist students in 449 and an additional design project or more in-depth analysis and design.

M S E 550. Nondestructive Evaluation.

(Cross-listed with E M). (3-2) Cr. 4. S. *Prereq:* E M 324, MATH 385

Principles of five basic NDE methods and their application in engineering inspections. Materials behavior and simple failure analysis. NDE reliability, and damage-tolerant design. Advanced methods such as acoustic microscopy, laser ultrasonics, thermal waves, and computed tomography are analyzed. Computer-based experiments on a selection of methods: ultrasonics, eddy currents, x-rays are assigned for student completion.

M S E 551. Characterization Methods in Materials Science.

(2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* MAT E 214

Characterization of ceramic, metal, polymer and glassy materials using modern analytical techniques. Spectroscopic (IR, Raman, UV/VIS/NIR, and NMR), thermal (DSC, DTA/TGA, and DMA) methods, mechanical and rheological testing, magnetic and electrical characterization, and powder characterization.

M S E 552. Scanning and Auger Electron Microscopy.

(2-3) Cr. 3. F. *Prereq:* PHYS 222

Characterization of materials using scanning electron microscope (SEM), electron microprobe, and auger spectrometer. Compositional determination using energy and wavelength dispersive x-ray and Auger spectroscopies. Specimen preparation. Laboratory covers SEM operation.

M S E 554. Polymer Composites and Processing.

(Dual-listed with MAT E 454). (3-0) Cr. 3. S. *Prereq:* MAT E 351

Basic concepts in polymer composites, blends, and block copolymers. Phase separation and miscibility, microstructures and mechanical behavior. Fiber reinforced and laminated composites. Viscosity, rheology, viscoelasticity of polymers. Polymer melt processing methods such as injection molding and extrusion; selection of suitable processing methods and their applications.

M S E 556. Biomaterials.

(Dual-listed with MAT E 456). (3-0) Cr. 3. F. *Prereq:* MAT E 216 or MAT E 273 or MAT E 392

Presentation of the basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

M S E 557. Chemical and Physical Metallurgy of Rare Earth Metals.

(Dual-listed with MAT E 457). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: MAT E 311 or CHEM 325 AND CHEM 324 or PHYS 322

Electronic configuration, valence states, minerals, ores, beneficiation, extraction, separation, metal preparation and purification. Crystal structures, phase transformations and polymorphism, and thermochemical properties of rare earth metals. Chemical properties: inorganic and organometallic compounds, alloy chemistry, nature of the chemical bonding. Physical properties: mechanical and elastic properties, magnetic properties, resistivity, and superconductivity.

M S E 564. Fracture and Fatigue.

(Cross-listed with AER E, E M, M E). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* E M 324 and either MAT E 216 or MAT E 273 or MAT E 392.

Undergraduates: Permission of instructor

Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

M S E 569. Mechanics of Composite and Combined Materials.

(Cross-listed with AER E, E M). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: E M 324*

Mechanics of fiber-reinforced materials. Micromechanics of lamina. Macromechanical behavior of lamina and laminates. Strength and interlaminar stresses of laminates. Failure criteria. Stress analysis of laminates. Thermal moisture and residual stresses. Joints in composites.

M S E 570. Toying With Technology for Practicing Teachers.

(Cross-listed with C I). (2-0) Cr. 2. SS. *Prereq: C I 201 or 202 or 505 or equivalent*
A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Other technological advances with K-12 applications will be explored. K-12 teachers will leave the course with complete lesson plans for use in their classrooms.

M S E 581. Computational Modeling of Materials.

(Dual-listed with MAT E 481). (3-0) Cr. 3. F. *Prereq: Math 265 and (MatE 311 or ChE 381 or Chem 325 or Phys 304)*

Introduction to the basic methods used in the computational modeling and simulation of materials, from atomistic simulations to methods at the mesoscale. Students will be expected to develop and run sample programs. Topics to be covered include, for example, electronic structure calculations, molecular dynamics, Monte Carlo, phase-field methods, etc.

M S E 588. Eddy Current Nondestructive Evaluation.

(Dual-listed with MAT E 488). (Cross-listed with E E). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: MATH 265 and (MAT E 216 or MAT E 272 or E E 311 or PHYS 364)*

Electromagnetic fields of various eddy current probes. Probe field interaction with conductors, cracks and other material defects. Ferromagnetic materials. Layered conductors. Elementary inversion of probe signals to characterize defects. Special techniques including remote-field, transient, potential drop nondestructive evaluation and the use of Hall sensors. Practical assignments using a 'virtual' eddy current instrument will demonstrate key concepts.

M S E 590. Special Topics.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

M S E 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:**M S E 601. Materials Seminar.**

(1-0) Cr. 1. Repeatable. F.S. *Prereq: MSE Graduate Student Status*
Seminar course - presentations given on a weekly basis by leading U.S. and International researchers that are experts in their respective fields closely related to Materials Science.

M S E 610. Academic Teaching Practices.

(2-0) Cr. 2. Repeatable. S. *Prereq: Permission of instructor*
Provides instruction and directed experience in undergraduate level teaching practices. Students engage in lesson planning, classroom/laboratory teaching, student and course assessment, web-based lessons, and other aspects of academic course delivery.

M S E 620. Fundamentals of Phase Transformations.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: M S E 520*
Explores various advanced theoretical treatments of the energetics and kinetics of multicomponent materials. Topics include analytical and computational descriptions of thermodynamic quantities, experimental measurement of essential physical properties, analytical and computational treatments of kinetic processes, and the use of theoretical predictions of phase equilibria and evolution in materials systems.

M S E 630. Physical Properties of Solids.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: M S E 530*
Advanced course in the behavior of solids within the framework of solid state physics and chemistry. Includes magnetic, dielectric, transport, and optical phenomena in solids. Influence of phase transformations and crystal symmetry on the physical properties.

M S E 651. Powder Diffraction Methods.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: M S E 510*
Advanced structural characterization of materials using powder diffraction. Production of X-ray and neutron radiation. Review of symmetry, group and kinematical theories of diffraction. Mathematical and computational backgrounds of powder diffraction data. Introduction to single crystal diffraction methods, origin of powder diffraction pattern, history of the technique. Modern powder diffraction methods. Indexing of powder diffraction patterns, figures of merit, precise lattice parameters. Phase problem, determining crystal structures from symmetry and geometry, Patterson, direct and Fourier methods. Rietveld method, precise crystal structures: atomic parameters, qualitative and quantitative phase identification, preferred orientation, grain size, strain, residual stress, order-disorder. Powder diffraction at non-ambient conditions. Applications of powder diffraction: data bases, phase transformations, phase diagrams, local structures, magnetism.

M S E 690. Advanced Topics in Materials Science.

Cr. arr. Repeatable. *Prereq: Permission of instructor*

M S E 697. Engineering Internship.

Cr. R. Repeatable. F.S.SS. *Prereq: Permission of department, graduate classification*

One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

M S E 699. Research.

Cr. arr. Repeatable.

Mathematics (MATH)

Courses primarily for undergraduates:

MATH 010. High School Algebra.

(4-0) Cr. 0. F.S.

For students who do not have adequate facility with topics from high school algebra or do not meet the algebra admission requirement. The course is divided into tracks of one- and two-semester lengths. For most students a diagnostic exam will determine which track must be taken. Students will receive a grade in MATH 25 or MATH 30 respectively depending on the level of material covered. Satisfactory completion of MATH 30 is recommended for students planning to take MATH 140, MATH 143, MATH 145, MATH 150, or MATH 151, while MATH 25 is sufficient for MATH 104, MATH 105, MATH 195, STAT 101 or STAT 105. Students must complete MATH 30 to remove a deficiency in the algebra admission requirement. Topics include signed numbers, polynomials, rational and radical expressions, exponential and logarithmic expressions, and equations. Offered on a satisfactory-fail basis only.

MATH 025. High School Algebra.

(4-0) Cr. 0. F.S.

Students should initially enroll in MATH 10. See description of MATH 10. Offered on a satisfactory-fail basis only.

MATH 030. High School Algebra.

(4-0) Cr. 0. F.S.

Students should initially enroll in MATH 10. See description of MATH 10. Offered on a satisfactory-fail basis only.

MATH 101. Orientation in Mathematics.

(1-0) Cr. 1. F.S.

For new majors. Academic policies and procedures. Campus resources and opportunities available to students. Careers and programs of study in mathematics. Mathematical reasoning, culture and resources. Description of main branches of mathematics. Offered on a satisfactory-fail basis only.

MATH 104. Introduction to Probability.

(3-0) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry*
Permutations, combinations, probability, expected value, and applications. Either MATH 104 or MATH 150 may be counted toward graduation, but not both.

MATH 105. Introduction to Mathematical Ideas.

(3-0) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry*
Topics from mathematics and mathematical applications with emphasis on their nontechnical content.

MATH 140. College Algebra.

(3-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra; 1 year of high school geometry*
Coordinate geometry, quadratic and polynomial equations, functions, graphing, rational functions, exponential and logarithmic functions, inverse functions, quadratic inequalities. Students in the College of Liberal Arts and Sciences may not count MATH 140 toward the General Education Requirements.

MATH 143. Preparation for Calculus.

(4-0) Cr. 4. F.S. *Prereq: Satisfactory performance on placement exam.*
Preparation for MATH 160, 165, and 181. Functions, graphing, basic trigonometry, logarithms, exponentials. Emphasis on co-variational reasoning. Students in the College of Liberal Arts and Sciences may not count MATH 143 toward General Education Requirements. Only one of MATH 143 and 145 may count toward graduation.

MATH 145. Applied Trigonometry.

(3-0) Cr. 3. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry; or minimum of C- in MATH 140.*

Mathematical ideas regarding the conception of space. General trigonometry, with an emphasis on the calculation of lengths, areas, and angles. The Law of Sines and the Law of Cosines. Polar, cylindrical, and spherical coordinate systems. Conic sections and quadric surfaces. Students in the College of Liberal Arts and Sciences may not count Math 145 toward the General Education Requirements. Only one of Math 143 and 145 may count toward graduation.

MATH 150. Discrete Mathematics for Business and Social Sciences.

(2-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry*
Linear equations and inequalities, matrix algebra, linear programming, discrete probability. Either MATH 104 or MATH 150 may be counted toward graduation, but not both.

MATH 151. Calculus for Business and Social Sciences.

(2-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry*
Differential calculus, applications to max-min problems, integral calculus and applications. Will not serve as prerequisite for MATH 265 or MATH 266. Only one of MATH 151, MATH 160, the sequence MATH 165-MATH 166, or the sequence MATH 181-MATH 182 may be counted towards graduation.

MATH 160. Survey of Calculus.

(4-0) Cr. 4. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry; or MATH 143*
Analytic geometry, derivatives and integrals of elementary functions, simple differential equations, and applications. Will not serve as a prerequisite for MATH 265 or MATH 266. Only one of MATH 151, MATH 160, the sequence MATH 165-MATH 166, or the sequence MATH 181-MATH 182 may be counted towards graduation.

MATH 165. Calculus I.

(4-0) Cr. 4. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry; or MATH 143*

Differential calculus, applications of the derivative, introduction to integral calculus. Only one of Math 151 or 160 or the sequence MATH 165-MATH 166, or the sequence MATH 181-MATH 182 may be counted towards graduation.

MATH 166. Calculus II.

(4-0) Cr. 4. F.S.SS. *Prereq: Minimum of C- in MATH 165 or high math placement scores*
Integral calculus, applications of the integral, infinite series, parametric curves and polar coordinates. Only one of MATH 151, MATH 160, the sequence MATH 165-MATH 166, or the sequence MATH 181-MATH 182 may be counted towards graduation.

MATH 166H. Calculus II, Honors.

(4-0) Cr. 4. F. *Prereq: Permission of instructor and MATH 165 or high math placement scores*
Integral calculus, applications of the integral, infinite series, parametric curves, and polar coordinates. Additional material of a theoretical, conceptual, computational, or modeling nature. Some of the work may require more ingenuity than is required for MATH 166. Preference will be given to students in the University Honors Program. Only one of MATH 151 or MATH 160, the sequence MATH 165-MATH 166, or the sequence MATH 181-MATH 182 may be counted towards graduation.

MATH 181. Calculus and Mathematical Modeling for the Life Sciences I.

(4-0) Cr. 4. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry, 1 semester of trigonometry; or MATH 143*
Exponential and logarithm functions, difference equations, derivatives, and applications of the derivative. Examples taken from biology. Only one of MATH 151, MATH 160, the sequence MATH 165- MATH 166, or the sequence MATH 181-MATH 182 may be counted towards graduation.

MATH 182. Calculus and Mathematical Modeling for the Life Sciences II.

(4-0) Cr. 4. S. *Prereq: MATH 181*
Integration, first and second order differential equations, applications of the definite integral, introduction to multivariable calculus. Examples taken from biology. Only one of MATH 151, MATH 160, the sequence MATH 165-MATH 166, or the sequence MATH 181-MATH 182 may be counted towards graduation.

MATH 195. Mathematics for Elementary Education I.

(2-2) Cr. 3. F.S. *Prereq: Satisfactory performance on placement exam, 2 years high school algebra, 1 year of high school geometry, enrollment in elementary education or early childhood education*
Theoretical and hands-on models, mathematical analysis of: elementary students' thinking, standard and non-standard algorithms, and properties related to whole number operations; structure of the decimal system; linear measurement, and two- and three-dimensional geometric shapes and spatial sense; algebra as it relates to elementary curricula. Students in the College of Liberal Arts and Sciences may not count MATH 195 toward General Education Requirements.

MATH 196. Mathematics for Elementary Education II.

(2-2) Cr. 3. F.S. *Prereq: Minimum of C- in MATH 195 and enrollment in elementary education or early childhood education.*
Integer, fraction and decimal operations through analysis of properties, theoretical and hands-on models, mathematical analysis of elementary students' thinking, standard and non-standard algorithms: two- and three-dimensional measurement; probability, statistics, algebra as it relates to elementary curricula/ teaching profession.

MATH 201. Introduction to Proofs.(3-0) Cr. 3. F.S. *Prereq: MATH 166 or MATH 166H*

Logic and techniques of proof including induction. Communicating mathematics. Writing proofs about sets, functions, real numbers, limits, sequences, infinite series and continuous functions.

MATH 207. Matrices and Linear Algebra.(3-0) Cr. 3. F.S.SS. *Prereq: 2 semesters of calculus*

Systems of linear equations, determinants, vector spaces, linear transformations, orthogonality, least-squares methods, eigenvalues and eigenvectors. Emphasis on applications and techniques. Only one of MATH 207 and MATH 317 may be counted toward graduation.

MATH 265. Calculus III.(4-0) Cr. 4. F.S.SS. *Prereq: Minimum of C- in MATH 166 or MATH 166H*

Analytic geometry and vectors, differential calculus of functions of several variables, multiple integrals, vector calculus.

MATH 265H. Calculus III, Honors.(4-0) Cr. 4. F.S. *Prereq: Permission of the instructor; and MATH 166 or MATH 166H*

Analytic geometry and vectors, differential calculus of functions of several variables, multiple integrals, vector calculus. Additional material of a theoretical, conceptual, computational, or modeling nature. Some of the work may require more ingenuity than is required in MATH 265. Preference will be given to students in the University Honors Program.

MATH 266. Elementary Differential Equations.(3-0) Cr. 3. F.S.SS. *Prereq: Minimum of C- in MATH 166 or MATH 166H*

Solution methods for ordinary differential equations. First order equations, linear equations, constant coefficient equations. Eigenvalue methods for systems of first order linear equations. Introduction to stability and phase plane analysis.

MATH 267. Elementary Differential Equations and Laplace Transforms.(4-0) Cr. 4. F.S.SS. *Prereq: Minimum of C- in MATH 166 or MATH 166H*

Same as MATH 266 but also including Laplace transforms and series solutions to ordinary differential equations.

MATH 268. Laplace Transforms.(1-0) Cr. 1. F.S.SS. *Prereq: MATH 266*

Laplace transforms and series solutions to ordinary differential equations. Together, MATH 266 and MATH 268 are the same as MATH 267.

MATH 269. Systems of Differential Equations.(1-0) Cr. 1. F.S.SS. *Prereq: Familiarity with ordinary differential equations of first and second order, permission of department.*

Systems portion of MATH 266 and MATH 267: Eigenvalue methods for systems of first order linear equations. Introduction to stability and phase plane analysis. For students supplementing transfer courses in differential equations in order to earn credit in MATH 266 or 267. Students with credit in 266 or 267 may not earn credit in 269.

MATH 290. Independent Study.

Cr. 1-3. Repeatable. *Prereq: Permission of the instructor.*
Independent study.

MATH 290H. Independent Study, Honors.

Cr. 1-3. Repeatable. *Prereq: Permission of the instructor.*
Independent study.

MATH 297. Intermediate Topics for School Mathematics.(2-2) Cr. 3. F. *Prereq: Enrollment in elementary education and minimum of C- in MATH 196*

Mathematical reasoning and topics in Euclidean and non-Euclidean geometry including transformations, congruence, and similarity. Exploration of probability with simulations. Use of technology to learn and teach mathematics.

MATH 301. Abstract Algebra I.(3-0) Cr. 3. F.S. *Prereq: MATH 166 or MATH 166H, MATH 317 or MATH 407, and grade of C- or better in MATH 201*

Theory of groups. Homomorphisms. Quotient groups. Introduction to rings. Emphasis on writing proofs.

MATH 302. Abstract Algebra II.(3-0) Cr. 3. S. *Prereq: MATH 301*

Theory of rings and fields. Introduction to Galois theory. Emphasis on writing proofs.

MATH 304. Combinatorics.(3-0) Cr. 3. F. *Prereq: MATH 166 or MATH 166H; MATH 201 or experience with proofs*

Enumeration strategies involving permutations, combinations, partitions, binomial coefficients, inclusion-exclusion principle, recurrence relations, generating functions. Additional topics selected from probability, algebraic combinatorics, and applications.

MATH 314. Graph Theory.(3-0) Cr. 3. S. *Prereq: MATH 166 or MATH 166H; MATH 201 or experience with proofs*

Structure and extremal properties of graphs. Topics are selected from: trees, networks, colorings, paths and cycles, connectivity, planarity, directed graphs, matchings, Ramsey theory, forbidden structures, enumeration, applications.

MATH 317. Theory of Linear Algebra.(4-0) Cr. 4. F.S. *Prereq: Credit or enrollment in MATH 201*

Systems of linear equations, determinants, vector spaces, inner product spaces, linear transformations, eigenvalues and eigenvectors. Emphasis on writing proofs and results. Only one of MATH 207 and MATH 317 may be counted toward graduation.

MATH 331. Topology.(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: MATH 301*

Set theory, metric spaces, topological spaces, continuity, connectedness, functions, homeomorphisms, compactness, and topological invariants. Examples from surfaces, knots, and various abstract objects. Emphasis on writing proofs.

MATH 341. Introduction to the Theory of Probability and Statistics I.(Cross-listed with STAT). (3-0) Cr. 3. F.S. *Prereq: MATH 265 (or MATH 265H)*

Probability; distribution functions and their properties; classical discrete and continuous distribution functions; multivariate probability distributions and their properties; moment generating functions; simulation of random variables and use of the R statistical package. Credit for both STAT 341 and STAT 447 may not be applied toward graduation.

MATH 342. Introduction to the Theory of Probability and Statistics II.(Cross-listed with STAT). (3-0) Cr. 3. F.S. *Prereq: STAT 341; MATH 207 or MATH 317*

Transformations of random variables; sampling distributions; confidence intervals and hypothesis testing; theory of estimation and hypothesis tests; linear model theory; use of the R statistical package for simulation and data analysis.

MATH 350. Number Theory.(Cross-listed with COM S). (3-0) Cr. 3. S. *Prereq: MATH 201 or COM S 330*

Divisibility, integer representations, primes and divisors, linear diophantine equations, congruences, and multiplicative functions. Applications to cryptography.

MATH 365. Complex Variables with Applications.(3-0) Cr. 3. S. *Prereq: MATH 265*

Functions of a complex variable, including differentiation, integration and series expansions, residues, evaluation of integrals, conformal mapping.

MATH 373. Introduction to Scientific Computing.(3-0) Cr. 3. F. *Prereq: MATH 265*

Vector and matrix programming and graphing in MATLAB for scientific applications. Polynomial interpolation and approximation. Systems of linear equations and numerical linear algebra. Numerical differentiation and integration. Newton methods for solving nonlinear equations and optimization in one and several variables. Fast Fourier transform. Emphasis on effective use of mathematical software and understanding of its strengths and limitations.

MATH 385. Introduction to Partial Differential Equations.(3-0) Cr. 3. F.S. *Prereq: MATH 265 and one of MATH 266, MATH 267*

Separation of variables methods for elliptic, parabolic, and hyperbolic partial differential equations. Topics from Fourier series, Sturm-Liouville theory, Bessel functions, spherical harmonics, and method of characteristics.

MATH 397. Teaching Secondary Mathematics Using University Mathematics.(2-2) Cr. 3. S. *Prereq: MATH 201, MATH 301*

Coursework in university mathematics including calculus, abstract algebra, discrete mathematics, geometry, and other topics as it relates to teaching mathematics in grades 5-12.

MATH 398. Cooperative Education.

Cr. R. Repeatable, maximum of 2 times. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

MATH 407. Applied Linear Algebra.

(Dual-listed with MATH 507). (3-0) Cr. 3. F. *Prereq: MATH 207 or MATH 317*
Advanced topics in applied linear algebra including eigenvalues, eigenvalue localization, singular value decomposition, symmetric and Hermitian matrices, nonnegative and stochastic matrices, matrix norms, canonical forms, matrix functions. Applications to mathematical and physical sciences, engineering, and other fields.

MATH 414. Analysis I.

(3-0) Cr. 3. F.S.SS. *Prereq: Minimum of C- in MATH 201*
A careful development of calculus of functions of one real variable: real number properties and topology, limits, continuity, differentiation, integration, series.

MATH 415. Analysis II.

(3-0) Cr. 3. S. *Prereq: MATH 414; MATH 265; and MATH 317 or MATH 407*
Sequences and series of functions of a real variable, uniform convergence, power series and Taylor series, Fourier series, topology of n-dimensional space, implicit function theorem, calculus of the plane and 3-dimensional space. Additional topics may include metric spaces or Stieltjes or Lebesgue integration.

MATH 421. Logic for Mathematics and Computer Science.

(Cross-listed with COM S). (3-0) Cr. 3. S. *Prereq: MATH 301 or MATH 307 or MATH 317 or COM S 330*

Propositional and predicate logic. Topics selected from Horn logic, equational logic, resolution and unification, foundations of logic programming, reasoning about programs, program specification and verification, model checking and binary decision diagrams, temporal logic and modal logic.

MATH 424. Introduction to High Performance Computing.

(2-2) Cr. 3. F. *Prereq: MATH 265; MATH 207 or MATH 317*
Numerical serial and parallel computing using the Message Passing Interface. Oral and written semester project.

MATH 435. Geometry I.

(3-0) Cr. 3. F. *Prereq: MATH 207 or MATH 317*
Euclidean geometry. Points, lines, circles, triangles, congruence, similarity, properties invariant under rigid motions. Synthetic, analytic, and axiomatic methods.

MATH 436. Geometry II.

(3-0) Cr. 3. S. *Prereq: MATH 435*
Continuation of Euclidean geometry with topics from elliptic, projective, or hyperbolic geometry. Emphasis on analytic methods.

MATH 439. Mathematics of Fractals and Chaos.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: MATH 265 and either MATH 266 or MATH 267*
Iteration of maps; classification of periodic points; Julia sets and the Mandelbrot set; fractals and fractal dimension; chaos.

MATH 481. Numerical Methods for Differential Equations.

(Cross-listed with COM S). (3-0) Cr. 3. S. *Prereq: MATH 265 and either MATH 266 or MATH 267; knowledge of a programming language*
First order Euler method, high order Runge-Kutta method, and multistep method for solving ordinary differential equations. Finite difference and finite element methods for solving partial differential equations. Local truncation error, stability, and convergence for finite difference method. Numerical solution space, polynomial approximation, and error estimate for finite element method.

MATH 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: Permission of instructor.*
No more than 9 credits of Math 490 or Math 490H may be counted toward graduation.

MATH 490H. Independent Study: Honors.

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: Permission of the instructor.*
No more than 9 credits of Math 490 or 490H may be counted toward graduation.

MATH 491. Undergraduate Thesis.

Cr. 2-3.
Writing and presenting a formal mathematics paper. Upon approval by the department, the paper will satisfy the departmental advanced English requirement.

MATH 492. Undergraduate Seminar.

(2-0) Cr. 2. F.S. *Prereq: MATH 317 or MATH 407*
Introduction to independent mathematical thought, with emphasis on oral communication of an advanced topic. Seminar content varies.

MATH 497. Teaching Secondary School Mathematics.

(Cross-listed with C I). (3-0) Cr. 3. F. *Prereq: 15 credits in college mathematics and admission to a teacher licensure program, concurrent enrollment in C I 426 or C I 526; C I 480C*

Theory and methods for teaching mathematics in grades 5-12. Includes critical examination of instructional strategies, curriculum materials, learning tools, assessment methods, Common Core State Standards-Mathematics, and equity issues.

MATH 498. Cooperative Education.

Cr. R. Repeatable, maximum of 2 credits. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification*
Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduates:**MATH 501. Introduction to Real Analysis.**

(3-0) Cr. 3. F. *Prereq: MATH 265 and (MATH 207 or MATH 317)*
A development of the real numbers. Study of metric spaces, completeness, compactness, sequences, and continuity of functions. Differentiation and integration of real-valued functions, sequences of functions, limits and convergence, equicontinuity.

MATH 502. Topology.

(3-0) Cr. 3. S. *Prereq: MATH 414 or MATH 501*
Introduction to general topology. Topological spaces, continuous functions, connectedness, compactness. Topics selected from countability and separation axioms, metrization, and complete metric spaces. Topics in algebraic topology.

MATH 504. Abstract Algebra I.

(3-0) Cr. 3. F. *Prereq: MATH 302*
Algebraic systems and their morphisms, with emphasis on groups and rings.

MATH 505. Abstract Algebra II.

(3-0) Cr. 3. S. *Prereq: MATH 504*
Continuation of Math 504. Algebraic systems and their morphisms, with emphasis on modules and fields.

MATH 507. Applied Linear Algebra.

(Dual-listed with MATH 407). (3-0) Cr. 3. F. *Prereq: MATH 207 or MATH 317*
Advanced topics in applied linear algebra including eigenvalues, eigenvalue localization, singular value decomposition, symmetric and Hermitian matrices, nonnegative and stochastic matrices, matrix norms, canonical forms, matrix functions. Applications to mathematical and physical sciences, engineering, and other fields.

MATH 510. Linear Algebra.

(3-0) Cr. 3. F. *Prereq: MATH 317 or MATH 407 or (MATH 207 and one of MATH 301 or MATH 414)*
Advanced topics in linear algebra including canonical forms; unitary, normal, Hermitian and positive-definite matrices; variational characterizations of eigenvalues.

MATH 511. Functions of a Single Complex Variable.

(3-0) Cr. 3. S. *Prereq: MATH 414 or MATH 501*
Theory of analytic functions, integration, topology of the extended complex plane, singularities and residue theory, maximum principle.

MATH 515. Real Analysis I.

(3-0) Cr. 3. F. *Prereq: MATH 414 or MATH 501*
Lebesgue measure and Lebesgue integral, one variable differentiation theory, Fubini and Tonelli theorems in \mathbb{R}^n , L_p spaces.

MATH 516. Real Analysis II.

(3-0) Cr. 3. S. *Prereq: MATH 515*
Metric spaces, topological spaces, compactness, abstract theory of measure and integral, differentiation of measures, Banach spaces.

MATH 517. Finite Difference Methods.

(3-0) Cr. 3. S. *Prereq: MATH 481 or MATH 561*
Finite difference methods for partial differential equations, with emphasis on parabolic and hyperbolic equations, and other partial differential equations from application areas. Topics include convergence, stability and implementation issues.

MATH 519. Methods of Applied Mathematics I.(3-0) Cr. 3. F. *Prereq:* MATH 414 or MATH 501

Techniques of classical and functional analysis with applications to differential equations and integral equations. Vector spaces, metric spaces, Hilbert and Banach spaces. Sobolev spaces and other function spaces, contraction mapping theorem, distributions, Fourier series and Fourier transform, linear operators, spectral theory of differential and integral operators, Green's functions and boundary value problems, weak solutions of partial differential equations and variational methods, calculus in Banach spaces and applications.

MATH 520. Methods of Applied Mathematics II.(3-0) Cr. 3. S. *Prereq:* MATH 519

Continuation of Math 519.

MATH 525. Numerical Analysis of High Performance Computing.(Cross-listed with COM S, CPR E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* CPR E 308 or MATH 481; *experience in scientific programming; knowledge of FORTRAN or C*

Introduction to parallelization techniques and numerical methods for state-of-the-art high performance computers. A major component will be a final project in an area related to each student's research interests.

MATH 533. Cryptography.(Cross-listed with CPR E, INFAS). (3-0) Cr. 3. S. *Prereq:* MATH 301 or CPR E 310 or COM S 330

Basic concepts of secure communication, DES and AES, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, applications. Relevant material on number theory and finite fields.

MATH 535. Steganography and Digital Image Forensics.(Cross-listed with CPR E, INFAS). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* E E 524 or MATH 317 or MATH 407 or COM S 330

Basic principles of covert communication, steganalysis, and forensic analysis for digital images. Steganographic security and capacity, matrix embedding, blind attacks, image forensic detection and device identification techniques. Related material on coding theory, statistics, image processing, pattern recognition.

MATH 540. Seminar in Mathematics Education.(1-0) Cr. 1. SS. *Prereq:* Enrollment in the Master of School Mathematics program or professional studies in education

Research studies in mathematics learning and teaching, exemplary practices in mathematics education, and current state and national trends in the mathematics curriculum in grades K-12. Students in MSM take each of 540A, 540B, and 540C. Topics are offered on a 3-year cycle..A. Assessment, equity, and teaching of statistics. Offered SS 2017..B. Geometry and discrete mathematics, and problem solving. Offered SS 2018..C. Teaching of analysis, algebra, and the use of technology. Offered SS 2016.

MATH 540A. Seminar in Mathematics Education: Assessment, equity, and teaching of statistics..(1-0) Cr. 1. *Prereq:* Enrollment in the Master of School Mathematics program or professional studies in education

Research studies in mathematics learning and teaching, exemplary practices in mathematics education, and current state and national trends in the mathematics curriculum in grades K-12. Topics are offered on a 3-year cycle. Offered SS 2017.

MATH 540B. Seminar in Mathematics Education: Geometry and discrete mathematics, and problem solving..(1-0) Cr. 1. *Prereq:* Enrollment in the Master of School Mathematics program or professional studies in education

Research studies in mathematics learning and teaching, exemplary practices in mathematics education, and current state and national trends in the mathematics curriculum in grades K-12. Offered on a 3-year cycle. Offered SS 2018.

MATH 540C. Seminar in Mathematics Education: Teaching of analysis, algebra, and the use of technology..(1-0) Cr. 1. *Prereq:* Enrollment in the Master of School Mathematics program or professional studies in education

Research studies in mathematics learning and teaching, exemplary practices in mathematics education, and current state and national trends in the mathematics curriculum in grades K-12. Topics are offered on a 3-year cycle. Offered SS 2016.

MATH 545. Intermediate Calculus.(4-0) Cr. 4. *Prereq:* 3 semesters of calculus and enrollment in the master of school mathematics program

Offered on a 3-year cycle, offered SS. 2016. The fundamental concepts of calculus which are critical to the effective understanding of the material in first year calculus. Emphasis is on a constructivist approach to learning, cooperative groups, problem solving, and use of technology.

MATH 546. Algorithms in Analysis and Their Computer Implementation.(2-2) Cr. 3. *Prereq:* 3 semesters in calculus or concurrent enrollment in 545 and enrollment in the master of school mathematics program

Offered on a 3- year cycle, offered SS. 2016. The use of technology in secondary mathematics with an emphasis on the exploration, creation, and implementation of algorithms.

MATH 547. Discrete Mathematics and Applications.(4-0) Cr. 4. *Prereq:* Enrollment in the master of school mathematics program

Offered on a 3-year cycle, offered SS. 2018. Applications of graph theory, game theory, voting theory, recursion, combinatorics, and algebraic structures. Issues in integrating discrete topics into the secondary curriculum. Use of the computer to explore discrete mathematics.

MATH 549. Intermediate Geometry.(3-0) Cr. 3. *Prereq:* MATH 435 or equivalent and enrollment in the master of school mathematics program

Offered on a 3-year cycle, offered SS. 2018. A study of geometry with emphasis on metrics, the group of isometries, and the group of similarities. Specific spaces studied normally include the Euclidean plane, the 2-sphere, projective 2-space, and hyperbolic geometry. Emphasis on analytical methods. Incorporation of geometry software.

MATH 554. Introduction to Stochastic Processes.(Cross-listed with STAT). (3-0) Cr. 3. F. *Prereq:* STAT 542

Markov chains on discrete spaces in discrete and continuous time (random walks, Poisson processes, birth and death processes) and their long-term behavior. Optional topics may include branching processes, renewal theory, introduction to Brownian motion.

MATH 557. Ordinary Differential Equations and Dynamical Systems.(3-0) Cr. 3. F. *Prereq:* MATH 415 or MATH 501

The initial-value problem, existence and uniqueness theorems, continuous dependence on parameters, linear systems, stability and asymptotic behavior of solutions, linearization, dynamical systems, bifurcations, and chaotic behavior.

MATH 561. Numerical Analysis I.(3-0) Cr. 3. F. *Prereq:* MATH 414 or MATH 501

Approximation theory, including polynomial spline interpolation and best approximation; numerical differentiation and integration; numerical methods for ordinary differential equations.

MATH 562. Numerical Analysis II.(3-0) Cr. 3. S. *Prereq:* MATH 317

Numerical linear algebra including eigenvalue problems; numerical solution of nonlinear equations.

MATH 565. Continuous Optimization.(3-0) Cr. 3. S. *Prereq:* MATH 265 and one of MATH 317, 507, 510

Theory and methods for constrained and unconstrained optimization. Steepest-descent, conjugate gradient, Newton and quasi-Newton, line search and trust-region, first and second order necessary and sufficient conditions, quadratic and general nonlinear programming.

MATH 566. Discrete Optimization.(3-0) Cr. 3. F. *Prereq:* MATH 317 or MATH 507 or MATH 510

Algorithms for linear programming, integer and combinatorial optimization. Linear programming, duality theory, simplex algorithm; the solution of the shortest-path, minimum spanning tree, max-flow/min-cut, minimum cost flow, maximum matching, and traveling salesman problems; integer linear programming, branch-and-bound, local and global search algorithms.

MATH 577. Linear Systems.(Cross-listed with AER E, E E, M E). (3-0) Cr. 3. F. *Prereq:* E E 324 or AER E 331 or MATH 415; and MATH 207

Linear algebra review. Least square method and singular value decomposition. State space modeling of linear continuous-time systems. Solution of linear systems. Controllability and observability. Canonical description of linear equations. Stability of linear systems. State feedback and pole placements. Observer design for linear systems.

MATH 578. Nonlinear Systems.(Cross-listed with AER E, E E, M E). (3-0) Cr. 3. S. *Prereq:* E E 577

Linear vs nonlinear systems. Phase plane analysis. Bifurcation and center manifold theory. Lyapunov stability. Absolute stability of feedback systems. Input-output stability. Passivity theory and feedback linearization. Nonlinear control design techniques.

MATH 590. Independent Study.

Cr. arr. Repeatable.

MATH 591. Orientation for Mathematics Graduate Students I.

(0.5-0) Cr. 0.5. F.

Fall semester orientation seminar. Required for graduate students in Mathematics and Applied Mathematics. Topics include teaching at the university level and communication of mathematics. Offered on a satisfactory-fail basis only.

MATH 592. Orientation for Mathematics Graduate Students II.

(0.5-0) Cr. 0.5. S.

Spring semester orientation seminar. Required for graduate students in Mathematics and Applied Mathematics. Topics include teaching at the university level and communication of mathematics. Offered on a satisfactory-fail basis only.

MATH 595. Special Topics.

Cr. arr. Repeatable.

MATH 599. Creative Component.

Cr. arr.

Courses for graduate students:**MATH 601. Mathematical Logic.**(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: MATH 504*

Model theory of propositional and predicate logic, the Soundness Theorem, the Compactness Theorem, the Goedel-Henkin Completeness Theorem, the Incompleteness Theorem, computability theory. As time permits: modal and temporal logic, set theory (the continuum hypothesis). Emphasis on the relationship between 'provable' and 'true' and the relationship between 'computable' and 'definable'.

MATH 605. Design Theory and Association Schemes.(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: MATH 504*

Combinatorial designs and Latin squares. Construction methods including finite fields. Error-correcting codes. Adjacency matrices and algebraic combinatorics.

MATH 606. Enumerative Combinatorics and Ordered Sets.(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: MATH 504*

Ordered sets and lattices. Generating functions. Moebius inversion and other enumeration methods.

MATH 607. Modern (Structural) Graph Theory.(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: MATH 504*

Structural and extremal theory of graphs. Topics include basic structures (trees, paths and cycles), networks, colorings, connectivity, topological graph theory, Ramsey theory, forbidden graphs and minors, introduction to random graphs, applications.

MATH 608. Extremal Graph Theory.(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: Math 607*

Study of extremal graph problems and methods. Topics include Szemerédi's regularity lemma, generalizations of the theorems of Turan and Ramsey, and the theory of random graphs.

MATH 610. Seminar.

Cr. arr.

MATH 615. General Theory of Algebraic Structures I.(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: MATH 504*

First semester of full-year course. Subalgebras, homomorphisms, congruence relations, and direct products. Lattices and closure operators. Varieties and quasivarieties of algebras, free algebras, Birkhoff's theorems, clones, Mal'cev conditions. Advanced topics.

MATH 616. General Theory of Algebraic Structures II.(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: MATH 615*

Continuation of MATH 615.

MATH 617. Category Theory.(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: MATH 504*

Categories and functors and their applications.

MATH 618. Representation Theory.(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: MATH 504*

Representations of algebraic structures. Content varies by semester.

MATH 624. Manifolds, Tensors and Differential Geometry.(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: MATH 501 or MATH 515*

Topics selected from: Geometry of curves and surfaces. Manifolds, coordinate systems. Tangent and cotangent vectors, vector fields. Tensors, differential forms, Riemannian metrics. Connections, covariant differentiation, curvature tensors.

MATH 633. Functional Analysis.(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: MATH 515*

Fundamental theory of normed linear spaces and algebras, such as topology and continuity, duality and spectral theory, emphasizing aspects that provide a framework for the study of boundary-value problems, eigenvalue problems, harmonic analysis, analytic function theory, and modern operator theory.

MATH 641. Foundations of Probability Theory.(Cross-listed with STAT). (3-0) Cr. 3. F. *Prereq: MATH 414 or MATH 501 or equivalent course.*

Sequences and set theory; Lebesgue measure, measurable functions. Absolute continuity of functions, integrability and the fundamental theorem of Lebesgue integration. General measure spaces, probability measure, extension theorem and construction of Lebesgue-Stieljes measures on Euclidean spaces. Measurable transformations and random variables, induced measures and probability distributions. General integration and expectation, Lp-spaces and integral inequalities. Uniform integrability and absolute continuity of measures. Probability densities and the Radon-Nikodym theorem. Product spaces and Fubini-Tonelli theorems.

MATH 642. Advanced Probability Theory.(Cross-listed with STAT). (3-0) Cr. 3. S. *Prereq: STAT 641, or STAT 543 and MATH 515.*

Probability spaces and random variables. Kolmogorov's consistency theorem. Independence, Borel-Cantelli lemmas and Kolmogorov's 0 - 1 Law. Comparing types of convergence for random variables. Sums of independent random variables, empirical distributions, weak and strong laws of large numbers. Convergence in distribution and its characterizations, tightness, characteristic functions, central limit theorems and Lindeberg-Feller conditions. Conditional probability and expectation. Discrete parameter martingales and their properties and applications.

MATH 645. Advanced Stochastic Processes.

(Cross-listed with STAT). (3-0) Cr. 3. S.

Weak convergence. Random walks and Brownian motion. Martingales. Stochastic integration and Ito's Formula. Stochastic differential equations and applications.

MATH 646. Mathematical Modeling of Complex Physical Systems.

(Cross-listed with PHYS). (3-0) Cr. 3. S.

Modeling of the dynamics of complex systems on multiple scales: Classical and dissipative molecular dynamics, stochastic modeling and Monte-Carlo simulation; coarse grained nonlinear dynamics, interface propagation and spatial pattern formation.

MATH 655. Partial Differential Equations I.(3-0) Cr. 3. F. *Prereq: MATH 515 or MATH 519*

Study of model problems of elliptic, parabolic and hyperbolic types, first order equations, conservation laws, transform methods, introduction to linear partial differential equations of arbitrary order, fundamental solutions.

MATH 656. Partial Differential Equations II.(3-0) Cr. 3. S. *Prereq: MATH 655*

Sobolev spaces, general theory of second order linear elliptic, parabolic and hyperbolic partial differential equations, first order linear hyperbolic systems, variational methods, fixed point methods.

MATH 666. Finite Element Methods.(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: MATH 516 or MATH 520 or MATH 561 or MATH 656*

Weak and variational formulations of elliptic problems; weak derivatives and Sobolev spaces; Lax-Milgram theorem, Bramble-Hilbert lemma; examples of finite element spaces; polynomial approximation theory; error estimates for finite element methods; implementation issues; mixed finite element methods for Stokes problems; applications.

MATH 680. Advanced Topics.

Cr. 3. Repeatable.

MATH 680A. Advanced Topics: Algebra.

Cr. 3. Repeatable.

MATH 680B. Advanced Topics: Analysis.

Cr. 3. Repeatable.

MATH 680C. Advanced Topics: Applied Mathematics.

Cr. 3. Repeatable.

MATH 680D. Advanced Topics: Combinatorics.

Cr. 3. Repeatable.

MATH 680E. Advanced Topics: Differential Equations.

Cr. 3. Repeatable.

MATH 680F. Advanced Topics: Linear Algebra.

Cr. 3. Repeatable.

MATH 680G. Advanced Topics: Logic and Foundations.

Cr. 3. Repeatable.

MATH 680H. Advanced Topics: Number Theory.

Cr. 3. Repeatable.

MATH 680I. Advanced Topics: Numerical Analysis.

Cr. 3. Repeatable.

MATH 680J. Advanced Topics: Optimization.

Cr. 3. Repeatable.

MATH 680K. Advanced Topics: Probability.

Cr. 3. Repeatable.

MATH 680L. Advanced Topics: Topology.

Cr. 3. Repeatable.

MATH 699. Research.

Cr. arr. Repeatable.

Mechanical Engineering (M E)

Courses primarily for undergraduates:

M E 160. Mechanical Engineering Problem Solving with Computer Applications.

(2-2) Cr. 3. F.S. Prereq: M E majors only. MATH 142 or satisfactory scores on Mathematics placement examinations; credit or enrollment in MATH 165. Introduction to the field of Mechanical Engineering through problem-solving in a range of topics including statics, mechanics of materials and thermo-fluids. Techniques to professionally present and communicate solutions. Use of MATLAB computer programming to aid problem solving, including curve fitting and graphing. Only one of M E 160, ENGR 160, Aer E 160, C E 160, CPR E 185, E E 185, S E 185 and I E 148 may count towards graduation.

M E 170. Engineering Graphics and Introductory Design.

(2-2) Cr. 3. F.S. Prereq: Satisfactory scores on mathematics placement assessments; credit or enrollment in MATH 142. Integration of fundamental graphics, computer modeling, and engineering design. Applications of multiview drawings and dimensioning. Techniques for visualizing, analyzing, and communicating 3-D geometries. Application of the design process including written and oral reports. Freehand and computer methods.

M E 190. Learning Communities.

(1-0) Cr. 1. Repeatable. F.S.
Enrollment in M E learning communities.

M E 202. Mechanical Engineering - Professional Planning.

(1-0) Cr. R. F.S. Prereq: Sophomore classification. Preparation for a career in mechanical engineering; discussion of opportunities for leadership, undergraduate research, experiential learning.

M E 220. Global Sustainability.

(Cross-listed with ANTHR, ENV S, GLOBE, MAT E, SOC, T SC). (3-0) Cr. 3. F.S. An introduction to the key global issues in sustainability. Focuses on interconnected roles of energy, materials, human resources, economics, and technology in building and maintaining sustainable systems. Applications discussed will include challenges in both the developed and developing world and will examine the role of technology in a resource-constrained world. Cannot be used for technical elective credit in any engineering department. Meets International Perspectives Requirement.

M E 231. Engineering Thermodynamics I.

(3-0) Cr. 3. F.S.SS. Prereq: MATH 265, CHEM 167, PHYS 222. Fundamental concepts based on zeroth, first and second laws of thermodynamics. Properties and processes for ideal gases and solid-liquid-vapor phases of pure substances. Applications to vapor power cycles. Credit for either M E 231 or 330, but not both, may be applied toward graduation.

M E 270. Introduction to Mechanical Engineering Design.

(1-6) Cr. 3. F.S. Prereq: M E 160 or equivalent, M E 170 or equivalent, PHYS 221. Overview of mechanical engineering design with applications to thermal and mechanical systems. Introduction to current design practices used in industry. Semester-long team project focused on addressing societal needs. Past projects include designing human powered charging systems and products for developing nations.

M E 298. Cooperative Education.

Cr. R. F.S.SS. Prereq: Permission of department. First professional work period in the cooperative education program. Students must register for this course before commencing work.

M E 324. Manufacturing Engineering.

(3-0) Cr. 3. F.S.SS. Prereq: M E 270, E M 324, MAT E 273 and M E 324L or permission of instructor. Fundamentals of manufacturing processes including forming, machining, casting and welding with emphasis on design considerations in manufacturing. Mechanical behavior of metallic materials. Modern manufacturing practices.

M E 324L. Manufacturing Engineering Laboratory.

(0-2) Cr. 1. F.S.SS. Prereq: M E 270, MAT E 273. Laboratory exercises in metrology, mechanical testing (tensile/compression and hardness tests), computer aided design (CAD), machining operations, metal welding, metal casting, and bulk/sheet metal forming.

M E 325. Mechanical Component Design.

(3-0) Cr. 3. F.S.SS. Prereq: M E 170, E M 324, and STAT 305. Philosophy of design and design methodology. Consideration of stresses and failure models useful for static and fatigue loading. Analysis, selection and synthesis of machine elements.

M E 332. Engineering Thermodynamics II.

(3-0) Cr. 3. F.S.SS. Prereq: M E 231. Gas power cycles. Fundamentals of gas mixtures, psychrometry, and thermochemistry. Applications to one-dimensional compressible flow, refrigeration, air conditioning and combustion processes.

M E 335. Fluid Flow.

(3-2) Cr. 4. F.S.SS. Prereq: E M 345, MATH 266 or MATH 267, credit or enrollment in M E 332. Incompressible and compressible fluid flow fundamentals. Dimensional analysis and similitude. Internal and external flow applications. Lab experiments emphasizing concepts in thermodynamics and fluid flow. Written reports are required.

M E 370. Engineering Measurements.

(2-3) Cr. 3. F.S.SS. Prereq: E E 442, STAT 305. Fundamentals of design, selection, and operation of components of measuring systems. Measurement processes, data acquisition systems, analysis of data, and propagation of measurement uncertainty.

M E 396. Summer Internship.

Cr. R. Repeatable. SS. Prereq: Permission of department and Engineering Career Services. Summer professional work period.

M E 397. Engineering Internship.

Cr. R. Repeatable. F.S. Prereq: Permission of department and Engineering Career Services. Professional work period, one semester maximum per academic year.

M E 398. Cooperative Education.

Cr. R. F.S.SS. Prereq: M E 298, permission of department and Engineering Career Services. Second professional work period in the cooperative education program. Students must register for this course before commencing work.

M E 410. Mechanical Engineering Applications of Mechatronics.

(2-2) Cr. 3. S. Prereq: E E 442, E E 448, credit or enrollment in M E 421. Fundamentals of sensor characterization, signal conditioning and motion control, coupled with concepts of embedded computer control. Digital and analog components used for interfacing with computer controlled systems. Mechanical system analysis combined with various control approaches. Focus on automation of hydraulic actuation processes. Laboratory experiences provide hands-on development of mechanical systems.

M E 411. Automatic Controls.

(2-2) Cr. 3. F. Prereq: M E 421. Methods and principles of automatic control. Pneumatic, hydraulic, and electrical systems. Representative applications of automatic control systems. Mathematical analysis of control systems.

M E 412. Ethical Responsibilities of a Practicing Engineer.

(3-0) Cr. 3. F. Prereq: Credit or enrollment in M E 325. The study of ethics in engineering design and the engineering profession. A comprehensive look at when ethical decisions must be made and an approach to make them. The approach takes into account moral, legal, technical, experiential, and standards to aid in ethical decision making. Each area will be studied through lectures, debates, guest speakers, class discussion, and case studies.

M E 413. Fluid Power Engineering.

(Cross-listed with A B E). (2-2) Cr. 3. F. Prereq: Credit or enrollment in E M 378 or M E 335, A B E 216 or M E 270. Properties of hydraulic fluids. Performance parameters of fixed and variable displacement pumps and motors. Hydraulic circuits and systems. Hydrostatic transmissions. Characteristics of control valves. Analysis and design of hydraulic systems for power and control functions.

M E 415. Mechanical Systems Design.

(0-6) Cr. 3. F.S. Prereq: M E 324, M E 325. Mechanical Engineering Capstone Design course. Team approach to solving design problems involving mechanical systems. Teams will use current design practices they will encounter in industry. Document decisions concerning form and function, material specification, manufacturing methods, safety, cost, and conformance with codes and standards. Solution description includes oral and written reports. Projects often worked with industry sponsors.

M E 417. Advanced Machine Design.

(Dual-listed with M E 517). (3-0) Cr. 3. S. *Prereq: M E 325, MAT E 273*
Stress life, strain life, and fracture mechanics approaches to fatigue life and design with metals, polymers and ceramics. Introduction to material selection in design of machine components. Thermal and structural considerations in design of machine components and hybrid materials. Course project and relevant literature review required for graduate credit.

M E 418. Mechanical Considerations in Robotics.

(Dual-listed with M E 518). (3-0) Cr. 3. S. *Prereq: Credit or enrollment in M E 421*
Three dimensional kinematics, dynamics, and control of robot manipulators, hardware elements and sensors. Laboratory experiments using industrial robots.

M E 419. Computer-Aided Design.

(3-0) Cr. 3. F. *Prereq: M E 325*
Theory and applications of computer-aided design. Computer graphics programming, solid modeling, assembly modeling, and finite element modeling. Mechanical simulation, process engineering, rapid prototyping and manufacturing integration.

M E 421. System Dynamics and Control.

(3-2) Cr. 4. F.S.SS. *Prereq: E E 442, E E 448, E M 345, MATH 267*
Modeling and simulation of mechanical, electrical, fluid, and/or thermal systems. Development of equations of motion and dynamic response characteristics in time and frequency domains. Fundamentals of classical control applications, including mathematical analysis and design for closed loop control systems. Introduction to computer interfacing for simulation, data acquisition, and control. Laboratory exercises for hands-on system investigation and control implementation.

M E 423. Creativity and Imagination for Engineering and Design.

(Dual-listed with M E 523). (3-0) Cr. 3. F. *Prereq: Graduate classification*
Broad exposure to the study of creativity, both in scientific research and in engineering design practice. Exploration of the subject includes readings from a variety of fields; in-class discussion and activities; and individual and team projects that enable students to develop their creativity. Graduate students also will do independent research on creativity and develop a related teaching module.

M E 425. Optimization Methods for Complex Designs.

(Dual-listed with M E 525). (3-0) Cr. 3. S. *Prereq: M E 160, MATH 265*
Optimization involves finding the 'best' according to specified criteria. Review of a range of optimization methods from traditional nonlinear to modern evolutionary methods such as Genetic algorithms. Examination of how these methods can be used to solve a wide variety of design problems across disciplines, including mechanical systems design, biomedical device design, biomedical imaging, and interaction with digital medical data. Students will gain knowledge of numerical optimization algorithms and sufficient understanding of the strengths and weaknesses of these algorithms to apply them appropriately in engineering design. Experience includes code writing and off-the-shelf routines. Numerous case-studies of real-world situations in which problems were modeled and solved using advanced optimization techniques.

M E 433. Alternative Energy.

(3-0) Cr. 3. F. *Prereq: PHYS 221/PHYS 222 and CHEM 167*
Basic principles, performance, and cost analysis of alternative energy systems including biofuels, bioenergy, wind, solar, fuel cells, storage and other alternative energy systems. Performance analysis and operating principles of systems and components, and economic analysis for system design and operation will be taught. Emphasis is on alternative energy technologies needed to meet our future energy needs at various scales ranging from household to city to national levels.

M E 436. Heat Transfer.

(3-2) Cr. 4. F.S.SS. *Prereq: M E 335*
Heat transfer by conduction, convection, and radiation. Similarity concepts in heat, mass, and momentum transfer. Methods for determination of heat transfer coefficients. Combined modes of heat transfer. Heat exchangers. Lab experiments emphasizing concepts in thermodynamics and heat transfer. Written reports are required.

M E 437. Introduction to Combustion Engineering.

(3-0) Cr. 3. S. *Prereq: Credit in M E 332 or equivalent and credit or enrollment in M E 335 or equivalent.*
Introduction to the fundamentals of combustion and the analysis of combustion systems for gaseous, liquid, and solid fuels-including biomass fuels. Combustion fundamentals are applied to the analysis of engines; turbines, biomass cookstoves; suspension, fixed-bed, and fluidized-bed furnaces; and other combustion devices.

M E 441. Fundamentals of Heating, Ventilating, and Air Conditioning.

(3-0) Cr. 3. F. *Prereq: Credit or enrollment in M E 436*
Space conditioning and moist air processes. Application of thermodynamics, heat transfer, and fluid flow principles to the analysis of heating, ventilating, and air conditioning components and systems. Performance and specification of components and systems.

M E 442. Heating and Air Conditioning Design.

(1-5) Cr. 3. S. *Prereq: M E 441*
Design criteria and assessment of building environment and energy requirements. Design of heating, ventilating, and air conditioning systems. System control and economic analysis. Oral and written reports required.

M E 444. Elements and Performance of Power Plants.

(3-0) Cr. 3. S. *Prereq: M E 332, credit or enrollment in M E 335*
Basic principles, thermodynamics, engineering analysis of power plant systems. Topics include existing power plant technologies, the advanced energyplex systems of the future, societal impacts of power production, and environmental and regulatory concerns.

M E 448. Fluid Dynamics of Turbomachinery.

(Cross-listed with AER E). (3-0) Cr. 3. S. *Prereq: AER E 311 or M E 335*
Applications of principles of fluid mechanics and thermodynamics in performance analysis and design of turbomachines. Conceptual and preliminary design of axial and radial flow compressors and turbines using velocity triangles and through-flow approaches.

M E 449. Internal Combustion Engines.

(3-1) Cr. 3. F. *Prereq: M E 335*
Basic principles, thermodynamics, combustion, and exhaust emissions of spark-ignition and compression-ignition engines. Laboratory determination of fuel properties and engine performance. Effects of engine components and operating conditions on performance. Written reports required.

M E 451. Engineering Acoustics.

(Cross-listed with E E, E M). (2-2) Cr. 3. Alt. S., offered even-numbered years. *Prereq: PHYS 221 and MATH 266 or MATH 267*
Properties of sound waves and noise metrics (pressure, power levels, etc). Sound sources and propagation. Principles of wave propagation in one-, two-, and three-dimensions. Wave reflection and transmission. Wave propagation in rectangular, cylindrical, and annular ducts. Acoustics fields for model noise sources. Introduction to aerodynamic noise sources in aircraft, aircraft engines, and wind turbines. Selected laboratory experiments.

M E 456. Machine Vision.

(Dual-listed with M E 556). Cr. 3. Repeatable. *Prereq: MATH 317, M E 421 or permission of instructor*
Broad exposure to the study of creativity, both in scientific research and in engineering design practice. Exploration of the subject includes readings from a variety of fields; in-class discussion and activities; and individual and team projects that enable students to develop their creativity. Graduate students also will do independent research on creativity and develop a related teaching module.

M E 466. Multidisciplinary Engineering Design.

(Cross-listed with A B E, AER E, CPR E, E E, ENGR, I E, MAT E). (1-4) Cr. 3. Repeatable. F.S. *Prereq: Student must be within two semesters of graduation and permission of instructor.*
Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

M E 467. Multidisciplinary Engineering Design II.

(Cross-listed with AER E, CPR E, E E, ENGR, I E, MAT E). (1-4) Cr. 3. Repeatable, maximum of 2 times. F.S. *Prereq: Student must be within two semesters of graduation or receive permission of instructor.*
Build and test of a conceptual design. Detail design, manufacturability, test criteria and procedures. Application of design tools such as CAD and CAM and manufacturing techniques such as rapid prototyping. Development and testing of a full-scale prototype with appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

M E 475. Modeling and Simulation.

(3-0) Cr. 3. S. *Prereq: M E 421, credit or enrollment in M E 436*
Introduction to computer solution techniques required to simulate flow, thermal, and mechanical systems. Methods of solving ordinary and partial differential equations and systems of algebraic equations; interpolation, numerical integration; finite difference and finite element methods.

M E 479. Sustainability Science for Engineering Design.

(3-0) Cr. 3. S. *Prereq:* Any engineering design course
 Scientific principles and quantitative methods concerning sustainability. Analysis of environmental issues associated with engineering design and product manufacturing in an economic and social context. Heuristic and analytical methods for assessing the sustainability of existing or potential product/service designs. Application to a design problem in teams.

M E 484. Technology, Globalization and Culture.

(Dual-listed with M E 584). (Cross-listed with WLC). (3-0) Cr. 3. F. *Prereq:* senior classification for M E 484; graduate classification for M E 584

Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

Meets International Perspectives Requirement.

M E 486. Appropriate Technology Design.

(3-0) Cr. 3. F. *Prereq:* M E 231, M E 270, enrollment in M E 335; or permission of instructor.

Hands-on design experience utilizing knowledge acquired in core mechanical engineering courses. Emphasis with engineering problem formulation and solution, oral and written communication, team decision-making and ethical conduct. Design projects include engineering considerations in appropriate technology which have multidisciplinary components in economics and sociology.

M E 490. Independent Study.

Cr. 1-6. Repeatable. *Prereq:* Senior classification

Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490H. Independent Study: Honors.

Cr. 1-6. Repeatable. *Prereq:* Senior classification

Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490J. Independent Study: Thermodynamics and Energy Utilization.

Cr. 1-6. Repeatable. *Prereq:* Senior classification

Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490M. Independent Study: Nuclear Engineering.

Cr. 1-6. Repeatable. *Prereq:* Senior classification

Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490O. Independent Study: Design and Optimization.

Cr. 1-6. Repeatable. *Prereq:* Senior classification

Investigation of topics holding special interest of student and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490P. Dynamic Systems and Controls.

Cr. 1. Repeatable. *Prereq:* Senior classification

Investigation of topics holding special interest of student and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490Q. Independent Study: Materials Processing and Mechanics.

Cr. 1-6. Repeatable. *Prereq:* Senior classification

Investigation of topics holding special interest of student and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490R. Independent Study: Thermo-fluids.

Cr. 1-6. Repeatable. *Prereq:* Senior classification

Investigation of topics holding special interest of student and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490S. Independent Study: Emerging Areas.

Cr. 1-6. Repeatable. *Prereq:* Senior classification

Investigation of topics holding special interest of student and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. *Prereq:* M E 298, permission of department and Engineering Career Services

Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduates:

M E 511. Advanced Control Design.

(3-0) Cr. 3. S. *Prereq:* M E 411

Application of control design methods using continuous, discrete, and frequency-based models. Approaches include classical, pole assignment, model reference, internal model, and adaptive control methods. Mechanical design projects.

M E 517. Advanced Machine Design.

(Dual-listed with M E 417). (3-0) Cr. 3. S. *Prereq:* M E 325, M A T E 273

Stress life, strain life, and fracture mechanics approaches to fatigue life and design with metals, polymers and ceramics. Introduction to material selection in design of machine components. Thermal and structural considerations in design of machine components and hybrid materials. Course project and relevant literature review required for graduate credit.

M E 518. Mechanical Considerations in Robotics.

(Dual-listed with M E 418). (3-0) Cr. 3. S. *Prereq:* Credit or enrollment in M E 421

Three dimensional kinematics, dynamics, and control of robot manipulators, hardware elements and sensors. Laboratory experiments using industrial robots.

M E 520. Material and Manufacturing Considerations in Design.

(3-0) Cr. 3. F. *Prereq:* M E 324, M E 325

Integration of materials, design and manufacturing. Materials selection. Design for assembly and manufacturing (DFMA). Design and redesign to facilitate cost-effective manufacturing using material selection and DFMA software.

M E 521. Mechanical Behavior and Manufacturing of Polymers and Composites.

(Cross-listed with M S E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* M E 324 or M A T E 272 and E M 324

Effect of chemical structure and morphology on properties. Linear viscoelasticity, damping and stress relaxation phenomena. Structure and mechanics of filler and fiber reinforced composites. Mechanical properties and failure mechanisms. Material selection and designing with polymers. Processing of polymer and composite parts.

M E 523. Creativity and Imagination for Engineering and Design.

(Dual-listed with M E 423). (3-0) Cr. 3. F. *Prereq:* Graduate classification

Broad exposure to the study of creativity, both in scientific research and in engineering design practice. Exploration of the subject includes readings from a variety of fields; in-class discussion and activities; and individual and team projects that enable students to develop their creativity. Graduate students also will do independent research on creativity and develop a related teaching module.

M E 525. Optimization Methods for Complex Designs.

(Dual-listed with M E 425). (Cross-listed with HCl). (3-0) Cr. 3. S. *Prereq:* M E 160, M A T H 265

Optimization involves finding the 'best' according to specified criteria. Review of a range of optimization methods from traditional nonlinear to modern evolutionary methods such as Genetic algorithms. Examination of how these methods can be used to solve a wide variety of design problems across disciplines, including mechanical systems design, biomedical device design, biomedical imaging, and interaction with digital medical data. Students will gain knowledge of numerical optimization algorithms and sufficient understanding of the strengths and weaknesses of these algorithms to apply them appropriately in engineering design. Experience includes code writing and off-the-shelf routines. Numerous case-studies of real-world situations in which problems were modeled and solved using advanced optimization techniques.

M E 527. Mechanics of Machining and Finishing Processes.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* M E 324

Mechanics of material removal for ductile materials. Shear zone theory. Oblique cutting. Heat transfer in machining. Milling and grinding. Mechanics of material removal for brittle materials. Optimal selection and design of cutting parameters. Control of machining processes. Principles of precision finishing. Design considerations for machining and finishing processes.

M E 528. Micro/Nanomanufacturing.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* M E 324

Concepts and applications of micro/nanotechnology appropriate to the manufacturing field. An overview of micro/nano-fabrication techniques including mechanical, EDM, laser and lithography. MEMS device fabrication. Scaling laws. Top down and bottom up approaches of nanomanufacturing. Experimental or theoretical project leading to potential submission of a manuscript for journal or conference.

M E 530. Advanced Thermodynamics.

(3-0) Cr. 3. F. *Prereq:* M E 332

Fundamentals of thermodynamics from the classical viewpoint with emphasis on the use of the first and second laws for analysis of thermal systems. Generalized thermodynamic relationships. Computer applications of thermodynamic properties and system analysis. Selected topics.

M E 531. Advanced Energy Systems and Analysis.

Cr. 3. Repeatable. *Prereq: any undergraduate thermodynamics course; mathematics through differential equations*
Introduction to energy systems including economic and thermodynamic principles. Various production systems will be analyzed. Application to transportation and building systems will be emphasized. Sustainability, climate change and other current energy system topics.

M E 532. Compressible Fluid Flow.

(Cross-listed with AER E). (3-0) Cr. 3. S. *Prereq: AER E 310, 311 or equivalent*
Thermodynamics of compressible flow. Viscous and inviscid compressible flow equations. One dimensional steady flow; isentropic flow, shocks, expansions. Multidimensional compressible flow aspects. Linear and nonlinear wave analysis and method of characteristics. Subsonic, transonic, supersonic and hypersonic flows.

M E 535. Thermochemical Processing of Biomass.

(Cross-listed with BRT). (3-0) Cr. 3. S. *Prereq: Undergraduate course work in thermodynamics and transport phenomena*
Introduction to thermal and catalytic processes for the conversion of biomass to biofuels and other biobased products. Topics include gasification, fast pyrolysis, hydrothermal processing, syngas to synfuels, and bio-oil upgrading. Application of thermodynamics, heat transfer, and fluid dynamics to bioenergy and biofuels.

M E 536. Advanced Heat Transfer.

(3-0) Cr. 3. S. *Prereq: M E 436*
Advanced treatment of heat transmission by conduction, convection, and radiation.

M E 538. Advanced Fluid Flow.

(3-0) Cr. 3. F. *Prereq: Credit or enrollment in M E 436*
Detailed analysis of incompressible/compressible, viscous/inviscid, laminar/turbulent, and developing fluid flows on a particle/point control volume basis.

M E 542. Advanced Combustion.

(3-0) Cr. 3. S. *Prereq: M E 332 or CH E 381*
Thermochemistry and transport theory applied to combustion. Gas phase equilibrium. Energy balances. Reaction kinetics. Flame temperatures, speed, ignition, and extinction. Premixed and diffusion flames. Combustion aerodynamics. Mechanisms of air pollution.

M E 543. Introduction to Random Vibrations and Nonlinear Dynamics.

(Cross-listed with E M). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: 444*
Vibrations of continuous systems. Nonlinear vibration phenomena, perturbation expansions; methods of multiple time scales and slowly-varying amplitude and phase. Characteristics of random vibrations; random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process. Transmission of random vibration, response of simple single and two-degree-of-freedom systems to stationary random excitation. Fatigue failure due to random excitation.

M E 545. Thermal Systems Design.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: M E 436*
Integrating thermodynamics, fluid mechanics, and heat transfer to model thermal equipment and to simulate thermal systems. Second law and parametric analysis; cost estimation, life cycle analysis and optimization. Some computer programming required.

M E 546. Computational Fluid Mechanics and Heat Transfer I.

(Cross-listed with AER E). (3-0) Cr. 3. F. *Prereq: AER E 310 or M E 335, and programming experience*
Basic concepts of discretization, consistency, and stability. Explicit and implicit methods for ordinary differential equations. Methods for each type of partial differential equation. Iterative solution methods; curvilinear grids. Students will program basic algorithms.

M E 547. Computational Fluid Mechanics and Heat Transfer II.

(Cross-listed with AER E). (3-0) Cr. 3. S. *Prereq: AER E 546 or equivalent*
Application of computational methods to current problems in fluid mechanics and heat transfer. Methods for solving the Navier-Stokes and reduced equation sets such as the Euler, boundary layer, and parabolized forms of the conservation equations. Introduction to relevant aspects of grid generation and turbulence modeling.

M E 552. Advanced Acoustics.

(Cross-listed with E M). (3-0) Cr. 3. F. *Prereq: E M 451*
Theoretical acoustics: wave propagation in fluids; acoustic radiation, diffraction and scattering; nonlinear acoustics; radiation force; cavitation; and ray acoustics.

M E 556. Machine Vision.

(Dual-listed with M E 456). Cr. 3. Repeatable. *Prereq: MATH 317, M E 421 or permission of instructor*
Broad exposure to the study of creativity, both in scientific research and in engineering design practice. Exploration of the subject includes readings from a variety of fields; in-class discussion and activities; and individual and team projects that enable students to develop their creativity. Graduate students also will do independent research on creativity and develop a related teaching module.

M E 557. Computer Graphics and Geometric Modeling.

(Cross-listed with COM S, CPR E). (3-0) Cr. 3. F.S. *Prereq: M E 421, programming experience in C*
Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing.

M E 561. Scanning Probe Microscopy.

(2-1) Cr. 3. Alt. F., offered even-numbered years. *Prereq: First year physics, chemistry*
Introduction to the scanning probe microscope (SPM, also known as atomic force microscope or AFM) and associated measurement techniques. Overview of instrumentation system, basic principles of operation, probe-sample interaction and various operational modes to obtain micro/nanoscale structure and force spectroscopy of material surfaces. Examples of SPM significance and applications in science and engineering research, nanotechnology and other industries. Laboratory work involving use of a scanning probe microscope system is an integral part of the course.

M E 563. Micro and Nanoscale Mechanics.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: E M 324 and M E 325*
Review of Fundamentals: (Elasticity, Electromagnetism, Mechanical response), Mechanics of thermally, electrostatically and magnetically actuated microsystems, Mechanics and design of nanostructured materials, mechanics of surface stress engineering and its implications to sensors and thin film structures.

M E 564. Fracture and Fatigue.

(Cross-listed with AER E, E M, M S E). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: E M 324 and either MAT E 216 or MAT E 273 or MAT E 392. Undergraduates: Permission of instructor*
Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

M E 566. Phase Transformation in Elastic Materials.

(Cross-listed with E M). (3-0) Cr. 3. S. *Prereq: E M 510 or E M 516 or E M 514*
Continuum thermodynamics and kinetics approaches to phase transformations. Phase field approach to stress- and temperature-induced martensitic transformations and twinning at the nanoscale. Nucleation and growth. Nanostructural evaluation. Analytical and numerical solutions. Surface stresses and energy. Surface-induced phase transformations. Large Strain formulation.

M E 573. Random Signal Analysis and Kalman Filtering.

(Cross-listed with AER E, E E). (3-0) Cr. 3. F. *Prereq: E E 324 or AER E 331 or M E 370 or M E 411 or MATH 341*
Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

M E 574. Optimal Control.

(Cross-listed with AER E, E E). (3-0) Cr. 3. S. *Prereq: E E 577*
The optimal control problem. Variational approach. Pontryagin's principle, Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

M E 575. Introduction to Robust Control.

(Cross-listed with AER E, E E). (3-0) Cr. 3. *Prereq: E E 577*
Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H₂, H_∞, and L₁ control problems. Tools for robustness analysis and synthesis.

M E 576. Digital Feedback Control Systems.

(Cross-listed with AER E, E E). (3-0) Cr. 3. F. *Prereq: E E 475 or AER E 432 or M E 411 or MATH 415; and MATH 267*

Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods: root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

M E 577. Linear Systems.

(Cross-listed with AER E, E E, MATH). (3-0) Cr. 3. F. *Prereq: E E 324 or AER E 331 or MATH 415; and MATH 207*

Linear algebra review. Least square method and singular value decomposition. State space modeling of linear continuous-time systems. Solution of linear systems. Controllability and observability. Canonical description of linear equations. Stability of linear systems. State feedback and pole placements. Observer design for linear systems.

M E 578. Nonlinear Systems.

(Cross-listed with AER E, E E, MATH). (3-0) Cr. 3. S. *Prereq: E E 577*

Linear vs nonlinear systems. Phase plane analysis. Bifurcation and center manifold theory. Lyapunov stability. Absolute stability of feedback systems. Input-output stability. Passivity theory and feedback linearization. Nonlinear control design techniques.

M E 580. Virtual Environments, Virtual Worlds, and Application.

(Cross-listed with HCI). (3-0) Cr. 3. F. *Prereq: Senior or Graduate status.*

A systematic introduction to the underpinnings of Virtual Environments (VE), Virtual Worlds, advanced displays and immersive technologies; and an overview of some of the applications areas particularly virtual engineering.

M E 584. Technology, Globalization and Culture.

(Dual-listed with M E 484). (Cross-listed with WLC). (3-0) Cr. 3. F. *Prereq: senior classification for M E 484; graduate classification for M E 584*

Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

Meets International Perspectives Requirement.

M E 590. Special Topics.

Cr. 1-8. Repeatable.

M E 590Q. Special Topics: Independent Literature Investigation.

Cr. 1-8. Repeatable.

M E 590T. Special Topics: Biological and Nanoscale Sciences.

Cr. 1-8. Repeatable.

M E 590U. Special Topics: Complex Fluid Systems.

Cr. 1-8. Repeatable.

M E 590V. Special Topics: Clean Energy Technologies.

Cr. 1-8. Repeatable.

M E 590W. Special Topics: Design and Manufacturing Innovation.

Cr. 1-8. Repeatable.

M E 590Z. Special Topics: Simulation and Visualization.

Cr. 1-8. Repeatable.

M E 599. Creative Component.

Cr. arr. Repeatable.

Courses for graduate students:**M E 600. Seminar.**

Cr. R. Repeatable.

(1-0).

M E 625. Surface Modeling.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: M E 557, programming experience in C*

Theory and implementation of contemporary parametric sculptured surface modeling technology. Non-uniform rational B-spline (NURBS) curves and surfaces. Fundamental computational algorithms. Construction techniques. Advanced modeling topics. Computer projects.

M E 632. Multiphase Flow.

(Cross-listed with CH E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: M E 538*

Single particle, multiparticle and two-phase fluid flow phenomena (gas-solid, liquid-solid and gas-liquid mixtures); particle interactions, transport phenomena, wall effects; bubbles, equations of multiphase flow. Dense phase (fluidized and packed beds) and ducted flows; momentum, heat and mass transfer. Computer solutions.

M E 637. Convection Heat Transfer.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: M E 436*

Convection heat transfer to internal or external flows under laminar or turbulent conditions. Dimensionless parameters. Classical solutions of Newtonian viscous flows. Forced and free convection. Special topics.

M E 638. Radiation Heat Transfer.

(3-0) Cr. 3. F. *Prereq: M E 436*

Techniques for analysis of radiation in enclosures. Radiative properties of surfaces. Radiative transfer in participating media. Combined modes of transfer. Approximate methods of analysis.

M E 647. Advanced Computational Fluid Dynamics.

(Cross-listed with AER E). (3-0) Cr. 3. S. *Prereq: AER E 547*

An examination of current methods in computational fluid dynamics. Differencing strategies. Advanced solution algorithms for unstructured meshes. Grid generation. Construction of higher-order CFD algorithms. Parallel computing. Current applications. Use of state of the art CFD codes.

M E 690. Advanced Topics.

Cr. arr. Repeatable.

Investigation of advanced topics of special interest to graduate students in mechanical engineering.

M E 690G. Advanced Topics: Advanced Machine Design.

Cr. arr. Repeatable.

Investigation of advanced topics of special interest to graduate students in mechanical engineering.

M E 690O. Advanced Topics: Engineering Computation.

Cr. arr. Repeatable.

Investigation of advanced topics of special interest to graduate students in mechanical engineering.

M E 690Q. Advanced Topics: Independent Literature Investigation.

Cr. arr. Repeatable.

Investigation of advanced topics of special interest to graduate students in mechanical engineering.

M E 690T. Advanced Topics: Biological and Nanoscale Sciences.

Cr. arr. Repeatable. F.S.SS.

Investigation of Special Topics: Biological and Nanoscale Sciences of special interest to graduate students in mechanical engineering.

M E 690U. Advanced Topics: Complex Fluid Systems.

Cr. arr. Repeatable. F.S.SS.

Investigation of Special Topics: Complex Fluid Systems of special interest to graduate students in mechanical engineering.

M E 690V. Advanced Topics: Clean Energy Technologies.

Cr. arr. F.S.SS.

Investigation of Special Topics: Clean Energy Technologies of special interest to graduate students in mechanical engineering.

M E 690W. Advanced Topics: Design and Manufacturing Innovation.

Cr. arr. Repeatable.

Investigation of Design & Manufacturing Innovation of special interest to graduate students in mechanical engineering.

M E 690Z. Advanced Topics: Simulation and Visualization.

Cr. arr. Repeatable. F.S.SS.

Investigation of Special Topics: Simulation and Visualization of special interest to graduate students in mechanical engineering.

M E 697. Engineering Internship.

Cr. R. Repeatable. *Prereq: Permission of Director of Graduate Education, graduate classification*

One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

M E 699. Research.

Cr. arr. Repeatable.

Offered on a satisfactory-fail basis only.

Meteorology (MTEOR)

Courses primarily for undergraduates:

MTEOR 107. Severe and Hazardous Weather.

(2-0) Cr. 1. F.

Understanding of atmospheric processes that play a role in creating severe and hazardous weather. Focus on thunderstorms, tornadoes, hurricanes, floods, blizzards, ice storms, and temperature extremes. Impacts on lives and property.

MTEOR 111. Synoptic Applications.

(1-0) Cr. 1. Repeatable. F. *Prereq: Credit or enrollment in MATH 165*

Current weather discussions and introduction to synoptic-scale interpretation of meteorology. Application and use of calculus in meteorology. Course restricted to majors. Others with permission of instructor.

MTEOR 112. Geoscience Orientation.

(Cross-listed with GEOL). (1-0) Cr. 1. F.

Orientation course for students enrolled in the Earth, Wind and Fire Learning Community. Provides an introduction to Iowa State University and meteorology, geology, and Earth science programs for students enrolled in the department's learning community. Activities include academic and social activities, talks and presentations on academic success, resume writing, and study abroad, as well as research talks by faculty members.

MTEOR 160. Water Resources of the World.

(Cross-listed with AGRON, ENV S, GEOL). (3-0) Cr. 3. S.

Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in society and the environment.

MTEOR 201. Introductory Seminar.

Cr. R. F. *Prereq: Credit or enrollment in PHYS 221*

An overview of the atmospheric sciences, the meteorology program at Iowa State, and the major research journals used in the discipline.

MTEOR 206. Introduction to Weather and Climate.

(Cross-listed with AGRON). (3-0) Cr. 3. F.S.

Basic concepts in weather and climate, including atmospheric measurements, radiation, stability, precipitation, winds, fronts, forecasting, and severe weather. Applied topics include global warming, ozone depletion, world climates and weather safety.

MTEOR 227. Computational Meteorology I.

(3-1) Cr. 3. F. *Prereq: Credit or concurrent enrollment in MTEOR 206, credit or concurrent enrollment in PHYS 221*

An introduction to computer programming using FORTRAN with focus on meteorological applications. Emphasis on basics of good programming techniques and style through extensive practice in top-down design, writing, running, and debugging small programs. Topics include operations and functions, selective execution, repetitive execution, arrays, input/output, file processing, and subprograms. This course is designed for majors.

MTEOR 265. Scientific Balloon Engineering and Operations.

(Cross-listed with AER E). (0-2) Cr. 1. Repeatable. F.

Engineering aspects of scientific balloon flights. Integration of science mission objectives with engineering requirements. Operations team certification. FAA and FCC regulations, communications, and command systems. Flight path prediction and control.

MTEOR 298. Cooperative Education.

Cr. R. F.S.S.S. *Prereq: Permission of the department cooperative education coordinator; sophomore classification*

Required of all cooperative education students. Students must register for this course prior to commencing the work period.

MTEOR 301. General Meteorology.

(4-0) Cr. 4. S. *Prereq: MATH 166, credit or enrollment in PHYS 222*

Global distribution of temperature, wind, and atmospheric constituents; atmospheric thermodynamics, radiative transfer, global energy balance, storms and clouds, introductory dynamics.

MTEOR 311. Introduction to Synoptic Meteorology.

(1-2) Cr. 2. F. *Prereq: MTEOR 301*

Concepts of weather map plotting and analysis. Introduction to forecasting and to the use of real-time UNIDATA computer products.

MTEOR 321. Meteorology Internship.

Cr. 1-2. Repeatable, maximum of 3 credits. F.S.S.S. *Prereq: MTEOR 311; junior or senior standing; permission of co-op program coordinator; acceptance by sponsoring agency*

Supervised practical experience in a professional meteorological agency. Experiences may include providing weather information for radio, TV, utilities, government agencies, construction, or agribusiness.

MTEOR 324. Energy and the Environment.

(Cross-listed with ENSCI, ENV S, GEOL). (3-0) Cr. 3. S.

Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, geothermal, biomass, hydroelectric, and solar energy. Biofuels. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, coal ash, mountaintop removal mining, oil drilling, hydraulic fracturing, groundwater contamination, nuclear waste disposal, and global climate change. Carbon sequestration and geoengineering solutions for reducing atmospheric CO₂ concentrations.

MTEOR 341. Atmospheric Physics I.

(3-0) Cr. 3. F. *Prereq: PHYS 222, credit or enrollment in MATH 266, MTEOR 301.*

Basic laws of thermodynamics, thermodynamics of water vapor, mixtures of gases, stability, hydrostatics, cloud physics.

MTEOR 342. Atmospheric Physics II.

(3-0) Cr. 3. S. *Prereq: MTEOR 341*

Precipitation physics, radar, atmospheric radiation, atmospheric optics, atmospheric electricity.

MTEOR 398. Cooperative Education.

Cr. R. F.S.S.S. *Prereq: Permission of the department cooperative education coordinator; junior classification*

Required of all cooperative education students. Students must register for this course prior to commencing the work period.

MTEOR 402. Watershed Hydrology.

(Dual-listed with MTEOR 502). (Cross-listed with ENSCI, GEOL, NREM). (3-3) Cr.

4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

MTEOR 404. Global Change.

(Dual-listed with MTEOR 504). (Cross-listed with AGRON, ENSCI, ENV S). (3-0)

Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Also offered online Alt. F, even-numbered years.

MTEOR 405. Environmental Biophysics.

(Dual-listed with MTEOR 505). (Cross-listed with AGRON, ENSCI). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: MATH 165 or MATH 182 or equivalent and some computer programming experience (any language)*

A description of the physical microenvironment in which organisms live. Emphasis on the movement of energy (heat and radiation) and mass (water and carbon) among organisms, the soil, and atmosphere. Applications to humans, other animals, plants, and plant communities.

MTEOR 406. World Climates.

(Cross-listed with AGRON, ENSCI). (3-0) Cr. 3. S. *Prereq: AGRON 206/MTEOR 206*

Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required.

Meets International Perspectives Requirement.

MTEOR 407. Mesoscale Meteorology.

(Dual-listed with MTEOR 507). (Cross-listed with AGRON). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: Math 166 and Mteor 443*

Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

MTEOR 411. Synoptic Meteorology.

(Dual-listed with MTEOR 511). (1-4) Cr. 3. F. *Prereq: MTEOR 311, Credit or enrollment in MTEOR 454*

Current weather forecasting and discussion. Applications of atmospheric physics and dynamics in real-time weather situations. Use of UNIDATA computer products.

MTEOR 416. Hydrologic Modeling and Analysis.

(Dual-listed with MTEOR 516). (Cross-listed with ENSCI, GEOL). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Four courses in Earth science, meteorology, or engineering; junior standing*

Study of the basic principles of hydrologic modeling, including rainfall-runoff analysis, lumped and distributed modeling, conceptual and physical models, parameter estimation and sensitivity analysis, input and validation data, uncertainty analysis, and the use of models in surface water hydrology. A range of common models are applied to study hydrologic topics such as flood forecasting and land use change impacts. Previous experience with Matlab or other programming language is needed.

MTEOR 417. Mesoscale Forecasting Laboratory.

(1-5) Cr. 3. S. *Prereq: Credit or enrollment in MTEOR 411*

Real-time computer analysis of current weather, with emphasis on small-scale features. Studies of severe weather, lake-effect snow, CSI, cold-air damming.

MTEOR 432. Instrumentation and Measurements.

(2-2) Cr. 3. S. *Prereq: Credit or enrollment in MATH 266, PHYS 222*

Principles of meteorological sensing and data analysis. Thermometry, barometry, hygrometry, anemometry, precipitation measurements, radiometry, radar, remote sensing, visibility, and cloud height. Calibration and measurement uncertainties. Digital signal processing. Field trip to the National Weather Service. Labs emphasize dataloggers and modern weather stations.

MTEOR 443. Dynamic Meteorology I.

(3-0) Cr. 3. S. *Prereq: MTEOR 341*

Conservation laws, governing equations, circulation and vorticity. Development of quasi-geostrophic theory.

MTEOR 452. Climate Modeling.

(Dual-listed with MTEOR 552). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: Mteor 301*

Developing and working with climate models based on fundamental physical principles that govern the climate systems of the Earth and other planets. Emphasis on coupled, nonlinear-system interactions of physical processes such as circulation dynamics, radiative transfer, and cloud/precipitation physics, starting with fairly simple 0- and 1-dimensional analytical and numerical models based on energy, mass, and momentum conservation. Observational study of seasonally evolving weather patterns that form climates around the world.

MTEOR 454. Dynamic Meteorology II.

(3-0) Cr. 3. F. *Prereq: MTEOR 443*

Planetary boundary layer, linear perturbation theory, atmospheric wave motions, baroclinic and convective instability, mesoscale circulations.

MTEOR 471. History of Modern Meteorology.

(Dual-listed with MTEOR 571). (1-0) Cr. 1. Alt. S., offered even-numbered years. *Prereq: MTEOR 341, MTEOR 342, MTEOR 411, MTEOR 443, MTEOR 452*

Development of meteorological theories and numerical weather prediction, discoveries of important meteorological phenomena, and impact of weather and climate on important historical events.

MTEOR 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

MTEOR 490A. Independent Study: Synoptic Meteorology..

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

MTEOR 490B. Independent Study: Dynamic Meteorology..

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

MTEOR 490C. Independent Study: Physical Meteorology..

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

MTEOR 490D. Independent Study: Instrumentation..

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

MTEOR 490E. Independent Study: Hydrology..

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

MTEOR 498. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

MTEOR 499. Senior Research.

(2-0) Cr. 2. F.

Required of all senior meteorology majors. Research projects in collaboration with faculty. Written and oral presentations of results at the end of the semester.

Courses primarily for graduate students, open to qualified undergraduates:**MTEOR 502. Watershed Hydrology.**

(Dual-listed with MTEOR 402). (Cross-listed with ENSCI, GEOL, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

MTEOR 504. Global Change.

(Dual-listed with MTEOR 404). (Cross-listed with AGRON, ENSCI). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Also offered online Alt. F, even-numbered years.

MTEOR 505. Environmental Biophysics.

(Dual-listed with MTEOR 405). (Cross-listed with AGRON, ENSCI). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: MATH 165 or MATH 182 or equivalent and some computer programming experience (any language)*

A description of the physical microenvironment in which organisms live. Emphasis on the movement of energy (heat and radiation) and mass (water and carbon) among organisms, the soil, and atmosphere. Applications to humans, other animals, plants, and plant communities.

MTEOR 507. Mesoscale Meteorology.

(Dual-listed with MTEOR 407). (Cross-listed with AGRON). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: Math 166 and Mteor 443*

Gallus. The physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure. Semester project and in-class presentation required.

MTEOR 511. Synoptic Meteorology.

(Dual-listed with MTEOR 411). (1-4) Cr. 3. F. *Prereq: MTEOR 311, Credit or enrollment in MTEOR 454*

Current weather forecasting and discussion. Applications of atmospheric physics and dynamics in real-time weather situations. Use of UNIDATA computer products.

MTEOR 516. Hydrologic Modeling and Analysis.

(Dual-listed with MTEOR 416). (Cross-listed with ENSCI, GEOL). (2-3) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Four courses in earth science, meteorology, or engineering; junior standing*

Study of the basic principles of hydrologic modeling, including rainfall-runoff analysis, lumped and distributed modeling, conceptual and physical models, parameter estimation and sensitivity analysis, input and validation data, uncertainty analysis, and the use of models in surface water hydrology. A range of common models are applied to study hydrologic topics such as flood forecasting and land use change impacts. Previous experience with Matlab or other programming language is needed.

MTEOR 518. Microwave Remote Sensing.

(Cross-listed with AGRON, E E). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: Math 265 or equivalent*

Microwave remote sensing of Earth's surface and atmosphere using satellite-based or ground-based instruments. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, ocean salinity, and soil moisture.

MTEOR 542. Physical Meteorology.

(3-0) Cr. 3. F. *Prereq:* MTEOR 342, MATH 266, PHYS 222
Planetary atmospheres, radiative equilibrium models, radiative transfer, the upper atmosphere, remote sounding from satellites.

MTEOR 543. Advanced Dynamic Meteorology I.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* MTEOR 455
The first half of a two semester sequence. Governing equations, scale analysis, simple types of wave motion in the atmosphere, instability theory.

MTEOR 544. Advanced Dynamic Meteorology II.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* MTEOR 543
Continuation of 543. General circulation and dynamics of zonally symmetric circulations, atmospheric energetics, nonlinear dynamics of planetary waves.

MTEOR 552. Climate Modeling.

(Dual-listed with MTEOR 452). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* Mteor 301
Developing and working with climate models based on fundamental physical principles that govern the climate systems of the Earth and other planets. Emphasis on coupled, nonlinear-system interactions of physical processes such as circulation dynamics, radiative transfer, and cloud/precipitation physics, starting with fairly simple 0- and 1-dimensional analytical and numerical models based on energy, mass, and momentum conservation. Observational study of seasonally evolving weather patterns that form climates around the world.

MTEOR 571. History of Modern Meteorology.

(Dual-listed with MTEOR 471). (1-0) Cr. 1. Alt. S., offered even-numbered years. *Prereq:* MTEOR 341, MTEOR 342, MTEOR 411, MTEOR 443, MTEOR 452
Development of meteorological theories and numerical weather prediction, discoveries of important meteorological phenomena, and impact of weather and climate on important historical events.

MTEOR 590. Special Topics.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590A. Special Topics: Boundary-layer Meteorology.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590B. Special Topics: Tropical Meteorology.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590C. Special Topics: Mesoscale Meteorology.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590D. Special Topics: Global Climate Systems.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590E. Special Topics: Climate Modeling.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590F. Special Topics: Numerical Weather Prediction.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590G. Special Topics: Satellite Observations.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590H. Special Topics: Statistical Methods in Meteorology.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590I. Special Topics: Field Observations.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590J. Special Topics: Low Frequency Modes.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590K. Special Topics: Cloud Physics.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590L. Special Topics: Atmospheric Radiation.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590M. Special Topics: Hydrology.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590N. Special Topics: Geophysical Fluid Dynamics.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 590O. Special Topics: Radar Meteorology.

Cr. 1-3. Repeatable. *Prereq:* Permission of instructor
Topics of current interest.

MTEOR 595. Graduate Seminar.

(Cross-listed with GEOL). Cr. 1. Repeatable. F.S. *Prereq:* Senior or graduate classification
Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Offered on a satisfactory-fail basis only.

MTEOR 595A. Graduate Seminar: Presentation Required.

(Cross-listed with GEOL). (1-0) Cr. 1. Repeatable. F.S. *Prereq:* Senior or graduate classification
Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Offered on a satisfactory-fail basis only.

MTEOR 595B. Graduate Seminar: Attendance Only.

(Cross-listed with GEOL). Cr. R. Repeatable. F.S. *Prereq:* Senior or graduate classification
Attendance only. Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Offered on a satisfactory-fail basis only.

Courses for graduate students:**MTEOR 605. Boundary-Layer Meteorology.**

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* MTEOR 443 or equivalent-level course in engineering fluids
Atmospheric boundary-layer structure and dynamics. Diurnal and seasonal variations, turbulent fluxes and turbulence kinetic energy. Measurements and empirical relations for wind and temperature near the ground. Numerical simulation and applications to wind energy.

MTEOR 699. Research.

Cr. arr. Repeatable.

Microbiology (MICRO)

Courses primarily for undergraduates:

MICRO 101. Microbial World.

(3-0) Cr. 3. F. *Prereq:* High school biology or equivalent

Introduction to the importance of viruses, bacteria, fungi, archaea and parasites both to humans and to the biosphere. Topics include past and present microbial impact on humans and society, ecology and diversity of microbes, biotechnology and microbial impact on the biosphere.

MICRO 110. Professional and Educational Preparation in Microbiology.

(1-0) Cr. 1. F.

An introduction to curriculum and research opportunities in microbiology at Iowa State. Topics include: easing the transition to life as a university student, development of specific goals, strengthening interpersonal communication, professional portfolio creation and resume building. Offered on a satisfactory-fail basis only.

MICRO 201. Introduction to Microbiology.

(2-0) Cr. 2. F.S. *Prereq:* One semester of college-level biology

Selected topics in microbiology with emphasis on the relationship of microorganisms to human and animal health, agricultural technology, and the environment. With written petition to the chair of the supervisory committee, students who obtain a grade of B or better may substitute 201 for Micro 302 in advanced courses.

MICRO 201L. Introductory Microbiology Laboratory.

(0-2) Cr. 1. F.S. *Prereq:* Credit or enrollment in MICRO 201 or MICRO 302

Basic microbiology laboratory techniques for non-microbiology majors. Credit for either Micro 201L or 302L, but not both, may be applied toward graduation.

MICRO 302. Biology of Microorganisms.

(3-0) Cr. 3. F.S.SS. *Prereq:* BIOL 211, credit or enrollment in BIOL 212; 1 semester of chemistry

Basic cell biology, physiology, metabolism, genetics and ecology of microorganisms, with an emphasis on prokaryotes and viruses, as well as the roles of microorganisms in the environment, disease, agriculture, and industry.

MICRO 302L. Microbiology Laboratory.

(0-3) Cr. 1. F.S. *Prereq:* Credit or enrollment in MICRO 302

Basic microbiology laboratory techniques for majors in microbiology, biological sciences and related fields. Credit for either Micro 201L or 302L, but not both, may be applied toward graduation.

MICRO 310. Medical Microbiology.

(3-0) Cr. 3. F. *Prereq:* MICRO 302 (or MICRO 201 if a B or better was obtained)

Study of infection by bacterial and viral pathogenic agents of humans with an overview of immune responses in controlling disease.

MICRO 310L. Medical Microbiology Laboratory.

(0-3) Cr. 1. F. *Prereq:* MICRO 201 or MICRO 302; MICRO 201L or MICRO 302L; credit or enrollment in MICRO 310

Microbiological tools and techniques to isolate, identify, and characterize medically significant microorganisms in relation to human diseases. Emphasis on the virulence factors of pathogenic organisms as compared to the normal flora.

MICRO 320. Molecular and Cellular Bacteriology.

(4-0) Cr. 4. S. *Prereq:* MICRO 302, BIOL 313, credit or enrollment in CHEM 332

Introductory course integrating physiological and genetic principles influencing bacterial growth, survival, and cellular differentiation. Emphasis is on prokaryotes although unicellular eukaryotes are also discussed. Topics include the structure, function, and assembly of cell components, bioenergetics and metabolism, regulation of gene expression, genetic adaptation, stress tolerance, biofilms, and cell-cell interactions and communication.

MICRO 349. The Genome Perspective in Biology.

(Cross-listed with BIOL, GEN, V PTH). (2-0) Cr. 2. S. *Prereq:* GEN 313 or GEN 320

Analysis of genome, RNA, and protein data using computer technology to answer biological questions on topics ranging from microbial diversity to human health. An introduction for students in the life sciences to the fields of genomics, bioinformatics and systems.

MICRO 353. Introductory Parasitology.

(Cross-listed with BIOL, V PTH). (3-0) Cr. 3. S. *Prereq:* BIOL 212

Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites.

MICRO 374. Insects and Our Health.

(Cross-listed with ENT). (3-0) Cr. 3. S. *Prereq:* 3 credits in biological sciences Identification, biology, and significance of insects and arthropods that affect the health of humans and animals, particularly those that are vectors of disease. Meets International Perspectives Requirement.

MICRO 374L. Insects and Our Health Laboratory.

(Cross-listed with ENT). (0-3) Cr. 1. Alt. S., offered even-numbered years. *Prereq:* Credit or enrollment in ENT 374

Laboratory and field techniques for studying medical or public health entomology, including: collection, identification and maintenance of medically significant arthropods and experimental design and execution related to the biology of arthropods or arthropod-pathogen interactions.

MICRO 381. Environmental Systems I: Introduction to Environmental Systems.

(Cross-listed with BIOL, ENSCI, ENV S). Cr. 3-4. F. *Prereq:* 12 credits of natural science including biology and chemistry

Introduction to the structure and function of natural environmental systems. Emphasis on the analysis of material and energy flows in natural environmental systems and the primary environmental factors controlling these systems.

MICRO 402. Microbial Genetics and Genomics.

(Dual-listed with MICRO 502). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: MICRO 302, Biol 313

The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of both vertical and horizontal genetic information transfer, gene regulation, and genetic approaches to study complex cellular processes. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics.

MICRO 407. Microbiological Safety of Foods of Animal Origins.

(Dual-listed with MICRO 507). (Cross-listed with FS HN). (3-0) Cr. 3. S. *Prereq:* MICRO 420

Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

MICRO 408. Virology.

(3-0) Cr. 3. F. *Prereq:* BIOL 313 or BBMB 301, BIOL 314 recommended

The molecular virology and epidemiology of human, animal, plant and insect viruses.

MICRO 410. Insect-Virus Interactions: a Molecular Perspective.

(Dual-listed with MICRO 510). (Cross-listed with ENT). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* Permission of an instructor.

Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

MICRO 419. Foodborne Hazards.

(Cross-listed with FS HN, TOX). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: MICRO 201 or MICRO 302, a course in biochemistry

Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Only one of FS HN 419 and FS HN 519 may count toward graduation.

MICRO 420. Food Microbiology.

(Cross-listed with FS HN, TOX). (3-0) Cr. 3. F. *Prereq:* MICRO 201 or MICRO 302

Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications.

MICRO 421. Food Microbiology Laboratory.

(Cross-listed with FS HN). (0-6) Cr. 3. F. *Prereq:* MICRO 201 or MICRO 302;

MICRO 201L or MICRO 302L. Credit or enrollment in FS HN/MICRO 420

Standard techniques used for the microbiological examination of foods. Independent and group projects on student-generated questions in food microbiology. Emphasis on oral and written communication and group interaction.

MICRO 430. Prokaryotic Diversity and Ecology.

(Dual-listed with MICRO 530). (Cross-listed with BBMB). (3-0) Cr. 3. Alt. S.,

offered odd-numbered years. *Prereq:* MICRO 302, MICRO 302L

Survey of the diverse groups of prokaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

MICRO 440. Laboratory in Microbial Physiology, Diversity, and Genetics. (Cross-listed with BBMB). (2-6) Cr. 4. F. *Prereq:* MICRO 302, MICRO 302L, CHEM 332, BIOL 313L

Fundamental techniques and theory for studying the cellular mechanisms and diversity of microbial life. Experimental techniques will include isolation and physiological characterization of bacteria that inhabit different environments. Also included are techniques for phylogenetic characterization, measuring gene expression, and genetic manipulation of diverse species of bacteria. Essential components for the effective communication of scientific results are also emphasized.

MICRO 450. Undergraduate Capstone Colloquium.

(2-0) Cr. 2. S. *Prereq:* SP CM 212 and senior standing in Microbiology
Required of all undergraduate majors in microbiology. Students demonstrate mastery of core courses in microbiology through discussion of current literature in microbiology and immunology, issues in scientific conduct, and bioethics in microbiology. Students present current papers in a journal club format and gain experience in writing and reviewing grant proposals.

MICRO 451. Senior Survey in Microbiology.

Cr. R. F. *Prereq:* Junior or Senior standing in Microbiology
Preparations for graduation. Topics include job search strategies, career information, mock interviews, graduate and professional school application processes and guidelines as well as outcomes assessment activities.

MICRO 456. Principles of Mycology.

(Cross-listed with BIOL). (2-3) Cr. 3. F. *Prereq:* 10 credits in biological sciences
Morphology, diversity, and ecology of fungi; their relation to agriculture, industry, and human health.

MICRO 475. Immunology.

(Dual-listed with MICRO 575). (3-0) Cr. 3. S. *Prereq:* MICRO 310
An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 475 or V MPM 520, but not both, may be applied to graduation.

MICRO 475L. Immunology Laboratory.

(1-4) Cr. 1. S. *Prereq:* Credit or enrollment in MICRO 310 or MICRO 475 or MICRO 575
Techniques in primary culture and tumor cell growth, measures of lymphocyte function, serological techniques and flow cytometry. Half semester course.

MICRO 477. Bacterial-Plant Interactions.

(Dual-listed with MICRO 577). (Cross-listed with PL P). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* 3 credits in microbiology or plant pathology
Overview of plant-associated bacteria including their ecology, diversity, and the physiological and molecular mechanisms involved with their interactions with plants. The course covers bacterial plant pathogens and pathogenesis, nitrogen fixation and plant symbioses, biological control and plant growth promotion, bacterial disease diagnosis and management, and approaches to the study of microbial communities in the rhizosphere and on leaves.

MICRO 485. Soil and Environmental Microbiology.

(Dual-listed with MICRO 585). (Cross-listed with AGRON, ENSCI). (2-3) Cr. 3. F. *Prereq:* AGRON 154 or AGRON 402, MICRO 201 (MICRO 201L recommended)
The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

MICRO 487. Microbial Ecology.

(Dual-listed with MICRO 587). (Cross-listed with BIOL, ENSCI). (3-0) Cr. 3. F. *Prereq:* Six credits in biology and 6 credits in chemistry
Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

MICRO 490. Independent Study.

Cr. 1-5. Repeatable, maximum of 6 credits. F.S.SS. *Prereq:* A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor
A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.

MICRO 490H. Independent Study, Honors.

Cr. 1-5. Repeatable, maximum of 6 credits. F.S.SS. *Prereq:* A minimum of 6 credits of 300-level or above coursework in microbiology, permission of instructor
A maximum of 6 credits of Micro 490 may be used toward the total of 128 credits required for graduation.

MICRO 495. Internship.

Cr. 1-2. F.S. *Prereq:* At least 6 credits of 300-level or above coursework in microbiology, approval of academic adviser
Participation in the Cooperative Extension Intern Program or an equivalent work experience. Written report of activities required. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

MICRO 502. Microbial Genetics and Genomics.

(Dual-listed with MICRO 402). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* MICRO 302, BIOL 313
The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of both vertical and horizontal genetic information transfer, gene regulation, and genetic approaches to study complex cellular processes. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics.

MICRO 507. Microbiological Safety of Foods of Animal Origins.

(Dual-listed with MICRO 407). (Cross-listed with FS HN). (3-0) Cr. 3. S. *Prereq:* MICRO 420
Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

MICRO 510. Insect-Virus Interactions: a Molecular Perspective.

(Dual-listed with MICRO 410). (Cross-listed with ENT). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* Permission of an instructor.
Overview of insect-virus interactions including insect immunity to viruses, genetic enhancement of viral insecticides, transgenic mosquitoes, disruption of virus transmission, and the role of insect and virus genomics in combating viral disease of both human and agricultural importance.

MICRO 525. Intestinal Microbiology.

(Cross-listed with V MPM). Cr. 3. Alt. S., offered even-numbered years. *Prereq:* Micro 302, BIOL 313
Overview of commensal microbiota in the health and well-being of vertebrates. Topics include diversity of intestinal structure, microbial diversity/function, innate immune development, community interactions and metabolic diseases associated with alterations of the intestinal microbiome.

MICRO 530. Prokaryotic Diversity and Ecology.

(Dual-listed with MICRO 430). (Cross-listed with BBMB). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* MICRO 302, MICRO 302L
Survey of the diverse groups of prokaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

MICRO 540. Livestock Immunogenetics.

(Cross-listed with AN S, V MPM). (2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq:* AN S 561 or MICRO 575 or V MPM 520
Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

MICRO 551. Microbial Diversity and Phylogeny.

(1-0) Cr. 1. F. *Prereq:* MICRO 302, BIOL 313
Comparisons among the three kingdoms of life (Bacteria, Archaea, and Eukarya). Topics will include metabolism, adaptation, methods of phylogenetic analysis, and comparative genomics.

MICRO 552. Bacterial Molecular Genetics and Physiology.

(1-0) Cr. 1. F. *Prereq:* MICRO 302, BIOL 313
Review of genetics and selected physiological topics of model bacteria.

MICRO 553. Pathogenic Microorganisms.

(1-0) Cr. 1. F. *Prereq:* MICRO 302, BIOL 313
Review and contrast/comparison of common bacterial pathogens of plants and animals and their mechanisms of virulence, including toxins, protein secretion, host invasion and iron acquisition strategies. An overview of eukaryotic cell biology that is relevant to pathogenesis will also be included.

MICRO 554. Virology.

(1-0) Cr. 1. S. *Prereq:* MICRO 302, BIOL 313
Introduction to virus life cycles including entry, gene expression strategies, replication, and mechanisms to modify and overcome host defenses. The roles of specific viruses and sub-viral agents in animal and plant disease will also be included.

MICRO 555. Fungal Biology.

(1-0) Cr. 1. S. Prereq: MICRO 302, BIOL 313

Ecology, genetics, physiology and diversity of fungi, from yeasts to mushrooms, and their importance in human affairs.

MICRO 556. Ecology of Microorganisms.

(1-0) Cr. 1. S. Prereq: MICRO 302, BIOL 313

The study of microorganisms in their natural environments, with a focus on terrestrial and aquatic ecosystems, including eukaryotic hosts; interactions within biofilms and communities, including intercellular communication and symbioses; microbial adaptations to extreme environments; and metagenomic, genomic, molecular and microscopy techniques for the study of microbes in natural systems.

MICRO 575. Immunology.

(Dual-listed with MICRO 475). (Cross-listed with V MPM). (3-0) Cr. 3. S. Prereq: MICRO 310

An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 575 or V MPM 520, but not both, may be applied toward graduation.

MICRO 577. Bacterial-Plant Interactions.

(Dual-listed with MICRO 477). (Cross-listed with PL P). (3-0) Cr. 3. Alt. S., offered even-numbered years. Prereq: 3 credits in microbiology or plant pathology

Overview of plant-associated bacteria including their ecology, diversity, and the physiological and molecular mechanisms involved with their interactions with plants. The course covers bacterial plant pathogens and pathogenesis, nitrogen fixation and plant symbioses, biological control and plant growth promotion, bacterial disease diagnosis and management, and approaches to the study of microbial communities in the rhizosphere and on leaves.

MICRO 585. Soil and Environmental Microbiology.

(Dual-listed with MICRO 485). (Cross-listed with AGRON, ENSCI). (2-3) Cr. 3. F. Prereq: AGRON 154 or AGRON 402, MICRO 201 (MICRO 201L recommended)

The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

MICRO 586. Medical Bacteriology.

(Cross-listed with V MPM). (4-0) Cr. 4. F. Prereq: Permission of instructor

Bacteria associated with diseases of vertebrates, including virulence factors and interaction of host responses.

MICRO 587. Microbial Ecology.

(Dual-listed with MICRO 487). (Cross-listed with EEOB, ENSCI). (3-0) Cr. 3. F.

Prereq: Six credits in biology and 6 credits in chemistry

Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in natural systems.

MICRO 590. Special Topics.

Cr. 1-5. Repeatable. F.S.SS. Prereq: Permission of instructor

Courses for graduate students:**MICRO 604. Seminar.**

(1-0) Cr. 1. Repeatable. F.S.

Course will expose students to the breadth of subdisciplines within microbiology, offer opportunities for direct interaction between the students and the faculty members within the Interdepartmental Microbiology Graduate Program, and promote interactions among the students within the program. Offered on a satisfactory-fail basis only.

MICRO 608. Molecular Virology.

(Cross-listed with PL P, V MPM). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: BBMB 405 or GDCB 511

Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

MICRO 615. Molecular Immunology.

(Cross-listed with BBMB, V MPM). (3-0) Cr. 3. Alt. F., offered odd-numbered years. Prereq: BBMB 405 or BBMB 502

Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signaling pathways leading to expression of genes that control and activate immune function.

MICRO 625. Mechanisms of Bacterial Pathogenesis.

(Cross-listed with V MPM). (4-0) Cr. 4. Alt. S., offered odd-numbered years.

Prereq: Credit in Biochemistry and Microbiology

Review of current concepts in specific areas of microbial pathogenesis including the genetic basis for bacterial disease, genetic regulation and control of virulence factors and their mechanisms of action, and host-pathogen interactions at the cellular and molecular levels. The application of microbial genetics to understanding pathogenesis will be included.

MICRO 626. Advanced Food Microbiology.

(Cross-listed with FS HN, TOX). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: FS HN 420 or FS HN 421 or FS HN 504

Topics of current interest in food microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

MICRO 627. Rapid Methods in Food Microbiology.

(Cross-listed with FS HN, TOX). (2-0) Cr. 2. Alt. S., offered even-numbered years.

Prereq: FS HN 420 or FS HN 421 or FS HN 504

Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests (phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

MICRO 685. Advanced Soil Biochemistry.

(Cross-listed with AGRON, ENSCI). (2-0) Cr. 2. Alt. S., offered even-numbered years. Prereq: AGRON 585

Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

MICRO 690. Current Topics.

Cr. 1-3. Repeatable. F.S.SS. Prereq: Permission of instructor

Colloquia or advanced study of specific topics in a specialized field.

MICRO 690A. Current Topics: Microbiology.

Cr. 1-3. Repeatable. F.S.SS. Prereq: Permission of instructor

Colloquia or advanced study of specific topics in a specialized field.

MICRO 690B. Current Topics: Immunology.

Cr. 1-3. Repeatable. F.S.SS. Prereq: Permission of instructor

Colloquia or advanced study of specific topics in a specialized field.

MICRO 690C. Current Topics: Infectious Diseases.

Cr. 1-3. Repeatable. F.S.SS. Prereq: Permission of instructor

Colloquia or advanced study of specific topics in a specialized field.

MICRO 692. Molecular Biology of Plant-Pathogen Interactions.

(Cross-listed with PL P). (3-0) Cr. 3. Alt. F., offered even-numbered years. Prereq:

PL P 506 or BBMB 405 or GEN 411 or MICRO 402 or strong background in molecular biology

Seminal and current research in molecular and physiological aspects of plant interactions with pathogens, including mechanisms of pathogenesis, host-pathogen recognition and host defense, with an emphasis on critical evaluation of primary literature. Students also complete a research proposal writing and peer review exercise.

MICRO 697. Graduate Research Rotation.

Cr. arr. Repeatable. F.S.

Graduate research projects performed under the supervision of selected faculty members in the Interdepartmental Microbiology major.

MICRO 698. Seminar in Molecular, Cellular, and Developmental Biology.

(Cross-listed with BBMB, GDCB, MCDB, V MPM). (2-0) Cr. 1-2. Repeatable. F.S.

Student and faculty presentations.

MICRO 699. Research.

Cr. arr. Repeatable.

Military Science (M S)

Courses primarily for undergraduates:

M S 101. Introduction to Military Science.

(1-0) Cr. 1. F. *Prereq: Concurrent enrollment in M S 101L required*

Examines the role of a Cadet in the Army Reserve Officer Training Corps and a Lieutenant in the United States Army. The course explores a military culture whose ultimate success is determined by the character and proficiency of its' leaders. Instruction introduces students to the cultural heritage and history of the U.S. Army. Students will begin to understand the structure of the U.S. Army and how it functions as an organization and institution. The curriculum promotes the development of students' communication skills to enhance their ability to transmit ideas. The class examines how the Army's cultural values drive the development of leadership in the Officer Corps. Hands-on activities enable students to gain insight on the skills and abilities required of cadets and officers interacting with civilians and soldiers.

M S 101L. Basic Leadership Laboratory I.

(0-2) Cr. 1. F. *Prereq: Concurrent enrollment in M S 101 required*

Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Students observe and participate in the rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. This concept provides a constant learning environment as they learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Marching, rifle firing, and tactical patrolling; students gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 102. Structure and Function of the U.S. Army.

(1-0) Cr. 1. S. *Prereq: Concurrent enrollment in M S 102L required*

Instructs students on the fundamental skills and proficiencies required of Cadets in the Army Reserve Officer Training Corps and Officers in the United States Army. Allows students to explore the Army culture whose ultimate success is determined by the character and proficiency of its' leaders. Students will gain an insight to the effects of human behavior and communication on the function of the Army's basic unit structures. Special focus is given to the emphasis the Army puts on the development and character of the leader and how that affects the culture and operation of the Army as an institution. Students will develop an understanding of the role that morals and ethics play in becoming an Army Officer and leading American Soldiers. Introduction to basic officer/soldier skills will elucidate the complex role of the Officer in the modern Army.

M S 102L. Basic Leadership Laboratory II.

(0-2) Cr. 1. S. *Prereq: Concurrent enrollment in M S 102 required*

Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. Provides a constant learning environment as they learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Students also learn various military tasks such as marching, rifle firing, and tactical patrolling; gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 150. Army Physical Readiness.

(0-3) Cr. 1. Repeatable. F.S.

This lab is designed to use basic military skills and instruction to develop confidence, leadership, and physical fitness. The team approach is utilized in the instruction and application of Army physical fitness requirements. Students will learn various Army physical fitness techniques as well as how to conduct physical fitness sessions. Teaching locations include Lied Recreation Center, Beyer Hall, State Gym as well as around campus. Full participation in all events will be determined based on students physical and medical eligibility.

M S 201. Principles of Leadership and Communication Skills.

(2-0) Cr. 2. F. *Prereq: Concurrent enrollment in M S 201L required*

Explores the development of leadership and communication skills by understanding and studying the principles, traits, and dynamics of leadership and effective communication techniques. These include; leadership dimensions, human behavior, time management skills, stress management, values and ethics, decision making process, problem solving skills, team building exercises, communication techniques, briefing skills, delegating, nutrition, fitness, and counseling. Leadership assessment programs, role playing, active class participation, speeches, country briefs, and video clips are used to enhance and reinforce the instruction.

M S 201L. Basic Leadership Laboratory III.

(0-2) Cr. 1. F. *Prereq: Concurrent enrollment in M S 201 required*

Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Students observe and participate in the rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. Learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Students also learn various military tasks such as marching, rifle firing, and tactical patrolling; gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 202. Map Reading and Land Navigation.

(2-0) Cr. 2. S. *Prereq: Concurrent enrollment in M S 202L required*

Class focuses on the characteristics and features of the earth's land mass and how to apply different methods of conducting navigation on land. These methods include; by use of topographical maps, compasses, aerial photographs, military maps, symbols, and all their practical application. These navigation techniques are used in class in conjunction with patrolling techniques and squad movement exercises. Students will utilize verbal and non-verbal communication, communication techniques, and briefing techniques during this class. Students are also assigned to read one professional book from the Army Reading List and complete a written review of the book in the Army writing style.

M S 202L. Basic Leadership Laboratory IV.

(0-2) Cr. 1. S. *Prereq: Concurrent enrollment in M S 202 required*

Uses basic military training, missions and scenarios to provide a hands-on method of developing confidence and leadership skills. Students observe and participate in the rotation through various levels of leadership positions at the platoon and squad level within the Army command structure. Learn to communicate effectively and work as a team while assigned to positions at various levels within the organization. Students also learn various military tasks such as marching, rifle firing, and tactical patrolling; gain confidence through rappelling and construction/use of rope bridges; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge (National Guard Facility), Pammel Woods (ISU campus), and ISU fitness centers. Full participation in all events will be determined based on students' physical and medical eligibility.

M S 250. Advanced Army Physical Readiness I.

(0-5) Cr. 2. F. *Prereq: Successfully complete M S 150 and permission of Department Chair*

Students learn to plan and conduct physical fitness sessions, following Army physical fitness readiness requirements. Development of physical fitness plan and leadership of training sessions. Participation determined by students' physical and medical eligibility.

M S 251. Advanced Army Physical Readiness II.

(0-5) Cr. 2. S. *Prereq: Successfully complete M S 150 and M S 250*

Students learn to plan and conduct physical fitness sessions, following Army physical fitness readiness requirements. Development of physical fitness plan, and leadership of training sessions. Participation determined by students' physical and medical eligibility.

M S 283. The U.S. Army in American Society to 1917.

(3-0) Cr. 3. F.

Survey of U.S. Army history focused on the Army's social and cultural interactions from colonial wars up to the First World War. Examines the roles of race and culture in Army structure and operations.

M S 290. Independent Study: Basic Military Study.

Cr. 1-3. Repeatable, maximum of 12 credits. F.S.SS. *Prereq: Permission of the Chair of Military Science Department*

Investigation of an approved topic. Must result in a professional journal-worthy paper on ethics, current military issues, interpersonal communications, or leadership development.

M S 301. Methods of Instructing Military Skills.

(3-0) Cr. 3. F. *Prereq:* Completion of the basic Military Science program, concurrent enrollment in M S 301L, and permission of the Chair of the Military Science Department

Develops student's proficiency in analyzing, planning, and executing complex operations within a military organizational structure. Students are given situational opportunities and then measured on their leadership abilities through systematic feedback. Student's evaluations are based on sixteen leadership dimensions within the realms of values, attributes, skills, and actions. Students develop an understanding of human cultural heritage and history, as it pertains to the armed forces.

M S 301L. Advanced Leadership Laboratory I.

(0-4) Cr. 1. F. *Prereq:* Completion of the basic program, concurrent enrollment in M S 301 and permission of the Chair of the Military Science Department

The lab compliments M S 301 by providing opportunities to practice the lessons from class. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs. Participating in the Water Survival test, Army Physical Fitness test and the Land Navigation test are required.

M S 302. Applied Leadership.

(3-0) Cr. 3. S. *Prereq:* Completion of the basic Military Science program, concurrent enrollment in M S 302L and permission of the Chair of the Military Science Department

Prepares students to attend the Leadership Develop and Assessment Course at Fort Lewis, Washington in which they will be assigned specific and situational tasks to accomplish by providing purpose, motivation, and direction to fellow students across the nation. Students will learn how to identify sixteen leadership dimensions in the under classmen and provide specific feedback on their leadership behaviors. Students will develop their oral communication skills about the plans developed by the class, through small group presentation settings. Students will develop methods of studying human behavior.

M S 302L. Advanced Leadership Laboratory II.

(0-4) Cr. 1. S. *Prereq:* Completion of the basic program, concurrent enrollment in M S 302 and permission of the Chair of the Military Science Department

The lab compliments M S 302 by providing opportunities to practice the lessons from class. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs. Participating in the Water Survival Test, Army Physical Fitness Test and the Land Navigation test required.

M S 401. Seminar: The Military Team.

(3-0) Cr. 3. F. *Prereq:* Completion of the basic program, concurrent enrollment in M S 401L and permission of the Chair of the Military Science Department

Develops student proficiency in analyzing and evaluating leadership behaviors, such as values, attributes, skills, and actions. Students are given situational opportunities to assess leadership and provide feedback to other students placed in leadership roles. Students will be measured by their ability to both give and receive systematic and specific feedback on leadership behaviors. Students will develop their ability to communicate thoughts and ideas orally through small group presentations and group discussions. Students will supervise and evaluate the planning and execution of complex operations within a military organizational structure.

M S 401L. Advanced Leadership Laboratory III.

(0-4) Cr. 1. F. *Prereq:* Completion of the basic program, concurrent enrollment in M S 401 and permission of the Chair of the Military Science Department

The lab compliments the instruction from class by demonstrating the indelible link between personal values and successful leadership. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs.

M S 402. Seminar: The Professional Military Officer.

(3-0) Cr. 3. S. *Prereq:* Completion of the basic program, concurrent enrollment in M S 402L and permission of the Chair of the Military Science Department

Explores the dynamics of leading in the complex situations of current military operations in a contemporary world. Students will examine the differences in customs, courtesies and operational principles in the face of international terrorism. Students will also explore aspects of interaction with nongovernmental organizations, civilians and media in a war zone and foreign national governments. The course uses case studies, scenarios, and practical exercises, which prepare the student to face complex ethical and practical demands of leading soldiers within a multifaceted military organizational structure.

M S 402L. Advanced Leadership Laboratory IV.

(0-4) Cr. 1. S. *Prereq:* Completion of the basic program, concurrent enrollment in M S 402 and permission of the Chair of the Military Science Department

The lab compliments the instruction from class by demonstrating the indelible link between personal values and successful leadership. On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs.

M S 490. Independent Study: Advanced Military Study.

(1-0) Cr. 1. Repeatable, maximum of 4 credits. F.S.SS. *Prereq:* M S 301, M S 302, M S 401 and M S 402 and permission of the Chair of the Military Science Department

Investigation of an approved topic. Must result in a professional journal-worthy paper on ethics, current military issues, interpersonal communications, or leadership development.

Molecular, Cellular and Developmental Biology (MCDB)

Courses primarily for graduate students, open to qualified undergraduates:

MCDB 511. Molecular Genetics.

(Cross-listed with GDCB). (3-0) Cr. 3. S. *Prereq: BIOL 313 and BBMB 405*
The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes.

MCDB 528. Advances in Molecular Cell Biology.

(Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered even-numbered years.
Prereq: Courses in general cell biology and biochemistry
Cell biological processes including cell signaling, cell division, intracellular trafficking, biogenesis of organelles, cell adhesion and motility.

MCDB 533. Advances in Developmental Biology.

(Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: BIOL 314 or Biol 423*
Fundamental principles in multicellular development. Emphasis on cellular and molecular regulation of developmental processes, and experimental approaches as illustrated in the current literature.

MCDB 545. Plant Molecular, Cell and Developmental Biology.

(Cross-listed with GDCB, PLBIO). (3-0) Cr. 3. Alt. F., offered odd-numbered years.
Prereq: Biol 313, BIOL 314, BIOL 330 or BBMB 405
Plant nuclear and organelle genomes; regulation of gene expression; hormone signaling; organization, function, and development of plant cells and subcellular structures; regulation of plant growth and development.

MCDB 590. Special Topics.

Cr. arr. Repeatable.

Courses for graduate students:

MCDB 676. Biochemistry of Gene Expression in Eucaryotes.

(Cross-listed with BBMB). (2-0) Cr. 2. Alt. S., offered even-numbered years.
Prereq: BBMB 404 or BBMB 501, BBMB 405 or BBMB 502 or GDCB 511
Analysis of the biochemical processes involved in expression of eucaryotic genes and the regulation thereof, including RNA polymerase, transcriptional regulatory proteins, enhancers and silencers, chromosome structure, termination, RNA processing, RNA transport, RNA turnover, small RNAs translational regulation, protein turnover.

MCDB 697. Graduate Research Rotation.

Cr. 1-6. Repeatable. F.S.
Graduate research projects performed under the supervision of selected faculty members in the molecular, cellular, and developmental biology program.

MCDB 698. Seminar in Molecular, Cellular, and Developmental Biology.

(Cross-listed with BBMB, GDCB, MICRO, V MPM). (2-0) Cr. 1-2. Repeatable. F.S.
Student and faculty presentations.

MCDB 699. Research.

Cr. arr. Repeatable.

Music (MUSIC)

Courses primarily for undergraduates:

MUSIC 101. Fundamentals of Music.

(1-2) Cr. 2. F.S. *Prereq:* Ability to read elementary musical notation
Notation, recognition, execution and analysis of scales, intervals, triads, and rhythm; key signatures; time signatures; transposition. Open to non-majors only.

MUSIC 102. Introduction to Music Listening.

(3-0) Cr. 3. F.S.SS.
Expansion of the music listening experiences for the general student through greater awareness of differences in techniques of listening, performance media, and materials of the art. The course focuses on the elements of music: rhythm, melody, harmony, form, and style, and how these elements are used in musics of different cultures and time periods. Ability to read or perform music not required. Meets International Perspectives Requirement.

MUSIC 105. Basic Musicianship.

(1-4) Cr. 3. F.S. *Prereq:* Performing arts major status or permission of instructor.
Beginning keyboard techniques, sight-reading, and ear training. Basic materials of music: notation, scales, intervals, key signatures, time signatures, rhythm, and harmony.

MUSIC 111. Wind Ensemble.

(0-3) Cr. 1. Repeatable. F.S. *Prereq:* Open to all students by audition
Emphasis on significant extended compositions for wind and percussion instruments. Performances include formal concerts on campus and the annual tour.

MUSIC 112. Concert Band.

(0-2) Cr. 1. Repeatable. F.S. *Prereq:* Open to all students who have performed on a wind or percussion instrument in high school band or orchestra
Repertoire includes the broad spectrum of band music. Two concerts are presented each semester.

MUSIC 113. Jazz Ensemble.

(0-2) Cr. 1. Repeatable. F.S. *Prereq:* Open to all students by audition
Designed to explore various styles and trends in contemporary jazz.

MUSIC 114. Marching and Pep Bands.

(0-5) Cr. 1. Repeatable.
Performances at athletic events.

MUSIC 114A. Marching and Pep Bands: Marching Band.

(0-5) Cr. 1. Repeatable. F.
Membership determined by audition and band application. Auditions held for woodwind, brass, percussion, flag, and twirler positions. Presentation of pre-game and half time shows at each home football game; additional performances are also scheduled on and off campus. Audition information is listed on the band website (www.music.iastate.edu/org/marching).

MUSIC 114B. Marching and Pep Bands: Pep Band.

(0-5) Cr. 1. Repeatable. S. *Prereq:* Students selected by audition from members of MUSIC 114A.
Performances at basketball games.

MUSIC 115. Symphonic Band.

(0-3) Cr. 1. Repeatable. F.S. *Prereq:* Open to all students by audition
Stresses high quality wind literature. Performances include formal concerts on campus.

MUSIC 118. Applied Music: Non-majors.

(0.5-0) Cr. 1-2. Repeatable. F.S. *Prereq:* Audition, permission of instructor
Applied music for the general student.

MUSIC 118A. Applied Music: Non-majors: Voice.

(0.5-0) Cr. 1-2. Repeatable. F.S. *Prereq:* Audition, permission of instructor
(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 118B. Applied Music: Non-majors: Piano.

(0.5-0) Cr. 1-2. Repeatable. F.S. *Prereq:* Audition, permission of instructor
(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 118C. Applied Music: Non-majors: Organ.

(0.5-0) Cr. 1-2. Repeatable. F.S. *Prereq:* Audition, permission of instructor
(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 118D. Applied Music: Non-majors: Strings.

(0.5-0) Cr. 1-2. Repeatable. F.S. *Prereq:* Audition, permission of instructor
(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 118E. Applied Music: Non-majors: Carillon.

(0.5-0) Cr. 1-2. Repeatable. F.S. *Prereq:* Audition, permission of instructor
(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 118F. Applied Music: Non-majors: Woodwinds.

(0.5-0) Cr. 1-2. Repeatable. F.S. *Prereq:* Audition, permission of instructor
(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 118G. Applied Music: Non-majors: Brass.

(0.5-0) Cr. 1-2. Repeatable. F.S. *Prereq:* Audition, permission of instructor
(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 118I. Applied Music: Non-majors: Percussion.

(0.5-0) Cr. 1-2. Repeatable. F.S. *Prereq:* Audition, permission of instructor
(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 118K. Applied Music: Non-majors: Harpsichord.

(0.5-0) Cr. 1-2. Repeatable. F.S. *Prereq:* Audition, permission of instructor
(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 119. Applied Music for Majors.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
Applied music for music majors.

MUSIC 119A. Applied Music for Majors: Voice.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 119B. Applied Music for Majors: Piano.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 119C. Applied Music for Majors: Organ.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 119D. Applied Music for Majors: Strings.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 119E. Applied Music for Majors: Carillon.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 119F. Applied Music for Majors: Woodwinds.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 119G. Applied Music for Majors: Brass.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 119I. Applied Music for Majors: Percussion.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 119K. Applied Music for Majors: Harpsichord.

(0.5-2) Cr. 1-3. Repeatable. F.S.SS. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 120. Introduction to Music Literature and Styles.

(3-0) Cr. 3. S. *Prereq: MUSIC 221; music major status or permission of instructor*
Directed studies via aural analysis for music majors with emphasis on the materials of music, form and aesthetic issues. Introduction to style and literature of the major performance media in context of historical chronology. Fundamentals of score reading and performance terminology. Only one of Music 120 and 302 can count toward graduation.

MUSIC 127. Class Study in Piano I.

(0-2) Cr. 1. F.S. *Prereq: Music major status or permission of instructor*

Beginning keyboard technique, transposition, harmonization, ensemble and solo repertory, and sight-reading skills.

MUSIC 128. Class Study in Piano II.

(0-2) Cr. 1. F.S. *Prereq: MUSIC 127 or permission of instructor*

Continuation of beginning keyboard technique, transposition, harmonization, ensemble and solo repertory, and sight-reading skills.

MUSIC 131. Vocal Jazz Ensemble: "Off the Record".

(0-2) Cr. 1. Repeatable. *Prereq: Open by audition and permission of instructor; concurrent enrollment in one of the following: MUSIC 141, MUSIC 151, MUSIC 161*

Small mixed chorus specializing in advanced vocal jazz techniques. Performances on and off campus.

MUSIC 141. Lyrica Women's Choir.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all female students by audition*

Large chorus; emphasis on fundamental vocal and choral skills, wide variety of literature. Campus concerts each semester.

MUSIC 151. Oratorio Chorus.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition*

Advanced skills required, high quality literature. Campus concerts each semester, some concerts in conjunction with orchestras. Men's and women's choirs separately and in combination.

MUSIC 151A. Oratorio Chorus: Cantamus Women's Choir.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition*

Advanced skills required, high quality literature. Campus concerts each semester, some concerts in conjunction with orchestras. Men's and women's choirs separately and in combination.

MUSIC 151B. Oratorio Chorus: Statesmen Men's Choir.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition*

Advanced skills required, high quality literature. Campus concerts each semester, some concerts in conjunction with orchestras. Men's and women's choirs separately and in combination.

MUSIC 161. Iowa State Singers.

(0-5) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition*

Concert choir specializing in performance of advanced music literature, Renaissance through contemporary. Campus concerts, annual spring tour.

MUSIC 181. Symphony Orchestra.

(0-4) Cr. 1. Repeatable. F.S. *Prereq: Open to all students by audition*

Reading, preparation, and performance of standard repertoire. Five or six concerts annually plus occasional off-campus appearances.

MUSIC 219. Applied Music: Majors.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

Applied music for music majors.

MUSIC 219A. Applied Music: Majors: Voice.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 219B. Applied Music: Majors: Piano.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 219C. Applied Music: Majors: Organ.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 219D. Applied Music: Majors: Strings.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 219E. Applied Music: Majors: Carillon.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 219F. Applied Music: Majors: Woodwinds.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 219G. Applied Music: Majors: Brass.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 219I. Applied Music: Majors: Percussion.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 219K. Applied Music: Majors: Harpsichord.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 224. Music Theory I.

(3-0) Cr. 3. F. *Prereq: Music major status or permission of instructor; concurrent enrollment in MUSIC 222 recommended*

Brief review of music fundamentals including keys, modes, rhythm and meter. Two-voice species counterpoint as an introduction to voice-leading principles in diatonic harmony. Application of these materials in analysis and four-part writing. Introduction to Finale notation software and other technology used in the study of music.

MUSIC 225. Aural Theory I.

(0-4) Cr. 2. F. *Prereq: Music major status or permission of instructor; credit or enrollment in MUSIC 221*

Aural discrimination of intervals, rhythms and patterns, as demonstrated by proficiency in ear training, sight singing, and related musicianship skills.

MUSIC 227. Class Study in Piano III.

(0-2) Cr. 1. F.S. *Prereq: MUSIC 128 or permission of instructor*

Intermediate keyboard technique, transposition, harmonization, improvisation, repertory, and sight-reading skills. Introduction to score reading, hymn playing, and accompanying at the piano.

MUSIC 228. Class Study in Piano IV.

(0-2) Cr. 1. F.S. *Prereq: MUSIC 227 or permission of instructor*

Continuation of intermediate keyboard technique, transposition, harmonization, improvisation, repertory, score reading, hymn playing, and accompanying at the piano.

MUSIC 234. Music Theory II.

(3-0) Cr. 3. S. *Prereq: MUSIC 221; concurrent enrollment in MUSIC 232 recommended*

Harmonic and melodic materials of tonal music with an emphasis on diatonic harmony. Application of these materials in analysis and writing. Techniques of melodic construction, formal design, and harmonization.

MUSIC 235. Aural Theory II.

(0-3) Cr. 1. S. *Prereq: MUSIC 222; credit or enrollment in MUSIC 231*

Development of sight singing, ear training, and related musicianship skills with emphasis on diatonic harmonic and melodic materials as well as rhythm.

MUSIC 246. Introduction to Music Technology.

(2-0) Cr. 2. F.S. Prereq: MUSIC 101, MUSIC 105, or MUSIC 221, or permission of instructor

Introduction to audio and MIDI applications using a digital audio workstation. Includes fundamentals of audio editing and mixing, MIDI theory, practical projects in software-based musical arrangements and composition.

MUSIC 248. Technology in Music Instruction.

(2-0) Cr. 2. S. Prereq: MUSIC 221 and MUSIC 222

Introduction to computer software applications used in musical arrangements and presentations, practical introduction to audio and MIDI technologies in lab-based music instruction, basic recording/sound reinforcement and music website management. Intended for Music Education Majors.

MUSIC 265. Music in Elementary Education.

(2-0) Cr. 2. F.S. Prereq: HD FS 102 or PSYCH 230

Experiencing and understanding the fundamentals of music through singing, playing classroom instruments, body movement, reading notation, listening, and creative activities. Developing lesson plan strategies and sequence, exploring multicultural musics, integrating music with other subjects in the elementary classroom, and evaluating aspects of musical learning.

MUSIC 266. Introduction to Music Education.

(1-2) Cr. 2. S. Prereq: Concurrent enrollment in MUSIC 280K

Required for first-year majors in music education. Historical, philosophical, and social foundations of music education; music curricula overview including goals of the music program, and contemporary and international curriculum development; psychology of teaching music including discipline techniques. Preparation for required observations in area schools.

MUSIC 280K. Pre-Student Teaching Experience I: Music.

(Cross-listed with C I). Cr. 0.5. Repeatable. S.

Pre-student teaching experience in music in school settings. Permission of Music coordinator required prior to enrollment. Clinical Experience Level 1. Offered on a satisfactory-fail basis only.

MUSIC 290. Special Problems.

Cr. arr. Repeatable. F.S. Prereq: Permission of instructor; 12 credits in music, approval of department head
Independent study.

MUSIC 290A. Special Problems: Education.

Cr. arr. Repeatable. F.S. Prereq: Permission of instructor; 12 credits in music, approval of department head
Independent study in music education.

MUSIC 290B. Special Problems: Theory.

Cr. arr. Repeatable. F.S. Prereq: Permission of instructor; 12 credits in music, approval of department head
Independent stud in music theory.

MUSIC 290C. Special Problems: Composition.

Cr. arr. Repeatable. F.S. Prereq: Permission of instructor; 12 credits in music, approval of department head
Independent study in music composition.

MUSIC 290D. Special Problems: History.

Cr. arr. Repeatable. F.S. Prereq: Permission of instructor; 12 credits in music, approval of department head
Independent study in music history.

MUSIC 290E. Special Problems: Literature.

Cr. arr. Repeatable. F.S. Prereq: Permission of instructor; 12 credits in music, approval of department head
Independent study in music literature.

MUSIC 290F. Special Problems: Applied Music.

Cr. arr. Repeatable. F.S. Prereq: Permission of instructor; 12 credits in music, approval of department head
Independent study in applied music.

MUSIC 290G. Special Problems: Conducting.

Cr. arr. Repeatable. F.S. Prereq: Permission of instructor; 12 credits in music, approval of department head
Independent study in conducting.

MUSIC 290H. Special Problems, Honors.

Cr. arr. Repeatable. F.S. Prereq: Permission of instructor; 12 credits in music, approval of department head
Independent honors project in music.

MUSIC 290J. Special Problems: Business.

Cr. arr. Repeatable. F.S. Prereq: Permission of instructor; 12 credits in music, approval of department head
Independent study in music business.

MUSIC 301. Opera Studio.

Cr. 1-3. Repeatable. F.S. Prereq: Permission of instructor

Study of selected opera scenes, chamber operas, and works from contemporary and classical music theater. Basic stagecraft, role interpretation, production.

MUSIC 301A. Opera Studio: Opera/Operetta.

Cr. 1-3. Repeatable. F.S. Prereq: Permission of instructor

Study of selected opera scenes and chamber operas. Basic stagecraft, role interpretation, production.

MUSIC 301B. Opera Studio: Music Theater.

Cr. 1-3. Repeatable. F.S. Prereq: Permission of instructor

Study of selected works from contemporary and classical music theater. Basic stagecraft, role interpretation, production.

MUSIC 302. Masterpieces of Music and Art in Western Culture..

(3-0) Cr. 3. S. Prereq: MUSIC 102

Exploration of several great works of classical music in light of the artistic culture in which they were composed; and trends in musical styles as well as individual composers' personalities over history through listening and discussion. Some concert attendance is required outside of class. An ability to read music is not required, but is recommended. Non-majors only. Only one of Music 120 and 302 can count toward graduation.

MUSIC 304. History of American Rock 'n' Roll.

(3-0) Cr. 3. S. Prereq: MUSIC 101, MUSIC 102, MUSIC 221, or MUSIC 222

Rock 'n' Roll from the mid 1950s through the 1990s, focusing on the development of rock styles from its roots in blues, folk, country, and pop. Expansion of listening experience through study of song forms, musical instruments of rock, and the socio-political significance of song lyrics. Examinations, research paper or in class presentation required. Ability to read or perform music not required. Meets U.S. Diversity Requirement

MUSIC 318. Applied Music: Non-majors.

(0.5-0) Cr. 1-2. Repeatable. F.S. Prereq: Audition, permission of instructor

Applied music for students other than music majors.

MUSIC 318A. Applied Music: Non-majors: Voice.

(0.5-0) Cr. 1-2. Repeatable. F.S. Prereq: Audition, permission of instructor

(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 318B. Applied Music: Non-majors: Piano.

(0.5-0) Cr. 1-2. Repeatable. F.S. Prereq: Audition, permission of instructor

(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 318C. Applied Music: Non-majors: Organ.

(0.5-0) Cr. 1-2. Repeatable. F.S. Prereq: Audition, permission of instructor

(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 318D. Applied Music: Non-majors: Strings.

(0.5-0) Cr. 1-2. Repeatable. F.S. Prereq: Audition, permission of instructor

(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 318E. Applied Music: Non-majors: Carillon.

(0.5-0) Cr. 1-2. Repeatable. F.S. Prereq: Audition, permission of instructor

(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 318F. Applied Music: Non-majors: Woodwinds.

(0.5-0) Cr. 1-2. Repeatable. F.S.SS. Prereq: Audition, permission of instructor

(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 318G. Applied Music: Non-majors: Brass.

(0.5-0) Cr. 1-2. Repeatable. F.S. Prereq: Audition, permission of instructor

(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 318I. Applied Music: Non-majors: Percussion.

(0.5-0) Cr. 1-2. Repeatable. F.S. Prereq: Audition, permission of instructor

(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 318K. Applied Music: Non-majors: Harpsichord.

(0.5-0) Cr. 1-2. Repeatable. F.S. Prereq: Audition, permission of instructor

(.5-0) for 1 cr. (1-0) for 2 cr. Applied music for the general student. Open only to non-majors. Will not satisfy applied music requirements for music majors.

MUSIC 319. Applied Music: Majors.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

Applied music for music majors.

MUSIC 319A. Applied Music: Majors: Voice.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 319B. Applied Music: Majors: Piano.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 319C. Applied Music: Majors: Organ.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 319D. Applied Music: Majors: Strings.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 319E. Applied Music: Majors: Carillon.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 319F. Applied Music: Majors: Woodwinds.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 319G. Applied Music: Majors: Brass.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 319I. Applied Music: Majors: Percussion.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 319K. Applied Music: Majors: Harpsichord.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq: Audition, permission of instructor; restricted to music majors*

(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 321. Advanced Ensemble.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor*

Performance in chamber music ensembles that demand high proficiency.

MUSIC 321A. Advanced Ensemble: Voice.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor*

Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.

MUSIC 321B. Advanced Ensemble: Piano.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor*

Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.

MUSIC 321C. Advanced Ensemble: Organ.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor*

Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.

MUSIC 321D. Advanced Ensemble: Strings.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor*

Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.

MUSIC 321F. Advanced Ensemble: Woodwinds.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor*

Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.

MUSIC 321G. Advanced Ensemble: Brass.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor*

Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.

MUSIC 321I. Advanced Ensemble: Percussion.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor*

Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.

MUSIC 321J. Advanced Ensemble: Mixed instruments/voice.

(0-3) Cr. 1. Repeatable. F.S. *Prereq: Advanced proficiency and performing ability, permission of instructor*

Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.

MUSIC 324. English and Italian Diction for Singing.

(2-0) Cr. 2. Alt. F., offered even-numbered years. *Prereq: Credit or enrollment in MUSIC 118A or MUSIC 119A*

The international phonetic alphabet and its application to correct pronunciation of English and Italian in singing.

MUSIC 325. French and German Diction for Singing.

(2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq: Credit or enrollment in MUSIC 118A or MUSIC 119A*

The international phonetic alphabet and its application to correct pronunciation of French and German in singing.

MUSIC 327. Functional Piano.

(0-3) Cr. 2.

Emphasis on sight reading, three and four-part score reading, improvisation, accompanying, and advanced harmonization.

MUSIC 327A. Functional Piano: Keyboard majors..

(0-3) Cr. 2. *Prereq: MUSIC 228 or permission of instructor*

Emphasis on sight reading, three and four-part score reading, improvisation, accompanying, and advanced harmonization.

MUSIC 327B. Functional Piano: Voice Majors.

(0-3) Cr. 2. S. *Prereq: MUSIC 228 or permission of instructor*

Emphasis on sight reading, three and four-part score reading, improvisation, accompanying, and advanced harmonization.

MUSIC 334. Music Theory III.

(3-0) Cr. 3. F. *Prereq: MUSIC 231; concurrent enrollment in 332 recommended*

Harmonic and melodic materials of tonal music with an emphasis on chromatic harmony. Application of these materials in analysis and writing. Techniques of melodic construction, formal design, and harmonization.

MUSIC 335. Aural Theory III.

(0-2) Cr. 1. F. *Prereq: MUSIC 232; credit or enrollment in 331*

Development of sight singing, ear training, and related musical skills with emphasis on melodic, harmonic and rhythmic materials from the eighteenth and nineteenth centuries.

MUSIC 344. Music Theory IV.

(3-0) Cr. 3. S. *Prereq: MUSIC 331; concurrent enrollment in MUSIC 338 recommended*

Writing and analysis based on musical styles since 1900.

MUSIC 345. Aural Theory IV.

(0-2) Cr. 1. S. *Prereq: MUSIC 332; credit or enrollment in MUSIC 337*

Development of sight singing, ear training, and related musical skills with emphasis on melodic, harmonic and rhythmic materials from the nineteenth and twentieth centuries.

MUSIC 346. MIDI and Digital Audio Techniques.

(3-0) Cr. 3. S. *Prereq: MUSIC 246 or permission of instructor*

Advanced MIDI and digital audio programming applications for composition and live performance.

MUSIC 350. Instrumental Techniques: Strings.

(0-2) Cr. 1. F. *Prereq: Instrumental music education majors: concurrent enrollment in MUSIC 358B. Limited to music majors*

Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

MUSIC 351. Instrumental Techniques: Clarinet, Flute, Saxophone.

(1-2) Cr. 2. S. *Prereq: Instrumental music education majors: concurrent enrollment in MUSIC 358B. Limited to music majors*

Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

MUSIC 352. Instrumental Techniques: Oboe, Bassoon.

(0-2) Cr. 1. F. *Prereq: MUSIC 351 or permission of instructor. Instrumental music education majors: concurrent enrollment in MUSIC 358B. Limited to music majors*

Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

MUSIC 353. Instrumental Techniques: Trumpet, Horn.

(0-2) Cr. 1. F. *Prereq: Instrumental music education majors: concurrent enrollment in MUSIC 358B. Limited to music majors*

Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

MUSIC 354. Instrumental Techniques: Trombone, Baritone, Tuba.

(0-2) Cr. 1. S. *Prereq: MUSIC 353 or permission of instructor. Instrumental music education majors: concurrent enrollment in MUSIC 358B. Limited to music majors*

Techniques and skills required for teaching of instruments. Examination of materials for school use. Intended for instrumental music education students.

MUSIC 355. Instrumental Techniques: Percussion.

(0-2) Cr. 1. S. *Prereq: Instrumental music education majors: concurrent enrollment in MUSIC 358B. Limited to music majors*

Techniques and skills required to teach percussion instruments in the schools. Techniques for performing and teaching snare drum, keyboard percussion instruments, timpani, band and orchestral hand instruments, drum set, and Latin percussion. Intended for instrumental music education students.

MUSIC 358. Lab Ensemble.

Cr. R. Repeatable.

Review and selection of appropriate literature for ensembles of differing levels and abilities; conducting and rehearsal experience. Intended for music education students.

MUSIC 358A. Lab Ensemble: Choral.

Cr. R. Repeatable. F.Alt. S., offered odd-numbered years.

Sight singing, conducting, and accompanying experience in conjunction with 362A. Required of all vocal music education majors every semester offered.

MUSIC 358B. Lab Ensemble: Instrumental.

Cr. R. Repeatable. F.S.

Performance on secondary instruments. Includes experiences with singing and vocal techniques. Required of all instrumental music education majors in those semesters when enrolled in 350, 351, 352, 353, 354, 355, or 362B. Offered on a satisfactory-fail basis only.

MUSIC 360. Voice Pedagogy.

(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: MUSIC 319A or vocal proficiency examination*

Physical, acoustical, and musical properties of the vocal instrument, including a survey of important texts and articles on singing and voice production.

MUSIC 361. Conducting I.

(1-2) Cr. 2. F. *Prereq: MUSIC 231, MUSIC 232, Music major status or permission of instructor*

Introduction to conducting; score reading and analysis. Conveying musical ideas through appropriate gestures. Leadership role of the conductor.

MUSIC 362. Conducting II.

(1-2) Cr. 2.

MUSIC 362A. Conducting II: Choral Conducting Techniques.

(1-2) Cr. 2. Alt. S., offered odd-numbered years. *Prereq: Music major status or permission of instructor; MUSIC 361; concurrent enrollment in MUSIC 358A and MUSIC 141, MUSIC 151, or MUSIC 161.*

Advanced baton technique, score preparation and interpretation of choral repertoire.

MUSIC 362B. Conducting II: Instrumental Conducting Techniques.

(1-2) Cr. 2. S. *Prereq: Music major status or permission of instructor; MUSIC 361; concurrent enrollment in MUSIC 358B*

Advanced baton technique. Score preparation. Specific problems of large instrumental ensembles.

MUSIC 366. Methods of Music Education.

(2-0) Cr. 2. F. *Prereq: Concurrent enrollment (1 cr.) in MUSIC 480K and SP ED 401; MUSIC 266 and admission into teacher education.*

Music education strategies and materials including development of appropriate objectives and plans for general music classes utilizing traditional and multicultural musics, evaluating musical learning; overview of Orff Schulwerk, Kodaly, and Dalcroze approaches; music in special education; required teaching in lab settings and observations in area schools.

MUSIC 367. Choral Literature.

(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: MUSIC 361 recommended*

Overview of choral repertoire from the sixteenth century to the present, including accessible works for the young conductor.

MUSIC 368. Marching Band and Jazz Ensemble Techniques.

(2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq: Credit or enrollment in MUSIC 362B recommended*

Techniques and materials for teaching marching band in the high school; philosophy, computer assisted drill design, music analysis, band set up, and other related skills. Jazz style, articulation, phrasing, materials and teaching techniques for secondary school jazz ensembles.

MUSIC 383. History of Music I.

(3-0) Cr. 3. F. *Prereq: MUSIC 120; music major status or permission of instructor* History of the stylistic and cultural development of music: Middle Ages through Baroque.

Meets International Perspectives Requirement.

MUSIC 384. History of Music II.

(3-0) Cr. 3. S. *Prereq: MUSIC 383; music major status or permission of instructor* History of the stylistic and cultural development of music: Classical through contemporary music.

Meets International Perspectives Requirement.

MUSIC 415. Literature and Pedagogy in Applied Music.

Cr. 1-4. Repeatable. F.S. *Prereq: Permission of instructor* Includes experience in technology relative to the particular discipline.

MUSIC 415A. Literature and Pedagogy in Applied Music: Voice.

Cr. 1-4. Repeatable. F.S. *Prereq: Permission of instructor* Includes experience in technology relative to the particular discipline.

MUSIC 415B. Literature and Pedagogy in Applied Music: Piano.

Cr. 1-4. Repeatable. F.S. *Prereq: Permission of instructor* Includes experience in technology relative to the particular discipline.

MUSIC 415C. Literature and Pedagogy in Applied Music: Organ.

Cr. 1-4. Repeatable. F.S. *Prereq: Permission of instructor* Includes experience in technology relative to the particular discipline.

MUSIC 415D. Literature and Pedagogy in Applied Music: Strings.

Cr. 1-4. Repeatable. F.S. *Prereq: Permission of instructor* Includes experience in technology relative to the particular discipline.

MUSIC 415E. Literature and Pedagogy in Applied Music: Carillon.

Cr. 1-4. Repeatable. F.S. *Prereq: Permission of instructor* Includes experience in technology relative to the particular discipline.

MUSIC 415F. Literature and Pedagogy in Applied Music: Woodwinds.

Cr. 1-4. Repeatable. F.S. *Prereq: Permission of instructor* Includes experience in technology relative to the particular discipline.

MUSIC 415G. Literature and Pedagogy in Applied Music: Brass.

Cr. 1-4. Repeatable. F.S. *Prereq: Permission of instructor* Includes experience in technology relative to the particular discipline.

MUSIC 415I. Literature and Pedagogy in Applied Music: Percussion.

Cr. 1-4. Repeatable. F.S. *Prereq: Permission of instructor* Includes experience in technology relative to the particular discipline.

MUSIC 415J. Literature and Pedagogy in Applied Music: Jazz Pedagogy and Performance.

Cr. 1-4. Repeatable. F.S. *Prereq: Permission of instructor* Includes experience in technology relative to the particular discipline.

MUSIC 417. Student Teaching.

Cr. 8-12. F.S. *Prereq: Minimum GPA of 2.5; Admission to teacher education, approval of coordinator during semester before student teaching* Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

MUSIC 417R. Student Teaching: Music-Elementary.

(Dual-listed with MUSIC 517R). (Cross-listed with C I). Cr. arr. F.S. *Prereq:* Minimum GPA of 2.5; Admission to teacher education, approval of coordinator during semester before student teaching
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

MUSIC 417S. Student Teaching: Music-Secondary.

(Dual-listed with MUSIC 517S). (Cross-listed with C I). Cr. arr. F.S. *Prereq:* Minimum GPA of 2.5; Admission to teacher education, approval of coordinator during semester before student teaching
Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

MUSIC 419. Applied Music: Majors.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
Applied music for music majors.

MUSIC 419A. Applied Music: Voice.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 419B. Applied Music: Piano.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 419C. Applied Music: Organ.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 419D. Applied Music: Strings.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 419E. Applied Music: Carillon.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 419F. Applied Music: Woodwinds.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 419G. Applied Music: Brass.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 419I. Applied Music: Percussion.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 419K. Applied Music: Harpsichord.

(1-2) Cr. 1-3. Repeatable. F.S. *Prereq:* Audition, permission of instructor; restricted to music majors
(.5-2) for 1 cr. (1-2) for 2-3 cr. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

MUSIC 420. Junior/Senior Recital.

Cr. R. Repeatable. F.S.SS. *Prereq:* Advanced performing ability, permission of instructor, concurrent registration in Music 319 or 419.
Performance of advanced repertory in a public concert. Preparation of program notes. Offered on a satisfactory-fail basis only.

MUSIC 440. Seminar in Music Theory.

(3-0) Cr. 3. Repeatable. S. *Prereq:* MUSIC 337, MUSIC 338
Various topics in music theory including analysis, counterpoint, arranging, pedagogy, and psychology of music. Content will vary. Contact the Department of Music for the current year offering.

MUSIC 446. Electronic Music Synthesis.

(3-0) Cr. 3. F. *Prereq:* MUSIC 246 or permission of instructor
Techniques of digital sound synthesis, software synthesizer design, and electronic music composition.

MUSIC 464. Instrumental Administration, Materials, and Methods.

(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq:* Credit or enrollment in MUSIC 362B recommended
Instructional materials and methods appropriate for teaching instrumental music in elementary, middle school, and high school music programs. Required observations in area schools. Intended for instrumental music education students.

MUSIC 465. Choral Materials and Methods.

(2-0) Cr. 2. F. *Prereq:* Concurrent enrollment in MUSIC 358A and MUSIC 141, MUSIC 151, or MUSIC 161
Instructional materials and methods appropriate for teaching choral music in the secondary school. Emphasis on pedagogy and rehearsal techniques. Required observations in area schools. Intended for vocal music education students.

MUSIC 466. Program Development and Evaluation in Music Education.

(2-1) Cr. 2. F. *Prereq:* Continuation Examination passed; MUSIC 362, MUSIC 366, concurrent enrollment (1 cr.) in MUSIC 480K
Developing a rationale for music education; music program development; evaluation of music curricula, programs and facilities; professional growth of the teacher; preparation for student teaching and the job market. Required observations in area schools.

MUSIC 472. History of American Music.

(3-0) Cr. 3. *Prereq:* Ability to read music; 9 credits from music, American literature, American history, art history
History and development of the sacred and secular music in North America from approximately 1600 to the present, exploring the diverse cultural backgrounds that have contributed to the variety of contemporary musical styles.
Meets U.S. Diversity Requirement

MUSIC 473. Music of the Baroque and Classical Eras.

(3-0) Cr. 3. *Prereq:* MUSIC 383, MUSIC 384
Offered F. 2011. Detailed survey of instrumental, vocal, choral, and keyboard music from 1600 to 1825.

MUSIC 475. Music of the Romantic Era.

(3-0) Cr. 3. *Prereq:* MUSIC 383, MUSIC 384
Offered F. 2012. Detailed survey of instrumental, vocal, choral, and keyboard music from 1825 to 1910.

MUSIC 476. Music of the Twentieth Century.

(3-0) Cr. 3. *Prereq:* MUSIC 383, MUSIC 384
Offered S 2013. Detailed survey of instrumental, vocal, choral, and keyboard music from 1900 to the present.

MUSIC 480. Field Experience for Secondary Teaching Preparation.

(Cross-listed with C I). Cr. 0.5-2. Repeatable, maximum of 2 times. F.S. *Prereq:* Permission of area coordinator required prior to enrollment
Observation and participation in a variety of school settings after admission to the teacher preparation program. Offered on a satisfactory-fail basis only.

MUSIC 480K. Pre-Student Teaching Experience III: Music.

(Cross-listed with C I). Cr. 1. Repeatable, maximum of 2 times. F.S. *Prereq:* Admission to teacher education
Participation in a K-12 school setting. Cross-listed with Music 480K. Permission of Music coordinator required prior to enrollment. Clinical Experience Level 2.
Offered on a satisfactory-fail basis only.

MUSIC 490. Independent Study.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Permission of instructor; 12 credits in music, approval of department head

MUSIC 490A. Independent Study: Education.

(Cross-listed with C I). Cr. arr. Repeatable. F.S.SS. *Prereq:* Permission of instructor; 12 credits in music, approval of department head

MUSIC 490B. Independent Study: Theory.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Permission of instructor; 12 credits in music, approval of department head

MUSIC 490C. Independent Study: Composition.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Permission of instructor; 12 credits in music, approval of department head

MUSIC 490D. Independent Study: History.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Permission of instructor; 12 credits in music, approval of department head

MUSIC 490E. Independent Study: Literature.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor; 12 credits in music, approval of department head*

MUSIC 490F. Independent Study: Applied Music.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor; 12 credits in music, approval of department head*

MUSIC 490G. Independent Study: Conducting.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor; 12 credits in music, approval of department head*

MUSIC 490H. Independent Study: Honors.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor; 12 credits in music, approval of department head*

MUSIC 490I. Independent Study: Electronic Music.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor; 12 credits in music, approval of department head*

Courses primarily for graduate students, open to qualified undergraduates:**MUSIC 517R. Student Teaching: Music-Elementary.**

(Dual-listed with MUSIC 417R). (Cross-listed with C I). Cr. arr. F.S. *Prereq: Minimum GPA of 2.5; Admission to teacher education, approval of coordinator during semester before student teaching*

Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

MUSIC 517S. Student Teaching: Music-Secondary.

(Dual-listed with MUSIC 417S). (Cross-listed with C I). Cr. arr. F.S. *Prereq: Minimum GPA of 2.5; Admission to teacher education, approval of coordinator during semester before student teaching*

Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

MUSIC 590. Special Topics.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head*

MUSIC 590A. Special Topics: Education.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head*

MUSIC 590B. Special Topics: Theory.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head*

MUSIC 590C. Special Topics: Composition.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head*

MUSIC 590D. Special Topics: History.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head*

MUSIC 590E. Special Topics: Literature.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head*

MUSIC 590F. Special Topics: Applied Music.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head*

MUSIC 590G. Special Topics: Conducting.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head*

MUSIC 590I. Special Topics: Electronic Music.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor, approval of department head*

Natural Resource Ecology and Management (NREM)

Courses primarily for undergraduates:

NREM 104. Practical Work Experience.

Cr. R.

Three months of relevant work experience in natural resources, animal ecology, or forestry. Study at a summer biological station may be applicable. See adviser for specific requirements and approval process.

NREM 110. Orientation in Natural Resource Ecology and Management.

Cr. 1. F.

Orientation to the University and to the Department of Natural Resource Ecology and Management. Discussion of departmental learning outcomes, strategies for academic success and academic planning. Offered on a satisfactory-fail basis only.

NREM 111. NREM Transitions Learning Community Seminar.

(1-0) Cr. 1. Repeatable. F.S.

Enrollment limited to members of the NREM Transitions Learning Community. Designed to assist new transfer students and continuing sophomore students with their transition to the academic expectations and professional development aspects of the natural resource program. Offered on a satisfactory-fail basis only.

NREM 112. Orientation to Learning and Productive Team Membership.

(Cross-listed with AER E, CON E, FS HN, HORT). (2-0) Cr. 2. F.

Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

NREM 114. Developing Responsible Learners and Effective Leaders.

(Cross-listed with CON E, FS HN, HORT). (2-0) Cr. 2. S. *Prereq: Hort 112 or NREM 112*

Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

NREM 120. Introduction to Renewable Resources.

(Cross-listed with AGRON, ENV S). (3-0) Cr. 3. F.S.

Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

NREM 130. Natural Resources and Agriculture.

(Cross-listed with ENV S). (3-0) Cr. 3. S.

Survey of the ecology and management of fish, forest, and wildlife resources in areas of intensive agriculture, with emphasis on Iowa. Conservation and management practices for private agricultural lands. Designed for nonmajors.

NREM 181. Artistry in Wood.

(1-0) Cr. 1. F.

A survey of the artistry of wood as appreciated in spatial scale from microscopic anatomy to engineered wood structures. Anatomical and physical properties that render wood as a medium for artistic expression. The works of local artists, designers and engineers will be featured. The University Museums collection and Art on Campus will be explored.

NREM 207. Natural Resource Management under the North American Model of Conservation.

(1-0) Cr. 1. F.

Introduction to North American model of conservation, current funding for natural resource management, role of hunting and angling in the North American model, critique and refinement of the model for the 21st century, and introduction to natural resource leadership, and outdoor skills and recreation. Offered on a satisfactory-fail basis only.

NREM 211. Careers in Natural Resources.

Cr. 1. F.S. *Prereq: Sophomore classification*

Career planning exploration in natural resources. Discussion of the job application process, including techniques for successful interviewing and development of an effective resume. Offered on a satisfactory-fail basis only.

NREM 270. Foundations in Natural Resource Policy and History.

(Cross-listed with ENV S, L A). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

The development of natural resource conservation philosophy and policy from the Colonial Era to the present. North American wildlife, forestry, and environmental policy; national parks and other protected lands; federal and state agencies. Relationship to cultural contexts, including urban reform and American planning movement. Discussion of common pool resources, public and private lands.

NREM 301. Natural Resource Ecology and Soils.

(Cross-listed with ENSCI). (3-3) Cr. 4. F. *Prereq: BIOL 211, BIOL 211L; FOR 201 or a second course in biology*

Effects of environmental factors on ecosystem structure and function using forest, prairie and agricultural ecosystems as models. Special emphasis is given to soil-forming factors and the role of soil in nutrient and water cycling and ecosystem dynamics. Additional emphasis is given to human influences on natural ecosystems and the role of perennial plant communities in agricultural landscapes.

NREM 303. Internship.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Permission of department mentor and sophomore standing*

Placement with county conservation boards, camps, zoos, parks, etc., for experience as interpreters, rangers, and technicians.

NREM 303I. Undergraduate Internships.

(Cross-listed with IA LL). Cr. 1-5. SS. *Prereq: Permission of instructor and sophomore standing*

Placement with county conservation boards, camps, parks, etc. for experience as interpreters, rangers, and technicians.

NREM 305. Seminar.

(2-0) Cr. 1-3. Repeatable. F.S. *Prereq: Permission of instructor*

Current topics in natural resources or related issues.

NREM 315. Genetics for Natural Resource Managers..

(3-0) Cr. 3. F. *Prereq: Prereq: Biol 211 and 212.*

Introduction into how genetic techniques and technologies can aid the management of the earth's biotic resources. Topics include an overview of DNA structure, function and inheritance; tools and techniques for measuring genetic diversity; genetic management of wild and captive populations: DNA forensics as management tool. The goal of this course is to prepare managers/biologists to interpret genetic data as they relate to natural resource conservation.

NREM 330. Principles of Interpretation.

(2-3) Cr. 3. S. *Prereq: 6 credits in biological sciences*

History, objectives, forms, and techniques of interpretation in the settings of county, state, national parks, and zoos. Principles of effective communication as they apply to natural resource fields including wildlife management, forestry, and wildlife rehabilitation. Planning and use of effective communications and outreach campaigns to manage and conserve natural resources.

NREM 345. Natural Resource Photogrammetry and Geographic Information Systems.

(Cross-listed with ENSCI). (2-3) Cr. 3. F. *Prereq: Junior classification*

Measurement and interpretation of aerial photos in resource management.

Introduction to Geographic Information Systems (GIS) using ArcGIS including digitizing, development and query of attribute tables, georeferencing, and use of multiple GIS layers in simple spatial analyses.

NREM 357. Midwestern Prairie Plants.

(1-2) Cr. 1. F.

Offered 1st half semester only. Survey of the major plant families, genera, and representative species of Midwestern prairies with emphasis on plant identification and use of keys. Prairie restoration, conservation, and management issues will also be considered.

NREM 358. Forest Herbaceous Layer: Ecology and Identification..

(Cross-listed with FOR). (0.5-1) Cr. 1. S. *Prereq: BIOL 212*

Survey of the major plant families, general, and representative species of the forest herbaceous layer. Functional ecology and restoration.

NREM 385. Natural Resource Policy.

(Dual-listed with NREM 585). (3-0) Cr. 3. S. *Prereq: Junior classification*

Development, theory and practice of natural resource policy. Integrative approach with topical policy studies in North American wildlife, forestry, and water. Policy formation, the role of science, introduction to federal law compliance. Readings, lectures, projects.

NREM 390. Fire Ecology and Management.

(3-0) Cr. 3. F.

Characteristics and role of fire in forest ecosystems. Major topics covered include fuels, fire weather, fire behavior, fire danger rating systems, fire control, prescribed burning, and fire dynamics in major ecosystem types.

NREM 402. Watershed Hydrology.

(Dual-listed with NREM 502). (Cross-listed with ENSCI, GEOL, MTEOR). (3-3) Cr.

4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

NREM 407. Watershed Management.

(Dual-listed with NREM 507). (Cross-listed with ENSCI, ENV S). (3-3) Cr. 4. S.

Prereq: A course in general biology

Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

NREM 446. Integrating GPS and GIS for Natural Resource Management.(Dual-listed with NREM 546). (Cross-listed with ENSCI). (2-3) Cr. 3. S. *Prereq:*

12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS

Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

NREM 452. Ecosystem Management.(Dual-listed with NREM 552). (Cross-listed with FOR). (2-3) Cr. 3. S. *Prereq:*

Senior classification, and NREM 120 or its equivalent

Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints.

NREM 460. Controversies in Natural Resource Management.(Cross-listed with ENV S). (3-0) Cr. 3. F.S. *Prereq: NREM 120, and A ECL 312 or NREM 301, and Junior classification*

Analysis of controversial natural resource issues using a case approach that considers uncertainty and adequacy of information and scientific understanding. Ecological, social, political, economic, and ethical implications of issues will be analyzed.

NREM 465. Landscape Change and Conservation.(Dual-listed with NREM 565). (3-0) Cr. 3. F. *Prereq: L A 202*

Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

NREM 466. Ecosystem Service Management.

(Dual-listed with NREM 566). (Cross-listed with ENSCI, ENT). (3-0) Cr. 3. Alt. S.,

offered odd-numbered years. *Prereq: permission of instructor*

Land use and conservation techniques for improving ecosystem services including: pollination of crops, biological control of pests, prevention of erosion and water quality improvement.

NREM 471. Agroforestry Systems; Local and Global Perspectives.

(Dual-listed with NREM 571). (2-3) Cr. 3. Alt. S., offered even-numbered years.

Prereq: 6 credits in biological science at 300 level or above

Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry. Meets International Perspectives Requirement.

NREM 490. Independent Study.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Junior or senior classification, permission of instructor*

NREM 490A. Independent Study: Animal Ecology.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Junior or senior classification, permission of instructor*

NREM 490B. Independent Study: Forestry.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Junior or senior classification, permission of instructor*

NREM 490E. Independent Study: Entrepreneurship.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Junior or senior classification, permission of instructor*

NREM 490H. Independent Study: Honors Program.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Junior or senior classification, permission of instructor*

NREM 490I. Iowa Lakeside Laboratory.

(Cross-listed with ANTHR, IA LL). Cr. 1-6. Repeatable, maximum of 9 credits.

Prereq: 8 credits in biology and permission of instructor

Research opportunities for undergraduate students in the biological sciences. No more than 9 credits in Biol 490 may be counted toward graduation and of those, only 6 credits may be applied to the major.

NREM 496. Travel Course: Domestic.(Dual-listed with NREM 596B). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq:*

Permission of instructor

Limited enrollment. Extended field trips to study ecological topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

NREM 496A. Travel Course: International.(Dual-listed with NREM 596A). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq:*

Permission of instructor

Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

Meets International Perspectives Requirement.

NREM 496B. Travel Course: Domestic.(Dual-listed with NREM 596B). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq:*

Permission of instructor

Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

NREM 498. Cooperative Education.

Cr. 1-3. *Prereq: Permission of departmental chair*

Required of all cooperative education students. Students must register prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduates:**NREM 502. Watershed Hydrology.**

(Dual-listed with NREM 402). (Cross-listed with ENSCI, GEOL, MTEOR). (3-3) Cr.

4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes.

NREM 504. Forest Landscapes, Wildlife, and Silviculture.(3-3) Cr. 4. F. *Prereq: NREM 301*

Detailed analysis of factors and processes underlying forest and stand growth and development. Applications of this knowledge to forest culture to support a diversity of use and protection objectives. Discussions of regional silviculture, tropical forests, and experimentation in forest biology.

NREM 505. Seminar.(2-0) Cr. 1-3. Repeatable, maximum of 3 times. F.S. *Prereq: Permission of*

instructor or graduate classification

Current topics in natural resources research and management.

NREM 507. Watershed Management.(Dual-listed with NREM 407). (Cross-listed with ENSCI). (3-3) Cr. 4. S. *Prereq: A*

course in general biology

Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

NREM 508I. Aquatic Ecology.(Cross-listed with ENSCI, IA LL). Cr. 4. SS. *Prereq: Courses in ecology, chemistry, and physics*

Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

NREM 535. Restoration Ecology.

(Cross-listed with EEOB, ENSCI). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: BIOL 366 or BIOL 474 or graduate standing*

Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies.

NREM 542. Introduction to Molecular Biology Techniques.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

NREM 542A. Introduction to Molecular Biology Techniques: DNA Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

NREM 542B. Introduction to Molecular Biology Techniques: Protein.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, VDPAM). Cr. 1. Repeatable. S.SS. *Prereq: Graduate classification*

Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

NREM 542C. Introduction to Molecular Biology Techniques: Cell Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

NREM 542D. Introduction to Molecular Biology Techniques: Plant Transformation.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

NREM 542E. Introduction to Molecular Biology Techniques: Proteomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

NREM 542F. Introduction to Molecular Biology Techniques: Metabolomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

NREM 542G. Introduction to Molecular Biology Techniques: Genomic.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

NREM 546. Integrating GPS and GIS for Natural Resource Management.

(Dual-listed with NREM 446). (Cross-listed with ENSCI). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS*

Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

NREM 552. Ecosystem Management.

(Dual-listed with NREM 452). (Cross-listed with FOR). (2-3) Cr. 3. F. *Prereq: Senior classification, and NREM 120 or its equivalent*

Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints.

NREM 565. Landscape Change and Conservation.

(Dual-listed with NREM 465). (3-0) Cr. 3. F. *Prereq: L A 202*

Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

NREM 566. Ecosystem Service Management.

(Dual-listed with NREM 466). (Cross-listed with ENSCI, ENT). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: permission of instructor*

Land use and conservation techniques for improving ecosystem services including: pollination of crops, biological control of pests, prevention of erosion and water quality improvement.

NREM 570. Advanced Decision-making in Natural Resource Allocation.

(2-2) Cr. 3. Alt. S., offered even-numbered years. *Prereq: FOR 451 or two courses in economics*

Analytical approach to economic aspects of forest resource management problems. Theory and application of economic decision-making criteria to traditional and modern forest resource management issues. Current problems in the allocation of forest resources.

NREM 571. Agroforestry Systems.

(Dual-listed with NREM 471). (Cross-listed with SUSAG). (2-3) Cr. 3. Alt. S., offered even-numbered years. *Prereq: 6 credits in biological science at 300 level or above*

Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry. Meets International Perspectives Requirement.

NREM 580. Research Orientation.

(2-0) Cr. 2. F. *Prereq: 20 credits in biological sciences and a course in statistics*

Research design, proposal preparation, and technical writing.

NREM 585. Natural Resource Policy.

(Dual-listed with NREM 385). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Graduate classification or permission of instructor*

Development, theory and practice of natural resource policy. Integrative approach with topical policy studies in North American wildlife, forestry, and water. Policy formation, the role of science, introduction to federal law compliance.

NREM 590. Special Topics.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Permission of instructor*

NREM 590A. Special Topics: Animal Ecology.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Permission of instructor*

NREM 590B. Special Topics: Forestry.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Permission of instructor*

NREM 593. Workshop.

Cr. 1-3. Repeatable. *Prereq: Graduate classification*

NREM 596. Travel Course: Domestic.

(Dual-listed with NREM 496B). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq: Permission of instructor*

Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

NREM 596A. Travel Course: International.

(Dual-listed with NREM 496A). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq: Permission of instructor*

Limited enrollment. Extended field trips to study ecological topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

NREM 596B. Travel Course: Domestic.

(Dual-listed with NREM 496B). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq: Permission of instructor*

Limited enrollment. Extended field trips to study ecological topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

NREM 598. Natural Resource Ecology and Management Teaching Practicum.

Cr. 1. F.S.SS. *Prereq: Graduate classification as M.S. candidate in a NREM major and permission of instructor.*

Graduate student experience in teaching. Student must plan and present at least one unit of subject matter in a course or extension workshop. Teaching practicum must be documented by the student and approved by the student's POS committee. Offered on a satisfactory-fail basis only.

NREM 599. Creative Component.

Cr. arr.

Courses for graduate students:

NREM 600. Seminar.

Cr. 1. Repeatable. F.S.

Current topics in natural resources research and management.

NREM 698. Natural Resource Ecology and Management Teaching Practicum.

Cr. 1. F.S. *Prereq: Graduate classification as a Ph.D. candidate in a NREM major and permission of instructor.*

Graduate student experience in teaching. Student must plan and present substantive subject matter for a minimum of three weeks in lecture and/or laboratory formats, or a series of extension seminars/workshops. Teaching practicum must be documented by the student and approved by the student's POS committee. Offered on a satisfactory-fail basis only.

NREM 699. Research.

Cr. 1-12. Repeatable, maximum of 12 credits.

Naval Science (N S)

Courses primarily for undergraduates:

N S 111. Introduction to Naval Science.

(3-0) Cr. 3. F.

Introduction to the organization, regulations, and capabilities of the US Navy, with emphasis on mission and principal warfare components.

N S 212. Seapower and Maritime Affairs.

(3-0) Cr. 3. S.

An historical survey of sea power in terms of national domestic environments, foreign policy, and the evolution of maritime forces with trends in technology, doctrine, and tactics. The student will develop an understanding of the role the US Navy has played in the nation's history, both in peace and war. Naval events, forces and policies will be studied as elements in the shaping of the national consciousness and sense of purpose. Course content will include the development of the concept of sea power, the role of various warfare components of the Navy, the implementation of sea power as an instrument of national policy, the evolution of naval tactics, and the influence of maritime affairs around the world.

N S 220. Leadership and Management.

(3-0) Cr. 3. Alt. F., offered even-numbered years.

Introduction to the basic concepts of management and organization, their application to operations and personnel management. Experiential approach to learning principles of leadership and management by examining various management theories and their applications. Skills are developed in the areas of communication, counseling, control, direction, management, and leadership through active guided participation.

N S 230. Navigation.

(3-0) Cr. 3. S. *Prereq: Sophomore classification*

Study of the fundamentals of marine navigation used by ships at sea; includes practical exercises in piloting using visual and electronic means. In-depth discussion of laws that govern conduct of vessels in national and international waters. Course is supplemented with review and analysis of case studies involving actual navigation incidents.

N S 320. Naval Ship Systems I (Engineering).

(3-0) Cr. 3. F. *Prereq: PHYS 221, sophomore classification*

An introduction to naval engineering with emphasis on the equipment and machinery involved in the conversion of energy for propulsion and other purposes aboard the major ship types of the U.S. fleet. Basic concepts of the theory and design of steam, gas turbine, diesel, and nuclear propulsion. Introduction to ship design, stability, hydrodynamic forces, compartmentalization, electrical and auxiliary systems.

N S 321. Evolution of Warfare.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: Sophomore classification*

Evolution of warfare from 3500 B.C. to contemporary times; analysis of the impact of historical precedents on modern military thought and action; emphasis on the historical development of military tactics, strategy, and technology.

N S 330. Naval Ship Systems II (Weapons).

(3-0) Cr. 3. S. *Prereq: PHYS 221, sophomore classification*

Introduction to the theory and principles of operation of naval weapon systems. Included coverage of types of weapons and fire control systems, capabilities and limitations; theory of target acquisition, identification and tracking; basics of naval ordnance.

N S 410. Naval Operations and Seamanship.

(3-0) Cr. 3. F. *Prereq: N S 230; senior classification*

Study of tactical naval operations; employs practical use of maneuvering boards together with shiphandling principles to arrive at tactical shipboard maneuvering solutions. Study also of naval command and control, communications, and the Naval Warfare Doctrine.

N S 412. Leadership and Ethics.

(3-0) Cr. 3. S. *Prereq: Requirements for NROTC students - N S 111, N S 212 or HIST 389, N S 220, N S 230, N S 320, N S 330 and N S 410*

Basic background concerning the duties and responsibilities of the junior naval officer and division officer in the areas of integrity and ethics, human resources management, personnel management, material management, and the administration of discipline. Preparation for responsibilities encountered immediately upon commissioning.

N S 421. Evolution of Amphibious Warfare.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: Sophomore classification*

Defines the concept of amphibious operations, origins, and development from 600 B.C., focusing on the history and development of amphibious warfare, the principles and techniques of amphibious warfare and the application of principles and techniques to selected examples from recent history.

N S 440. Senior Naval Science Seminar.

(1-0) Cr. 1. F.S. *Prereq: Senior classification*

Current leadership issues in the US Navy which will challenge the newly commissioned officer. Opportunities to analyze, provide solutions, and discuss actions related to a variety of real world situations.

N S 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: Senior classification and prior approval of Naval Science Department Chair, 6 credits in Naval Science*
No more than 9 credits of N S 490 may be counted toward graduation.

Neuroscience (NEURO)

Courses primarily for graduate students, open to qualified undergraduates:

NEURO 556. Cellular, Molecular and Developmental Neuroscience.

(Cross-listed with B M S, GDCB). (3-0) Cr. 3. F. *Prereq: BIOL 335 or BIOL 436; physics recommended*

Fundamental principles of neuroscience including cellular and molecular neuroscience, nervous system development, sensory, motor and regulatory systems.

NEURO 557. Advanced Neuroscience Techniques.

(Cross-listed with GDCB). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Neuro 556 or equivalent course*

Research methods and techniques; lectures, laboratory exercises and/or demonstrations representing individual faculty specialties.

Courses for graduate students:

NEURO 661. Current Topics in Neuroscience.

(Cross-listed with BBMB, GDCB). (2-0) Cr. 2-3. Repeatable. Alt. S., offered even-numbered years. *Prereq: NEURO 556 (or comparable course) or permission of instructor*

Topics may include molecular and cellular neuroscience, neurodevelopment, neuroplasticity, neurodegenerative diseases, cognitive neuroscience, sensory biology, neural integration, membrane biophysics, neuroethology, techniques in neurobiology and behavior.

NEURO 690. Journal Club in Neuroscience.

(1-0) Cr. 1. Repeatable. F.S. *Prereq: NEURO 556*

Students are required to attend and make at least one presentation at a weekly journal club focusing on current topics.

NEURO 696. Neuroscience Seminar.

(1-0) Cr. 1. Repeatable. F.S. *Prereq: NEURO 556*

Presentations and discussion of research by students, faculty, and visiting scholars.

NEURO 699. Research.

Cr. arr. Repeatable.

Nuclear Engineering (NUC E)

Courses primarily for undergraduates:

NUC E 401. Nuclear Radiation Theory and Engineering.

(3-0) Cr. 3. F. *Prereq: PHYS 222, MATH 266 or MATH 267*

Atomic and nuclear physics. Radioactivity and reaction rates. Cross sections. Introduction to neutron diffusion theory. Engineering applications of radiation theory.

NUC E 402. Nuclear Reactor Engineering.

(3-0) Cr. 3. S. *Prereq: NUC E 401, permission of Nuclear Engineering program director*

WWW only. Fission and chain reactions. Neutron diffusion and moderation. Reactor equations. Fermi Age theory. Multigroup and multiregional analysis. Contact Nuclear Engineering program director for enrollment information.

NUC E 405. Radiation Protection and Shielding.

(3-0) Cr. 3. *Prereq: NUC E 401, permission of Nuclear Engineering program director*

WWW only. Basic principles and concepts of radiation protection and design: dosimetric units and response functions, hazards of radiation dose, radiation sources, basic methods for dose evaluation, and shielding design techniques for photons and neutrons.

NUC E 410. Nuclear Reactor Theory.

(3-0) Cr. 3. F. *Prereq: NUC E 401, permission of Nuclear Engineering program director*

WWW only. An introduction to neutron diffusion theory, neutron moderation, conditions for criticality of nuclear reactors.

NUC E 421. Nuclear Criticality Safety.

Cr. 3. F. *Prereq: NUC E 401*

Nomenclature, theory, and practice of nuclear criticality safety. Review of nuclear criticality accidents, analytical methods used in criticality analysis, review of standards and regulations, and developing criticality safety evaluations.

NUC E 430. Nuclear Energy and Society.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: NUC E 401*

The relationship between nuclear energy and society is examined from the perspective of significant events in the commercial nuclear power industry. Event analysis includes differences and similarities of technologies along with environmental impact. Political, social, media and regulatory responses for each event are discussed along with the impact on future plant design.

NUC E 441. Probabilistic Risk Assessment.

(3-0) Cr. 3. S. *Prereq: STAT 305 or equivalent*

Methods for analysis of nuclear power systems. Fault tree and event tree analysis methods. Mathematical basics for dealing with reliability data, theory, and analysis. Case studies of accidents in nuclear power systems.

NUC E 461. Radiation Detection, Measurement and Simulation.

(3-0) Cr. 3. S. *Prereq: NUC E 401*

Principles of nuclear radiation safety and detection. Radiation energy spectroscopy. Counting statistics and error analysis. Monte Carlo simulation of radiation transport. Detection system performance parameters. Design projects.

NUC E 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 3 credits. *Prereq: Junior Classification*

Investigation of nuclear engineering topics. Election of course and topic must be approved in advance by supervising faculty.

Nutritional Sciences (NUTRS)

Courses primarily for graduate students, open to qualified undergraduates:

NUTRS 501. Biochemical and Physiological Basis of Nutrition: Macronutrients and Micronutrients.

(4-0) Cr. 4. F. *Prereq: Credit or enrollment in BBMB 404 or BBMB 420*
Integration of the molecular, cellular, and physiologic aspects of energy, macronutrient, and micronutrient metabolism in mammalian systems. Survey course that includes interactions among nutrients (dietary carbohydrate, fiber, lipid, protein, vitamins, and minerals) and non-nutrients, metabolic consequences of nutrient deficiencies or excesses, relevant polymorphisms, and major research methodologies.

NUTRS 503. Biology of Adipose Tissue.

(2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq: Undergraduate: consent of instructor; Graduate: NutrS 501*

Principles regarding the development of adipose tissue and its role in energy balance, and will focus considerably on endocrine and immune actions of the adipocyte. Course material will be in lecture format, including handouts and selected journal articles. Students will be asked to lead critical discussions of key research findings as summary material for a given topic. Species differences will be highlighted, particularly as they relate to research models.

NUTRS 504. Nutrition and Epigenetic Regulation of Gene Expression.

(1-0) Cr. 1. Alt. S., offered even-numbered years. *Prereq: graduate standing; undergraduate with consent of instructor*

Discussion of epigenetic regulation of gene expression and the role that nutrition plays in this process. Examination of current research literature to understand how different nutrients and physiological states influence epigenetics, as well as, the research methodology used to address these relations.

NUTRS 505. Short Course.

(1-0) Cr. 1. SS. *Prereq: Permission of instructor*

NUTRS 506. Diet and Cancer Prevention.

(Cross-listed with TOX). (1-0) Cr. 1. Alt. F., offered even-numbered years. *Prereq: BBMB 404 and BBMB 405 or BBMB 420*

Principles of cancer biology and cancer etiology will be integrated with the impacts of diet on cancer development and prevention. Contributions of research with humans, animals, cultured cells and cell free systems will be included. The importance of dietary contaminants, macronutrients and micronutrients will be examined with an emphasis on the strength of the evidence and mechanisms of action.

NUTRS 518. Digestive Physiology and Metabolism of Non Ruminants.

(Cross-listed with AN S). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: AN S 419 or NUTRS 501*

Digestion and metabolism of nutrients. Nutritional requirements and current research and feeding programs for poultry and swine.

NUTRS 519. Food Toxicology.

(Cross-listed with FS HN, TOX). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: A course in biochemistry*

Basic principles of toxicology. Toxicants in the food supply: modes of action, toxicant defense systems, toxicant and nutrient interactions, risk assessment. Only one of FS HN 419 and FS HN 519 may count toward graduation.

NUTRS 520. Digestive Physiology and Metabolism of Ruminants.

(Cross-listed with AN S). (2-2) Cr. 3. Alt. S., offered even-numbered years. *Prereq: AN S 419 or NUTRS 501*

Digestive physiology and nutrient metabolism in ruminant and preruminant animals.

NUTRS 542. Introduction to Molecular Biology Techniques.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

NUTRS 542A. Introduction to Molecular Biology Techniques: DNA Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

NUTRS 542B. Introduction to Molecular Biology Techniques: Protein.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, VDPAM). Cr. 1. Repeatable. S.SS. *Prereq: Graduate classification*

Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

NUTRS 542C. Introduction to Molecular Biology Techniques: Cell Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

NUTRS 542D. Introduction to Molecular Biology Techniques: Plant Transformation.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, V MPM, VDPAM). Cr. 1. Repeatable. S.

Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

NUTRS 542E. Introduction to Molecular Biology Techniques: Proteomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

NUTRS 542F. Introduction to Molecular Biology Techniques: Metabolomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

NUTRS 542G. Introduction to Molecular Biology Techniques: Genomic.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, V MPM, VDPAM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

NUTRS 549. Advanced Vertebrate Physiology I.

(Cross-listed with AN S, KIN). (4-0) Cr. 4. F. *Prereq: Biol 335; credit or enrollment in BBMB 404 or BBMB 420*

Overview of mammalian physiology. Cell biology, endocrinology, cardiovascular, respiratory, immune, digestive, skeletal muscle and reproductive systems.

NUTRS 552. Advanced Vertebrate Physiology II.

(Cross-listed with AN S, KIN). (3-0) Cr. 3. S. *Prereq: BIOL 335; credit or enrollment in BBMB 404 or BBMB 420*

Cardiovascular, renal, respiratory, and digestive physiology.

NUTRS 561. Medical Nutrition and Disease I.

(4-0) Cr. 4. F. *Prereq: FS HN 360, FS HN 361, FS HN 367, BIOL 256 and 256L or BIOL 306 or BIOL 335*

(Dual listed with FS HN 461.) Pathophysiology of selected chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state.

NUTRS 562. Assessment of Nutritional Status.

(3-0) Cr. 3. *Prereq: FS HN 461/NUTRS 561 or NUTRS 501*

Overview and practical applications of methods for assessing nutritional status, including: theoretical framework of nutritional health and disease, dietary intake, biochemical indices, clinical examination, and body composition.

NUTRS 563. Community Nutrition.

(3-0) Cr. 3. F. *Prereq: FS HN 265 or FS HN 360; FS HN 366 recommended*

Dual listed with FS HN 463. Survey of current public health nutrition problems among nutritionally vulnerable individuals and groups. Discussion of the multidimensional nature of those problems and of community programs addressing them. Grant writing as a means for funding community nutrition program development. Significant emphasis on written and oral communication at the lay and professional level. Field trip.

NUTRS 564. Medical Nutrition and Disease II.

(3-0) Cr. 3-4. S. *Prereq: FS HN 360, FS HN 461, or NUTRS 561.*

(Dual listed with FS HN 464.) Pathophysiology of selected acute and chronic disease states and their associated medical problems. Specific attention will be directed to medical nutrition needs of patients in the treatment of each disease state.

NUTRS 597. Nutritional Aspects of Oncology.

(Cross-listed with DIET). Cr. 3. Alt. S., offered even-numbered years. *Prereq: B.S. in nutrition, dietetics, biology, or related discipline.*

Understanding of basic cancer biology and methodology used to study nutrition and cancer relationships. Using current research as a basis, the role of nutrition in specific cancers will be explored. Students will learn about sources of information for cancer prevention programs, and how to apply this information to clinical patient management.

Courses for graduate students:**NUTRS 618. Vitamins and Minerals.**

(Cross-listed with AN S). Cr. 2. Alt. S., offered even-numbered years. *Prereq: Biochemistry, physiology, basic nutrition*

Understanding molecular aspects of vitamin and mineral metabolism and homeostasis in humans and animals. An in-depth examination of the chemistry of vitamins and minerals, including genetic mutations, proteins involved in absorption and excretion, and their necessity in biological processes.

NUTRS 619. Advanced Nutrition and Metabolism - Protein.

(Cross-listed with AN S). (2-0) Cr. 2. F. *Prereq: BBMB 405*

Digestion, absorption, and intermediary metabolism of amino acids and protein. Regulation of protein synthesis and degradation. Integration of cellular biochemistry and physiology of mammalian protein metabolism.

NUTRS 620. Advanced Nutrition and Metabolism - Energy.

(Cross-listed with AN S). (2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: BBMB 405*

Energy constituents of feedstuffs and energy needs of animals as related to cellular biochemistry and physiology. Interpretations of classical and current research.

NUTRS 680. Modern Views of Nutrition.

Cr. R. Repeatable. F.

Current concepts in nutrition and related fields. Required for all graduate students in nutrition.

NUTRS 690. Special Problems.

Cr. arr. Repeatable. F.S.SS.

NUTRS 695. Grant Proposal Writing.

(Cross-listed with FS HN). (1-0) Cr. 1. F. *Prereq: 3 credits of graduate course work in food science and/or nutrition*

Grant proposal preparation experiences including writing and critiquing of proposals and budget planning. Formation of grant writing teams in food science and/or nutrition. Offered on a satisfactory-fail basis only.

NUTRS 699. Research in Nutritional Sciences.

Cr. arr. F.S.SS.

Offered on a satisfactory-fail basis only.

Organization for Tropical Studies (OTS)

Courses primarily for graduate students, open to qualified undergraduates:

OTS 510. Tropical Biology: An Ecological Approach.

Cr. 8.

This course is designed for students in the early stages of graduate study in biology or a related field, with the goal of training graduate students in research methods by providing intensive field experience in diverse tropical ecosystems.

OTS 515. Topics in Tropical Biology.

Cr. 1-8.

This course is designated for students enrolled in graduate course offerings through OTS (excluding OTS 510). Examples of graduate courses offered by OTS include Tropical Plant Systematics, Tropical Ecology and Conservation, Molecular Methods in Tropical Ecology, and Tropical Agroecology.

Organizational Learning and Human Resource Development (OLHRD)

Courses primarily for graduate students, open to qualified undergraduates:

OLHRD 541. Adult Learning.

(3-0) Cr. 3.

Examines how adults acquire and use knowledge, skills, and attitudes within organizational settings; individual differences in learning as well as the principles and elements of the learning organization.

OLHRD 544. Performance Improvement and Change Through Learning Interventions.

(3-0) Cr. 3. *Prereq: OLHRD 541, OLHRD 542*

Examines the characteristics and elements of the performance improvement and change process, with special attention to the roles and responsibilities of employees, managers, and organizations when improving individual and organizational learning.

OLHRD 545. Learning Acquisition, Transfer, and Evaluation.

(3-0) Cr. 3. *Prereq: OLHRD 541, OLHRD 542, OLHRD 544*

Critical examination of learning acquisition, transfer, and evaluation barriers, partnerships, strategies, and activities; and the roles and responsibilities of human resource development professionals, managers, employees, and organizations in the application and evaluation of learning on the job.

Performing Arts (PERF)

Courses primarily for undergraduates:

PERF 105. Issues in the Performing Arts.

(1-0) Cr. R. F.S.

Cross-disciplinary analysis and discussion of topics in the performing arts. Six semesters required of performing arts majors.

PERF 310. Performing Arts Internship.

Cr. R. F.S.SS.

Required of performing arts majors. A job or internship with a professional or semi-professional performing arts organization. Offered on a satisfactory-fail basis only.

PERF 401. Performing Arts Seminar.

(2-0) Cr. 2. S.

Intensive collaborative study and practice of topics in music, dance and theatre. Required of performing arts majors.

Philosophy (PHIL)

Courses primarily for undergraduates:

PHIL 201. Introduction to Philosophy.

(3-0) Cr. 3. F.S.SS.

It has been rumored that the unexamined life is not worth living. Philosophy is an attempt to begin examining life by considering such questions as: What makes us human? What is the world ultimately like? How should we relate to other people? Is there a god? How can we know anything about these questions? Understanding questions of this kind and proposed answers to them is what this course is all about.

PHIL 206. Introduction to Logic and Scientific Reasoning.

(3-0) Cr. 3. F.S.SS.

Basic principles of critical reasoning and argument evaluation. A consideration of basic forms of argumentation in science and everyday life. Application to contemporary issues and controversies.

PHIL 207. Introduction to Symbolic Logic.

(Cross-listed with LING). (3-0) Cr. 3. S.

Introduction to fundamental logical concepts and logical symbolism. Development of natural deduction through first order predicate logic with identity. Applications to arguments in ordinary English and to philosophical issues. Linguistics majors should take LING/PHIL 207 as early as possible.

PHIL 230. Moral Theory and Practice.

(3-0) Cr. 3. F.S.SS.

Investigation of moral issues in the context of major ethical theories of value and obligation; e.g., punishment, abortion, economic justice, job discrimination, world hunger, and sexual morality. Emphasis on critical reasoning and argument analysis.

PHIL 235. Ethical Issues in A Diverse Society.

(3-0) Cr. 3. S.

This course will examine a range of arguments on diversity issues. Topics will include: the social status of women, the moral status of sexuality and homosexuality, the nature and role of racism in contemporary society, the relationship between biology, gender roles and social status, and various proposals for change from a variety of political perspectives. Meets U.S. Diversity Requirement

PHIL 310. Ancient Philosophy.

(Cross-listed with CL ST). (3-0) Cr. 3. F. Prereq: PHIL 201

Survey of ancient Greek philosophy, focusing on the pre-Socratics, Plato, and Aristotle. Questions concerning being, knowledge, language, and the good life are treated in depth.

PHIL 314. 17th Century Philosophy.

(3-0) Cr. 3. Alt. S., offered even-numbered years. Prereq: PHIL 201

Readings from philosophers such as Hobbes, Descartes, Spinoza, Leibniz, and Locke. Changing conceptions of knowledge, self, and deities in response to Galileo's new science and post-reformation challenge to ecclesiastical authority.

PHIL 315. 18th Century Philosophy.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: PHIL 201

Readings from philosophers such as Berkeley, Hume, and Kant. Development of Enlightenment thought. Issues include idealism, causation, freedom, and knowledge regarding science, ethics, and deities.

PHIL 316. 19th Century Continental Philosophy.

(3-0) Cr. 3. F. Prereq: PHIL 201

The thought of Hegel, Marx, Nietzsche, and their contemporaries. Various perspectives on the philosophy of history, the nature of reason and subjectivity, the contrast between dialectical and nondialectical philosophy, and the relationship between philosophy and society.

PHIL 317. 20th and 21st Century Continental Philosophy.

(3-0) Cr. 3. Alt. F., offered even-numbered years. Prereq: PHIL 201

Major movements of 20th and 21st century thought, such as Phenomenology, Critical Theory, Post-structuralism, Postmodernism, and Feminism. Issues include the assumptions and limits of Western metaphysics, the nature of reason, the relationship between language and power.

PHIL 318. 20th and 21st Century Anglo-American Philosophy.

(3-0) Cr. 3. S. Prereq: PHIL 201

Major movements in recent and contemporary philosophy such as realism, logical positivism, ordinary language philosophy, and naturalism. Russell, Wittgenstein, Quine and other leading figures. Topics include knowledge of the material world, mind, language, values, and philosophical method.

PHIL 320. Existentialism and Its Critics.

(3-0) Cr. 3. F. Prereq: PHIL 201

An investigation of Existentialism and its critics in historical and cultural context. Emphasis on existential phenomenology and French existentialism, and on criticisms. Existential Marxism and Heidegger's later philosophy.

PHIL 330. Ethical Theory.

(3-0) Cr. 3. F. Prereq: PHIL 201 or PHIL 230

Study of major theories of morality and the good life. Includes such topics as moral psychology, practical reasoning, and virtue theory.

PHIL 331. Moral Problems in Medicine.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: PHIL 230 or junior classification

In-depth study of some of the central moral problems arising in medicine, e.g., abortion, euthanasia, patients' rights, health care professionals' duties and responsibilities, allocation of medical resources. Major moral theories will be examined and applied.

PHIL 332. Philosophy of Law.

(Cross-listed with CJ ST). (3-0) Cr. 3. F.S. Prereq: PHIL 201 or PHIL 230

Extent of our obligation to obey the law; what constitutes just punishment; how much of the immoral should be made illegal? Relation of these questions to major theories of law and the state. Discussion of such concepts as coercion, equality, and responsibility.

PHIL 333. Family Ethics.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: 3 credits in philosophy

Moral dimensions of marriage and love, parent-child relations, domestic work, and moral education. Can parents and children be friends? What do children "owe" their parents? Is there a feminist mode of moral thinking?

PHIL 334. Environmental Ethics.

(Cross-listed with ENV S). (3-0) Cr. 3. F. Prereq: 3 credits in philosophy or junior classification

Thorough study of some of the central moral issues arising in connection with human impact on the environment, e.g., human overpopulation, species extinction, forest and wilderness management, pollution. Several world views of the proper relationship between human beings and nature will be explored.

PHIL 335. Social and Political Philosophy.

(3-0) Cr. 3. Alt. S., offered even-numbered years. Prereq: PHIL 201 or PHIL 230

Foundations of social and political life. The basis of political organization, the nature of social and political institutions, rights and authority, justice. Original texts.

PHIL 336. Bioethics and Biotechnology.

(3-0) Cr. 3. Prereq: PHIL 201 or PHIL 230 or PHIL 235

In-depth study of some central moral issues in the life sciences, e.g., genetic screening and testing, genetically engineered plants and animals, risk analysis, biotechnology patents, research ethics, biodiversity, the impact of biotechnology on society and the environment. Major moral theories will be discussed and applied. (Phil 336 contains almost no similarities to Phil 331.).

PHIL 338. Feminist Philosophy.

(Cross-listed with W S). (3-0) Cr. 3. F. Prereq: 3 credits in philosophy or women's studies recommended

A critical, theoretical examination of the oppression of women, especially as it relates to issues of race, class, and sexual orientation. How concepts such as sex and gender, self and other, nature and nurture, complicate our understanding of what it means to be a woman. Historical and contemporary feminist philosophers addressing topics such as violence, sexuality, pornography, political power, family structure and women's paid and unpaid labor. Meets U.S. Diversity Requirement

PHIL 340. Aesthetics.

(3-0) Cr. 3. F. Prereq: PHIL 201 or PHIL 230

Is liking all there is to appreciating works of art or natural beauty? We will examine our appreciative experiences, talk about such experiences (e.g., art criticism), and what makes them valuable. Do the different arts have common values? How are their differences important?

PHIL 343. Philosophy of Technology.

(Cross-listed with T SC). (3-0) Cr. 3. F.S. Prereq: 6 credits of social science or T SC 341 and 3 credits of social science

Moral and other philosophical problems related to developments in technology. Topics may include conditions under which technological innovations contribute to human emancipation, relationship of technology and democracy, utility and limits of technical rationality, and problems of ensuring that benefits of technological advance are communally shared. Topics discussed with reference to such issues as contemporary developments in microelectronics, technology transfer to the Third World, etc.

PHIL 350. Philosophy of Religion.(Cross-listed with RELIG). (3-0) Cr. 3. F. *Prereq: PHIL 201*

The value and truth of religious life and belief. Mystical experience; religious faith and language; arguments for God's existence; the problem of evil; miracles; and religion and morality. Historical and contemporary readings.

PHIL 364. Metaphysics: God, Minds, and Matter.(3-0) Cr. 3. S. *Prereq: 3 credits in philosophy*

A survey of classical and contemporary views on some basic metaphysical issues. Issues discussed include: Does God exist? Do you have a mind and, if so, how does it relate to your body? What is the nature of cause and effect? Do objects have any essential properties? How can we account for properties objects have in common?

PHIL 366. Truth, Belief and Reason.(3-0) Cr. 3. F. *Prereq: PHIL 201 or permission of instructor*

This course focuses on significant topics in theory of knowledge, including the value of true beliefs, the role of sense experience in supporting our theoretical views, and the place of reason in human nature. Historical and contemporary views will be considered.

PHIL 380. Philosophy of Science.(3-0) Cr. 3. F. *Prereq: PHIL 201 or 6 credits in a science*

Introduction to the philosophy of science. A variety of basic problems common to the natural and social sciences: the nature of explanation, the structure of theories, the unity of science, and the distinction between science and non-science.

PHIL 381. Philosophy of the Social and Behavioral Sciences.(3-0) Cr. 3. S. *Prereq: PHIL 201 or 6 credits in the social sciences*

Methodological, ideological, and doctrinal issues about the social and behavioral sciences against the background of influence of the natural sciences. Focus is on the historical and cultural background of 19th and 20th century western thought.

PHIL 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

PHIL 430. Value Theory.(3-0) Cr. 3. Repeatable, maximum of 6 credits. S. *Prereq: PHIL 230*

Theoretical and normative issues in ethics, aesthetics, religious thought, or political philosophy. Topics vary each time offered.

PHIL 450. Agency and Free Will.(3-0) Cr. 3. Repeatable, maximum of 1 times. F. *Prereq: 3 credits in philosophy; PHIL 207 strongly encouraged*

Personal identity, agency, free will, moral responsibility, causation, future contingents, and time will be discussed. What makes a person the same person over time? Do humans have free will? Are we not morally responsible if our actions are inevitable consequences of the past and the laws of nature? What distinguishes causes from non-causes? Are there facts about the future?

PHIL 460. Epistemology and Metaphysics.(3-0) Cr. 3. Repeatable, maximum of 6 credits. S. *Prereq: 6 credits in philosophy*

Issues in epistemology and metaphysics. Topics vary each time offered.

PHIL 465. Brains, Minds, and Computers.(3-0) Cr. 3. F. *Prereq: PHIL 201*

Examination of concepts such as computability, intelligence, programming, and free will; and of arguments about whether any human capacity is forever beyond realization in a machine.

PHIL 480. Controversies in Science.(3-0) Cr. 3. Repeatable. S. *Prereq: 3 credits in philosophy or 6 credits in a natural or social science*

Philosophical treatment of a branch of science that has (or has had) significant social, political, religious and/or moral implications. Possible topics include: the IQ debate, implications of Darwinism, the Galileo affair, the role of values in science, critical analysis of current science policy (e.g., the Human Genome Project). Topics will be arranged to meet the needs of interested students. Often team taught by a philosopher and a scientist from the relevant discipline.

PHIL 483. Philosophy of Biology.(3-0) Cr. 3. S. *Prereq: 3 credits in philosophy or 3 credits in biology*

Biology is powerful, both as a science and in its effects on our culture. Philosophy of biology evaluates this power. Possible topics include: What makes sciences such as evolutionary theory, ecology or molecular biology so good at explaining things? What is life? Can evolution account for design? What role does chance play in evolution? Has there been progress in the evolution of life on earth? What can sociobiology tell us about human nature, behavior and culture?

PHIL 485. Philosophy of Physics.(3-0) Cr. 3. *Prereq: 3 credits in Philosophy or 3 credits in Physics*

S. Conceptual and philosophical issues relating to the interpretation of theories in classical and modern physics. May include one or more of the following topics: the relationship between mathematics and the physical world; Newtonian physics (determinism and predictability); thermodynamics and statistical physics (the nature of probability; entropy and the direction of time); relativistic physics (indeterminism; realism and nonlocality; consciousness and the role of the observer).

PHIL 490. Independent Study.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq: 6 credits in philosophy; permission of instructor, approval of chair.*

Guided reading and research on special topics selected to meet needs of advanced students. No more than 9 credits of Phil 490 may be counted toward graduation.

PHIL 490H. Independent Study, Honors.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq: 6 credits in philosophy; permission of instructor, approval of chair.*

Guided reading and research on special topics selected to meet needs of advanced students. No more than 9 credits of Phil 490 may be counted toward graduation.

PHIL 492. Graduating Senior Survey.

Cr. R. F.S. *Prereq: Graduating senior*

Final presentation for graduation and the future. Outcomes assessment activities. Offered on a satisfactory-fail basis only.

PHIL 496. Ecology and Society.(Dual-listed with PHIL 596). (3-0) Cr. 3. *Prereq: Graduate classification in*

biological or environmental sciences/studies with at least one course in ecology Analysis of conceptual and methodological debates in ecology. Historical development of competing research traditions and philosophies. Topics include i) methodological issues in ecological science, ii) conceptual issues in theoretical ecology, iii) conceptual issues in applied ecology, iv) relation of ecology to environmental and social issues.

Courses primarily for graduate students, open to qualified undergraduates:**PHIL 535. Contemporary Political Philosophy.**

(Cross-listed with POL S). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: 6 credits of philosophy or political science

Examination of theories of justice proposed by contemporary political philosophers. Analysis of the philosophical foundations of perspectives such as liberalism, libertarianism, communitarianism, socialism, feminism. Normative assessments of socio-political institutions.

PHIL 548. Summer Bioethics Workshop for Teachers.

Cr. 1. SS.

Topics include moral theory, pedagogical issues in teaching bioethics, and substantive current issues in bioethics.

PHIL 590. Special Topics in Philosophy.Cr. 2-4. Repeatable. *Prereq: Permission of instructor, 9 credits in philosophy***PHIL 590A. Special Topics in Philosophy: History of Philosophy.**Cr. 2-4. Repeatable. *Prereq: Permission of instructor, 9 credits in philosophy***PHIL 590B. Special Topics in Philosophy: Epistemology and Metaphysics.**Cr. 2-4. Repeatable. *Prereq: Permission of instructor, 9 credits in philosophy***PHIL 590C. Special Topics in Philosophy: Value Theory.**Cr. 2-4. Repeatable. *Prereq: Permission of instructor, 9 credits in philosophy***PHIL 590D. Special Topics in Philosophy: Logic and Philosophy of Science.**Cr. 2-4. Repeatable. *Prereq: Permission of instructor, 9 credits in philosophy***PHIL 596. Ecology and Society.**(Dual-listed with PHIL 496). (3-0) Cr. 3. *Prereq: Graduate classification in*

biological or environmental sciences/studies with at least one course in ecology Analysis of conceptual and methodological debates in ecology. Historical development of competing research traditions and philosophies. Topics include i) methodological issues in ecological science, ii) conceptual issues in theoretical ecology, iii) conceptual issues in applied ecology, iv) relation of ecology to environmental and social issues.

Physics (PHYS)

Courses primarily for undergraduates:

PHYS 101. Physics for the Nonscientist.

(3-0) Cr. 3. F.S.

Survey of the principal areas of both classical and modern physics. Emphasis on the nature of the physical universe and the application of physical principles to life in the modern world. Not suitable to meet a general physics requirement for natural science majors.

PHYS 102L. Physical Sciences for Elementary Education.

(Cross-listed with CHEM). (1-5) Cr. 3. S. Prereq: MATH 195 or MATH 140

Introduction to physics and chemistry via weekly, guided-inquiry laboratories.

Topics to include states of matter and changes in states of matter, sound, light, electricity, magnetism, heat, forces and how they are related to an object's motion.

PHYS 111. General Physics.

(4-2) Cr. 5. F.S.SS. Prereq: 1 1/2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry

General background in physical concepts, principles, and methods for those who do not plan advanced study in physics or engineering. Mechanics, fluids, heat and thermodynamics, vibrations, waves, sound.

PHYS 112. General Physics.

(4-2) Cr. 5. F.S.SS. Prereq: PHYS 111

General background in physical concepts, principles, and methods for those who do not plan advanced study in physics or engineering. Electricity and magnetism, ray and wave optics, topics in modern physics.

PHYS 115. Physics for the Life Sciences.

(4-0) Cr. 4. F.S. Prereq: high school: 1 1/2 yr. algebra, 1 yr. geometry, 1 semester trigonometry

Emphasis on basic physics principles applied to biological problems. Topics include mechanics, fluids, thermodynamics, heat, light, sound, electricity and magnetism. A coordinated laboratory, Physics 115 laboratory is available.

PHYS 115L. Laboratory in Physics for the Life Sciences.

(0-2) Cr. 1. F.S.

Experiments related to the elementary topics of physics for the life sciences. Mechanics, fluids, thermodynamics, heat, light, sound, electricity and magnetism.

PHYS 198. Physics of Music.

(2-2) Cr. 3. F.

Introductory level course on sound for nonphysics majors. Properties of pure tones and harmonics; human perception of sound; room acoustics; scales; production, and analysis of musical by voice, string, woodwind, brass, and percussion instruments. Not suitable to meet a general physics requirement for natural science majors

PHYS 199. Introductory Seminar.

Cr. R. F.

(1-1) Gain experience in key skills that physicists/astronomers use routinely, but are rarely explicitly taught in formal courses. Participate in faculty-led discussions on frontier areas and careers. Offered on a satisfactory-fail basis only.

PHYS 221. Introduction to Classical Physics I.

(4.5-1) Cr. 5. F.S.SS. Prereq: Proficiency in algebra, trigonometry, vector manipulation, and topics covered in Math 165, and credit or enrollment in MATH 166.

For engineering and science majors. 3 hours of lecture each week plus 3 recitations and 1 laboratory every 2 weeks. Elementary mechanics including kinematics and dynamics of particles, work and energy, linear and angular momentum, conservation laws, rotational motion, oscillations, gravitation. Heat, thermodynamics, kinetic theory of gases; waves and sound.

PHYS 221H. Introduction to Classical Physics I: Honors.

(4.5-1) Cr. 5. F.S. Prereq: Proficiency in algebra, trigonometry, vector manipulation, and topics covered in Math 165, and credit or enrollment in MATH 166.

For engineering and science majors. 3 hours of lecture each week plus 3 recitations and 1 laboratory every 2 weeks. Elementary mechanics including kinematics and dynamics of particles, work and energy, linear and angular momentum, conservation laws, rotational motion, oscillations, gravitation. Heat, thermodynamics, kinetic theory of gases; waves and sound.

PHYS 222. Introduction to Classical Physics II.

(4-2) Cr. 5. F.S.SS. Prereq: PHYS 221 OR PHYS 241, MATH 166

3 hours of lecture each week plus 1 recitation and 1 laboratory each week. Electric forces and fields. Electrical currents; DC circuits. Magnetic forces and fields: LR, LC, LCR circuits; Maxwell's equations; ray optics and image formation; wave optics; topics in modern physics.

PHYS 222H. Introduction to Classical Physics II: Honors.

(4-2) Cr. 5. F.S. Prereq: PHYS 221 OR PHYS 241, MATH 166

3 hours of lecture each week plus 1 recitation and 1 laboratory each week. Electric forces and fields. Electrical currents; DC circuits. Magnetic forces and fields: LR, LC, LCR circuits; Maxwell's equations; ray optics and image formation; wave optics; topics in modern physics.

PHYS 241. Principles and Symmetries in Classical Physics I.

(4.5-1) Cr. 5. F. Prereq: Proficiency in algebra, trigonometry, vector manipulation, and topics covered in MATH 165, and credit or enrollment in MATH 166.

Covers all of mechanics; Kinematics and dynamics of particles, work and energy, linear and angular momentum, conservation laws, rotational motion, oscillations, gravitation, and extremum principles. Topics in kinetic theory, thermodynamics, waves and sound.

PHYS 241H. Principles and Symmetries in Classical Physics I, Honors..

(4.5-1) Cr. 5. F. Prereq: Proficiency in algebra, trigonometry, vector manipulation, and topics covered in MATH 165, and credit or enrollment in MATH 166.

Covers all of mechanics; Kinematics and dynamics of particles, work and energy, linear and angular momentum, conservation laws, rotational motion, oscillations, gravitation, and extremum principles. Topics in kinetic theory, thermodynamics, waves and sound.

PHYS 242. Principles and Symmetries in Classical Physics II.

(4-2) Cr. 5. S. Prereq: PHYS 221 or PHYS 241, credit or enrollment in MATH 166

Electrostatics, potentials and fields, currents, fields of moving charges, the magnetic field, electromagnetic induction, DC and AC circuits, Maxwell's equations and electromagnetic waves, electric and magnetic fields in matter. Topics in optics, special relativity and modern physics.

PHYS 242H. Principles and Symmetries in Classical Physics II, Honors (Spring)..

(4-2) Cr. 5. S. Prereq: PHYS 221 or PHYS 241, credit or enrollment in MATH 166

Electrostatics, potentials and fields, currents, fields of moving charges, the magnetic field, electromagnetic induction, DC and AC circuits, Maxwell's equations and electromagnetic waves, electric and magnetic fields in matter. Topics in optics, special relativity and modern physics.

PHYS 290. Independent Study.

Cr. 1-4. Repeatable. Prereq: Permission of instructor

PHYS 298. Cooperative Education.

Cr. R. F.S.SS. Prereq: Permission of the department cooperative education coordinator; sophomore classification

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

PHYS 302. The Challenge of Contemporary Physics.

(3-0) Cr. 3. S. Prereq: Sophomore classification

A largely nonmathematical but intellectually challenging exploration of physics, which assumes no previous work in the field. Selected material from classical and modern physics establishes the conceptual framework for the study of major areas of contemporary physics, culminating in the discussion of topics at the frontier of present knowledge. Topics vary yearly and may include quarks, lasers, superconductivity, fission and fusion, solid state devices, gravitational waves, string theory, facilities, left handed materials, and quantum computing. Not suitable to meet a general physics requirement for natural science majors.

PHYS 304. Thermal Physics.

(3-0) Cr. 3. F. Prereq: PHYS 222, MATH 266

Concepts of temperature, entropy, and other characteristic thermodynamic functions, with application to macroscopic properties of matter. The laws of thermodynamics. Introduction to statistical mechanics, including quantum statistics. Application to black body radiation, crystalline vibrations, magnetic ions in solids, electronic heat capacity of metals. Phase transformations and chemical reactions.

PHYS 306. Physics of Wave Motion.

(3-0) Cr. 3. S. Prereq: PHYS 222, credit or enrollment in MATH 267

Oscillating systems including damped and forced oscillations; fluids, geometric optics, water waves, the wave equation, Fourier and Laplace transforms, non-uniform media, cylindrical and spherical waves, polarization, interference and diffraction, transmission lines, non-linear waves.

PHYS 310. Electronic Instrumentation for Experimental Physics.(2-4) Cr. 4. F. *Prereq: PHYS 222; MATH 166*

Common electrical instruments; power supplies; transducers; passive and active devices, analog integrated circuits, including filters and amplifiers; digital integrated circuits; signal transmission and enhancement.

PHYS 311. Intermediate Laboratory.Cr. 1-2. Repeatable. S. *Prereq: PHYS 322*

Experiments in classical and modern physics performed independently by each student.

PHYS 311T. Intermediate Laboratory for Secondary Physics Teachers.(0-6) Cr. 3. Repeatable. S. *Prereq: PHYS 112 or PHYS 222*

Experiments in classical and modern physics performed independently by each student. For students preparing for a career in high school teaching.

PHYS 321. Introduction to Modern Physics I.(3-0) Cr. 3. F. *Prereq: PHYS 222, credit or enrollment in MATH 266*

Quantum nature of matter: photons, de Broglie's postulate: wave-like properties of matter; Bohr's model of hydrogen atom; Schrodinger equations in one dimension: energy quantization; detailed solutions for potential steps, barriers and wells; one-electron atoms, spin and magnetic interactions; ground states, optical and x-ray excitations of multi-electron atoms.

PHYS 321L. Introductory Laboratory in Modern Physics I.(0-2) Cr. 1. F. *Prereq: Credit or enrollment in PHYS 321*

Experiments related to the foundations of modern physics. The dual wave and particle character of electrons and photons, statistics, interferometry and x-ray spectroscopy.

PHYS 322. Introduction to Modern Physics II.(3-0) Cr. 3. S. *Prereq: PHYS 321*

Quantum statistics; lasers; physics of molecules. Properties of solids, including electron band structure, superconductivity and magnetism. Nuclear physics, including nuclear sizes and masses, stability, decay modes, reactions, fission and fusion. Elementary particles, including strangeness, charm, and quarks. Fundamental forces of nature.

PHYS 322L. Introductory Laboratory in Modern Physics II.(0-2) Cr. 1. S. *Prereq: Credit or enrollment in PHYS 322*

Experiments related to the foundations of modern physics. Radioactive decay, elementary particles, Hall effect, quantization, spectroscopy, statistics and instrumentation.

PHYS 361. Classical Mechanics.(3-0) Cr. 3. S. *Prereq: PHYS 222, MATH 265, credit or enrollment in MATH 266 or 267*

Newtonian mechanics including forced oscillations, central forces and orbital motion, collisions, moving frames of reference, Lagrange's equations.

PHYS 362. Intermediate Mechanics.(3-0) Cr. 3. F. *Prereq: PHYS 361*

Rigid body motion; small oscillations, normal modes. Special relativity including length contraction, time dilation, simultaneity, Lorentz transformation, 4-vector covariant formalism, relativistic mechanics.

PHYS 364. Electricity and Magnetism I.(3-0) Cr. 3. F. *Prereq: PHYS 222*

Static electric and magnetic fields, potential theory; electromagnetism, Maxwell's equations.

PHYS 365. Electricity and Magnetism II.(3-0) Cr. 3. S. *Prereq: PHYS 364, MATH 385*

Relativistic electromagnetic theory; radiation and propagation of electromagnetic waves; interaction with matter.

PHYS 389. Junior Seminar.

Cr. R. S.

Recommended for all junior physics majors. Career opportunities: graduate school programs and application, job placement, alternative careers, basic skills needed for the job market competition. Offered on a satisfactory-fail basis only.

PHYS 398. Cooperative Education.Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

PHYS 399. Seminar on Secondary School Physics.Cr. 1-2. Repeatable, maximum of 2 credits. F. *Prereq: Permission of instructor*

Review of materials and curricula for secondary school physics presented and discussed by members of the class. Required for approval to teach physics in secondary schools.

PHYS 421. Ultrafast Laser Science and Spectroscopy.(Dual-listed with PHYS 521). (3-0) Cr. 3. F. *Prereq: PHYS 321, PHYS 365, or equivalent with permission of instructor*

Introduction to ultrafast lasers, nonlinear optics, and their applications. Topics selected from: basic optics, atom-photon interactions, electrostatics of condensed matter, laser physics, ultrafast and nonlinear optics, ultrashort pulse generation, broadband pulse generation, time-resolved spectroscopy and instrumentation.

PHYS 432. Molecular and Cell Biophysics.(Dual-listed with PHYS 532). (3-0) Cr. 3. S. *Prereq: PHYS 304 or CHEM 325.*

Quantitative description of biological systems using basic physical laws, including a brief discussion of a variety of biophysical techniques. Topics include: thermodynamics, chemical equilibrium, gene expression, structure and physical properties of nucleic acids and proteins, folding of nucleic acids and proteins, chemical kinetics, catalysis, allosteric enzymes, cell membrane structure and physical properties, and machines in cell membranes.

PHYS 450. Undergraduate Research.Cr. 1-6. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Theoretical research under supervision of physics faculty.

PHYS 450L. Undergraduate Research.Cr. 1-6. Repeatable. F.S.SS. *Prereq: PHYS 311, permission of instructor*

Laboratory project under supervision of physics faculty.

PHYS 461. Physics of Biomolecules.(Dual-listed with PHYS 561). (3-0) Cr. 3. F. *Prereq: PHYS 304 or CHEM 325, BBMB 301, or permission of instructor*

Cell and Molecular Biophysics. Physical techniques used to characterize the structure, dynamics and properties of biomolecules with emphasis on single molecule techniques.

PHYS 470L. Applied Physics Laboratory.Cr. 2-5. Repeatable. F.S.SS. *Prereq: PHYS 322 and permission of instructor*

Studies in modern experimental techniques via experimentation and simulation in various areas of applied physics, e.g. superconductivity, optical spectroscopy, nuclear magnetic resonance, electron spin resonance, x-ray diffraction, and computation of electronic and structural properties of matter.

PHYS 480. Quantum Mechanics I.(3-0) Cr. 3. F. *Prereq: PHYS 322, MATH 385*

First semester of a full-year course. A systematic development of the formalism and applications of quantum mechanics. Solutions to the time independent Schrodinger equation for various one-dimensional potentials including the harmonic oscillator; operator methods; Heisenberg picture; angular momentum; the hydrogen atom; spin; symmetry properties.

PHYS 481. Quantum Mechanics II.(3-0) Cr. 3. S. *Prereq: PHYS 480*

Continuation of 480. Addition of angular momentum; charged particles in electromagnetic fields; time-independent perturbation theory; variational principles; WKB approximation; interaction picture; time-dependent perturbation theory; adiabatic approximation; scattering; selected topics in radiation theory; quantum paradoxes.

PHYS 490. Independent Study.Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq: 6 credits in physics, permission of instructor*

No more than 9 credits of Phys 490 may be counted toward graduation.

PHYS 490H. Independent Study, Honors.Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq: 6 credits in physics, permission of instructor*

No more than 9 credits of Phys 490 may be counted toward graduation.

PHYS 496. Modern Optics.(Cross-listed with E E). (3-0) Cr. 3. S. *Prereq: Credit or enrollment in PHYS 322, PHYS 365, and PHYS 480*

Review of wave and electromagnetic theory; topics selected from: reflection/refraction, interference, geometrical optics, Fourier analysis, dispersion, coherence, Fraunhofer and Fresnel diffraction, holography, quantum optics, nonlinear optics.

PHYS 498. Cooperative Education.Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduates:

PHYS 501. Oral Communication of Physics Seminar.

(2-0) Cr. 1. Repeatable. F.

A practical introduction to communication methods in physics and astronomy classrooms and professional settings. For graduate physics majors only. Offered on a satisfactory-fail basis only.

PHYS 502. Introductory Research Seminar.

Cr. R. F.

(1-1) Discussion by research staff of their research areas, expected thesis research work, and opportunities in the field. For graduate physics majors only. Offered on a satisfactory-fail basis only.

PHYS 511. Condensed Matter Physics I.(3-0) Cr. 3. F. *Prereq: PHYS 304, credit or enrollment in PHYS 481*

First semester of a full-year course. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

PHYS 512. Condensed Matter Physics II.(3-0) Cr. 3. S. *Prereq: PHYS 511*

Continuation of 511. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

PHYS 521. Ultrafast Laser Science and Spectroscopy.(Dual-listed with PHYS 421). (3-0) Cr. 3. F. *Prereq: PHYS 321, PHYS 365, or equivalent with permission of instructor*

Introduction to ultrafast lasers, nonlinear optics, and their applications. Topics selected from: basic optics, atom-photon interactions, electrodynamics of condensed matter, laser physics, ultrafast and nonlinear optics, ultrashort pulse generation, broadband pulse generation, time-resolved spectroscopy and instrumentation.

PHYS 526. Particle and Nuclear Physics.(4-0) Cr. 4. F. *Prereq: Credit or enrollment in PHYS 481*

Basic properties and structures of nuclei, hadrons, and elementary particles; weak and strong interactions; the Standard Model; accelerators and detectors; nuclear models; nuclear decay and stability; nuclear astrophysics; the Higgs mechanism; the CKM matrix; running coupling constants; relativistic heavy-ion collisions; selected topics beyond the standard model such as SUSY and grand unification.

PHYS 528. Mathematical Methods for the Physical Sciences.(3-0) Cr. 3. F. *Prereq: MATH 266 or MATH 267*

Fast-paced coverage of mathematical techniques needed for advanced analysis in the physical sciences, particularly for quantum mechanics and electrodynamics. Linear vector spaces and operators. Linear differential equations for time-evolution and steady-state problems, Green's functions and propagators, Sturm-Liouville problems. Functions of a complex variable, calculus of residues, series expansions, integral transforms and applications.

PHYS 531. Statistical Mechanics.(3-0) Cr. 3. S. *Prereq: PHYS 304 and credit or enrollment in PHYS 481, MATH 465, credit or enrollment in MATH 365 or MATH 426*

Thermodynamic properties of systems of many particles obeying Boltzmann, Fermi-Dirac, and Bose-Einstein statistics; microcanonical, canonical, and grand canonical ensembles and their application to physical problems; density matrices; introduction to phase transitions; renormalization group theory; kinetic theory and fluctuations.

PHYS 532. Molecular and Cell Biophysics.(Dual-listed with PHYS 432). (3-0) Cr. 3. S. *Prereq: PHYS 304 or CHEM 325.*

Quantitative description of biological systems using basic physical laws, including a brief discussion of a variety of biophysical techniques. Topics include: thermodynamics, chemical equilibrium, gene expression, structure and physical properties of nucleic acids and proteins, folding of nucleic acids and proteins, chemical kinetics, catalysis, allosteric enzymes, cell membrane structure and physical properties, and machines in cell membranes.

PHYS 534. Symmetry and Group Theory in Physics.(3-0) Cr. 3. S. *Prereq: Credit or enrollment in PHYS 481*

Theory of groups and group representations; introduction to both point and continuous groups, and their applications in physics.

PHYS 535. Physics of Semiconductors.(Cross-listed with E E). (3-3) Cr. 4. *Prereq: E E 311 and E E 332*

Basic elements of quantum theory, Fermi statistics, motion of electrons in periodic structures, crystal structure, energy bands, equilibrium carrier concentration and doping, excess carriers and recombination, carrier transport at low and high fields, space charge limited current, photo-conductivity in solids, phonons, optical properties, amorphous semiconductors, heterostructures, and surface effects. Laboratory experiments on optical properties, carrier lifetimes, mobility, defect density, doping density, photo-conductivity, diffusion length of carriers.

PHYS 536. Physics of Semiconductor Devices.(Cross-listed with E E). (3-0) Cr. 3. *Prereq: E E 535*

P-n junctions, band-bending theory, tunneling phenomena, Schottky barriers, heterojunctions, bipolar transistors, field-effect transistors, negative-resistance devices and optoelectronic devices.

PHYS 541. General Relativity.(3-0) Cr. 3. F. *Prereq: PHYS 362, MATH 307 or MATH 317*

Tensor analysis and differential geometry developed and used to formulate Einstein field equations. Schwarzschild and Kerr solutions. Other advanced topics may include gravitational radiation, particle production by gravitational fields, alternate gravitational theories, attempts at unified field theories, cosmology.

PHYS 551. Computational Physics.(0-4) Cr. 2. S. *Prereq: PHYS 365, credit or enrollment in PHYS 481*

Use of modern computational techniques to analyze topics in classical and modern physics. Offered on a satisfactory-fail basis only.

PHYS 561. Physics of Biomolecules.(Dual-listed with PHYS 461). (3-0) Cr. 3. F. *Prereq: PHYS 304 or CHEM 325, BBMB 301, or permission of instructor*

Cell and Molecular Biophysics. Physical techniques used to characterize the structure, dynamics and properties of biomolecules with emphasis on single molecule techniques.

PHYS 564. Advanced Classical Mechanics.(3-0) Cr. 3. S. *Prereq: PHYS 362, MATH 426, MATH 465*

Variational principles, Lagrange's equations, Hamilton's canonical equations, canonical transformations, Hamilton-Jacobi theory, infinitesimal transformations, classical field theory, canonical perturbation theory, classical chaos.

PHYS 571. Electricity and Magnetism I.(3-0) Cr. 3. F. *Prereq: PHYS 365, MATH 426*

Electrostatics, magnetostatics, boundary value problems, Maxwell's equations, wave phenomena in macroscopic media, wave guides.

PHYS 572. Electricity and Magnetism II.(3-0) Cr. 3. S. *Prereq: PHYS 571*

Special theory of relativity, least action and motion of charged particles in electromagnetic fields, radiation, collisions between charged particles, multipole fields, radiation damping.

PHYS 590. Special Topics.Cr. arr. Repeatable. *Prereq: Permission of instructor*
Topics of current interest.**PHYS 590A. Nuclear Physics.**Cr. arr. Repeatable. *Prereq: Permission of instructor*
Topics of current interest.**PHYS 590B. Condensed Matter Physics.**Cr. arr. Repeatable. *Prereq: Permission of instructor*
Topics of current interest.**PHYS 590C. High Energy Physics.**Cr. arr. Repeatable. *Prereq: Permission of instructor*
Topics of current interest.**PHYS 590D. Physics.**Cr. arr. Repeatable. *Prereq: Permission of instructor*
Topics of current interest.**PHYS 590E. Applied Physics.**Cr. arr. Repeatable. *Prereq: Permission of instructor*
Topics of current interest.**PHYS 590F. Biophysics.**Cr. arr. Repeatable. *Prereq: Permission of instructor*
Topics of current interest.**PHYS 591. Quantum Physics I.**(4-0) Cr. 4. F. *Prereq: PHYS 481*

First semester of a full-year course. Postulates of quantum mechanics; time-dependent and time-independent Schrodinger equations for one-, two-, and three-dimensional systems; theory of angular momentum; Rayleigh-Schrodinger time-independent perturbation theory.

PHYS 592. Quantum Physics II.(4-0) Cr. 4. S. *Prereq: PHYS 591*

Continuation of 591. Variational theorem and WKB method; time-dependent perturbation theory and 2nd quantization of the EM field in Coulomb gauge; method of partial waves and Born approximation for scattering by central potentials; identical particles and symmetry; Dirac and Klein-Gordon equation for free particles; path integral formalism.

PHYS 599. Creative Component.Cr. arr. *Prereq: Permission of instructor*

Individually directed study of research-level problems for students electing the nonthesis M.S. degree option.

Courses for graduate students:**PHYS 611. Quantum Theory of Condensed Matter.**(3-0) Cr. 3. S. *Prereq: PHYS 512 and PHYS 681 or permission of instructor.*

Quasiparticles in condensed matter: phonons, magnons, photons, electrons. Quantum theory of interacting many body systems: Green's functions and diagrammatic techniques.

PHYS 624. Advanced Nuclear Physics.(3-0) Cr. 3. *Prereq: PHYS 526 and PHYS 592*

Microscopic few-body and many-body theory; theory of effective Hamiltonians; relativistic nuclear physics; nuclear effects in hadron-nucleus, lepton-nucleus, and nucleus-nucleus reactions.

PHYS 625. Physics of Strong Interactions.(3-0) Cr. 3. *Prereq: PHYS 681*

Quark model; Quantum Chromodynamics (QCD); perturbation methods for QCD; effective field theories for pions and nucleons; finite temperature field theories; quark-gluon plasma; phase transitions in QCD.

PHYS 637. Elementary Particle Physics I.(3-0) Cr. 3. S. *Prereq: PHYS 526 and PHYS 592*

First semester of a full year course. Properties of leptons, bosons, and quarks and their interactions; quantum chromodynamics, Glashow-Weinberg-Salam model, grand unification theories, supersymmetry; modern theoretical techniques and tests of the Standard Model.

PHYS 638. Elementary Particle Physics II.(3-0) Cr. 3. *Prereq: PHYS 637*

Continuation of 637. Properties of leptons, bosons, and quarks and their interactions; quantum chromodynamics, Glashow-Weinberg-Salam model, grand unification theories, supersymmetry, and superstring theory; modern theoretical techniques.

PHYS 646. Mathematical Modeling of Complex Physical Systems.

(Cross-listed with MATH). (3-0) Cr. 3. S.

Modeling of the dynamics of complex systems on multiple scales: Classical and dissipative molecular dynamics, stochastic modeling and Monte-Carlo simulation; coarse grained nonlinear dynamics, interface propagation and spatial pattern formation.

PHYS 650. Advanced Seminar.

(1-0) Cr. 1. Repeatable. F.S.

Topics of current interest. Offered on a satisfactory-fail basis only.

PHYS 650A. Nuclear Physics.

(1-0) Cr. 1. Repeatable. F.S.

Topics of current interest. Offered on a satisfactory-fail basis only.

PHYS 650B. Condensed Matter Physics.

(1-0) Cr. 1. Repeatable. F.S.

Topics of current interest. Offered on a satisfactory-fail basis only.

PHYS 650C. High Energy Physics.

(1-0) Cr. 1. Repeatable. F.S.

Topics of current interest. Offered on a satisfactory-fail basis only.

PHYS 650D. Physics.

(1-0) Cr. 1. Repeatable. F.S.

Topics of current interest. Offered on a satisfactory-fail basis only.

PHYS 650E. Applied Physics.

(1-0) Cr. 1. Repeatable. F.S.

Topics of current interest. Offered on a satisfactory-fail basis only.

PHYS 650F. Biophysics.

(1-0) Cr. 1. Repeatable. F.S.

Topics of current interest. Offered on a satisfactory-fail basis only.

PHYS 660. Advanced Topics in Physics.

Cr. 1-3. Repeatable. F.S.

Courses on advanced topics and recent developments.

PHYS 660A. Nuclear Physics.

Cr. 1-3. Repeatable. F.S.

Courses on advanced topics and recent developments.

PHYS 660B. Condensed Matter Physics.

Cr. 1-3. Repeatable. F.S.

Courses on advanced topics and recent developments.

PHYS 660C. High Energy Physics.

Cr. 1-3. Repeatable. F.S.

Courses on advanced topics and recent developments.

PHYS 660D. Physics.

Cr. 1-3. Repeatable. F.S.

Courses on advanced topics and recent developments.

PHYS 660E. Applied Physics.

Cr. 1-3. Repeatable. F.S.

Courses on advanced topics and recent developments.

PHYS 660F. Biophysics.

Cr. 1-3. Repeatable. F.S.

Courses on advanced topics and recent developments.

PHYS 681. Quantum Field Theory I.(3-0) Cr. 3. F. *Prereq: PHYS 564, PHYS 572, PHYS 592*

Quantization of fields (canonical and path integral); Feynman rules; introduction to gauge theories; Quantum Electrodynamics; radiative corrections; renormalization and renormalization group.

PHYS 682. Quantum Field Theory II.(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: PHYS 681*

Continuation of 681. Systematics of renormalization; renormalization group methods; symmetries; spontaneous symmetry breaking; non-abelian gauge theories; the Standard Model and beyond; special topics.

PHYS 699. Research.Cr. arr. Repeatable. *Prereq: Instructor permission required.*

Graduate research.

Plant Biology (PLBIO)

Courses primarily for graduate students, open to qualified undergraduates:

PLBIO 513. Plant Metabolism.

(Cross-listed with GDCB). (2-0) Cr. 2. Alt. F., offered even-numbered years.

Prereq: BIOL 330, PHYS 111, CHEM 331; one semester of biochemistry recommended

Photosynthesis, respiration, and other aspects of plant metabolism.

PLBIO 545. Plant Molecular, Cell and Developmental Biology.

(Cross-listed with GDCB, MCDB). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: Biol 313, BIOL 314, BIOL 330 or BBMB 405

Plant nuclear and organelle genomes; regulation of gene expression; hormone signaling; organization, function, and development of plant cells and subcellular structures; regulation of plant growth and development.

Courses for graduate students:

PLBIO 696. Research Seminar.

(Cross-listed with AGRON, BBMB, FOR, GDCB, HORT). Cr. 1. Repeatable. F.S. Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

PLBIO 699. Research.

Cr. arr. Repeatable.

Plant Pathology (PL P)

Courses primarily for undergraduates:

PL P 391. Practical Plant Health.

(0-4) Cr. 2. F. *Prereq:* 6 credits in biological sciences

Diagnosis of all types of plant health problems caused by diseases, insects, weeds, nutrient deficiencies and toxicities, herbicide injury, and environmental stress. Emphasis is on acquiring practical skills. Students will gain experience in written and oral communication.

PL P 408. Principles of Plant Pathology.

(Dual-listed with PL P 508). (2-3) Cr. 3. F.S. *Prereq:* 8 credits in life sciences, including BIOL 211 or 212.

Braun. Principles underlying the nature, diagnosis, and management of plant diseases. Laboratory complements lecture topics and provides experience in plant disease diagnosis.

PL P 416. Forest Insects and Diseases.

(Cross-listed with FOR). (3-0) Cr. 3. F. *Prereq:* 8 credits in biological sciences, including BIOL 211 or equivalent.

Nature of insects and pathogens of forest and shade trees; their role in the dynamics of natural and managed forest ecosystems; and the management of indigenous and exotic pests.

PL P 416L. Forest Insects and Diseases Laboratory.

(Cross-listed with FOR). (0-3) Cr. 1. F. *Prereq:* 8 credits in biological sciences, including BIOL 211 or equivalent. Credit or enrollment in PI P 416.

Laboratory experience working with insect and fungal pests of trees.

PL P 452. Integrated Management of Diseases and Insect Pests of Turfgrasses.

(Dual-listed with PL P 552). (Cross-listed with ENT, HORT). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* HORT 351

Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

PL P 477. Bacterial-Plant Interactions.

(Dual-listed with PL P 577). (Cross-listed with MICRO). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* 3 credits in microbiology or plant pathology

Overview of plant-associated bacteria including their ecology, diversity, and the physiological and molecular mechanisms involved with their interactions with plants. The course covers bacterial plant pathogens and pathogenesis, nitrogen fixation and plant symbioses, biological control and plant growth promotion, bacterial disease diagnosis and management, and approaches to the study of microbial communities in the rhizosphere and on leaves.

PL P 483. Wood Deterioration and Preservation.

(Cross-listed with FOR). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* FOR 280

Deterioration of wood in use by biological and physical agents. Wood preservation and fire retardant treatments. Environmental impact of wood treating.

PL P 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq:* Junior or senior classification, 7 credits in biological sciences, permission of instructor
A maximum of 6 credits of PI P 490 may be used toward the total of 128 credits required for graduation.

PL P 490A. Independent Study: Plant Pathology.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq:* Junior or senior classification, 7 credits in biological sciences, permission of instructor
A maximum of 6 credits of PI P 490 may be used toward the total of 128 credits required for graduation.

PL P 490H. Independent Study: Honors.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq:* Junior or senior classification, 7 credits in biological sciences, permission of instructor
A maximum of 6 credits of PI P 490 may be used toward the total of 128 credits required for graduation.

PL P 494. Seed Pathology.

(Dual-listed with PL P 594). (2-0) Cr. 2. Alt. F., offered odd-numbered years.

Prereq: PL P 408

Significance of biotic and abiotic diseases that affect the production and utilization of seeds, during each phase of the seed life cycle: growing, harvesting, conditioning, storing, and planting seed. Mechanisms of seed infection and seed-to-seedling transmission are considered for fungi, bacteria, viruses/viroids, and nematodes. Aspects of epidemiology, management, and host-pathogen relationships are discussed. Emphases include the role of seed health testing in the global seed industry for quality control and phytosanitary certification, as well as the use of seed treatments to manage seedborne and soilborne pathogens and pests. Concurrent enrollment in PI P 494L/594L (Seed Pathology Laboratory) is strongly encouraged (on-campus students only). Credit may not be obtained for both PI P 494/594 and STB/PI P 592.

PL P 494L. Seed Pathology Laboratory.

(Dual-listed with PL P 594L). (0-3) Cr. 1. Alt. F., offered odd-numbered years.

Prereq: PL P 408

Laboratory in seed pathology. Seed health testing methods; effects of seed treatments and seed conditioning on seedborne pathogens.

Courses primarily for graduate students, open to qualified undergraduates:

PL P 506. Plant-Pathogen Interactions.

(2-0) Cr. 2. S. *Prereq:* PL P 408 or PL P 416, BIOL 313

Baum, Whitham. Introduction to mechanisms of plant-parasite interaction. Genetics and molecular genetics of plant disease resistance and pathogenicity.

PL P 508. Principles of Plant Pathology.

(Dual-listed with PL P 408). (2-3) Cr. 3. F.S. *Prereq:* 8 credits in life sciences, including BIOL 211 or 212.

Braun. Principles underlying the nature, diagnosis, and management of plant diseases. Laboratory complements lecture topics and provides experience in plant disease diagnosis.

PL P 511. Integrated Management of Tropical Crops.

(Cross-listed with ENT, HORT). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: PL P 408 or PL P 416 or ENT 370 or ENT 376 or HORT 221

Applications of Integrated Crop Management principles (including plant pathology, entomology, and horticulture) to tropical cropping systems. Familiarization with a variety of tropical agroecosystems and Costa Rican culture is followed by 10-day tour of Costa Rican agriculture during spring break, then writeup of individual projects.

Meets International Perspectives Requirement.

PL P 530. Ecologically Based Pest Management Strategies.

(Cross-listed with AGRON, ENT, SUSAG). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

PL P 543. Ecology and Epidemiology of Plant Diseases.

(2-2) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* PL P 408 or PL P 416

Nutter. Theory and practice related to the ecology and epidemiology of plant disease epidemics. Interactions among host and pathogen populations as affected by the environment are quantified with respect to time and space. Analysis of ecological and host and pathogen genetic factors that alter the course of plant disease epidemics. Risk assessment theory, disease forecasting, and modeling the impact of biotic plant stresses on yield and quality are also emphasized.

PL P 552. Integrated Management of Diseases and Insect Pests of Turfgrasses.

(Dual-listed with PL P 452). (Cross-listed with ENT, HORT). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* HORT 351

Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

PL P 574. Plant Nematology.

(2-0) Cr. 2. Alt. SS., offered odd-numbered years. *Prereq:* 8 credits in biological sciences, including BIOL 211 or equivalent

Morphology, anatomy, identification, management, and life cycles of common plant-parasitic nematodes; host parasite interactions; recent advances in plant nematology.

PL P 574L. Laboratory Techniques in Plant Nematology.

(0-3) Cr. 1. Alt. SS., offered odd-numbered years. *Prereq:* 8 credits in biological sciences, including BIOL 211 or equivalent. Must also be registered for PI P 574.

Practical skills of sample collection, processing, extraction, and identification of plant-parasitic nematodes from soil and roots; other techniques will be discussed.

PL P 577. Bacterial-Plant Interactions.

(Dual-listed with PL P 477). (Cross-listed with MICRO). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* 3 credits in microbiology or plant pathology
Overview of plant-associated bacteria including their ecology, diversity, and the physiological and molecular mechanisms involved with their interactions with plants. The course covers bacterial plant pathogens and pathogenesis, nitrogen fixation and plant symbioses, biological control and plant growth promotion, bacterial disease diagnosis and management, and approaches to the study of microbial communities in the rhizosphere and on leaves.

PL P 590. Special Topics.

Cr. 1-3. Repeatable. F.S.SS. *Prereq:* 10 credits in biological sciences, permission of instructor

PL P 592. Seed Health Management.

(Cross-listed with STB). (2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq:* Admission to the Graduate Program in Seed Technology and Business/Consent of instructor

Munkvold. Occurrence and management of diseases during seed production, harvest, conditioning, storage, and planting. Emphasis on epidemiology, disease management in the field, seed treatment, effects of conditioning on seed health, and seed health testing. Credit may not be obtained for both PI P/STB 592 and PI P 594.

PL P 594. Seed Pathology.

(Dual-listed with PL P 494). (2-0) Cr. 2. Alt. F., offered odd-numbered years.

Prereq: PL P 408

Significance of biotic and abiotic diseases that affect the production and utilization of seeds, during each phase of the seed life cycle: growing, harvesting, conditioning, storing, and planting seed. Mechanisms of seed infection and seed-to-seedling transmission are considered for fungi, bacteria, viruses/viroids, and nematodes. Aspects of epidemiology, management, and host-pathogen relationships are discussed. Emphases include the role of seed health testing in the global seed industry for quality control and phytosanitary certification, as well as the use of seed treatments to manage seedborne and soilborne pathogens and pests. Concurrent enrollment in PI P 494L/594L (Seed Pathology Laboratory) is strongly encouraged (on-campus students only). Credit may not be obtained for both PI P 494/594 and STB/PI P 592.

PL P 594L. Seed Pathology Laboratory.

(Dual-listed with PL P 494L). (0-3) Cr. 1. Alt. F., offered odd-numbered years.

Prereq: PL P 408

Laboratory in seed pathology. Seed health testing methods; effects of seed treatments and seed conditioning on seedborne pathogens.

Courses for graduate students:**PL P 608. Molecular Virology.**

(Cross-listed with MICRO, V MPM). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* BBMB 405 or GDCB 511

Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

PL P 628. Improving Professional Presentation Skills.

(2-0) Cr. 2. F. *Prereq:* Graduate student status.

Skill building to improve oral presentation fundamentals for graduate students in biological sciences. Principles and guidance in both personal speaking style and maximizing impact of presentation software. In-depth lectures and class discussions on all aspects of presentation skills. Video and anonymous peer review of individual speeches.

PL P 691. Field Plant Pathology.

(0-6) Cr. 2. Repeatable. Alt. SS., offered even-numbered years. *Prereq:* PL P 408 or PL P 416

Diagnosis of plant diseases, plant disease assessment methods, and the integration of disease management into commercial crop production practices. Objectives are to familiarize students with common diseases of Midwest crops and landscape plants, and to provide experience in disease diagnosis. Field trips include commercial operations, agricultural research facilities, and ornamental plantings.

PL P 692. Molecular Biology of Plant-Pathogen Interactions.

(Cross-listed with MICRO). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: PL P 506 or BBMB 405 or GEN 411 or MICRO 402 or strong background in molecular biology

Seminal and current research in molecular and physiological aspects of plant interactions with pathogens, including mechanisms of pathogenesis, host-pathogen recognition and host defense, with an emphasis on critical evaluation of primary literature. Students also complete a research proposal writing and peer review exercise.

PL P 694. Colloquium in Plant Pathology.

(2-0) Cr. 2. Repeatable. F.S. *Prereq:* PL P 408 or PL P 416, permission of instructor

Advanced topics in plant pathology, including biological control, cultural control, resistance gene deployment, genetic engineering for disease resistance, chemical control, integrated pest management, emerging diseases, fungal genetics, insect vector biology, professional communications, etc.

PL P 698. Seminar.

Cr. 1. Repeatable. F.S.

PL P 699. Thesis and Dissertation Research.

Cr. arr. Repeatable.

F.S.SS.

Political Science (POL S)

Courses primarily for undergraduates:

POL S 101. Orientation to Political Science.

(2-0) Cr. 1. F.S. *Prereq: Political Science and Open Option majors only or permission of the instructor*

Introduction to the discipline and sub-fields of Political Science, including an introduction to analytical thinking, and research skills relevant to political science. Orientation to university, college, and departmental structure, policies, and procedures; student roles and responsibilities; degree planning and career awareness. Offered on a satisfactory-fail basis only.

POL S 215. Introduction to American Government.

(3-0) Cr. 3. F.S.SS.

Fundamentals of American democracy; constitutionalism; federalism; rights and duties of citizens; executive, legislative, and judicial branches of government; elections, public opinion, interest groups, and political parties.

POL S 235. Introduction to Ethics and Politics.

(3-0) Cr. 3. F.SS.

Introduction to moral controversies surrounding political issues such as violence, deception, corruption, civil disobedience, democracy, justice, equality, and freedom. Students will read classic and contemporary texts and consider political applications.

POL S 241. Introduction to Comparative Government and Politics.

(3-0) Cr. 3. F.S.

Basic concepts and major theories; application to selected political systems, including non-western political systems.
Meets International Perspectives Requirement.

POL S 251. Introduction to International Politics.

(3-0) Cr. 3. F.S.

Dynamics of interstate relations pertaining to nationalism, the nation state; peace and war; foreign policy making; the national interest; military capability and strategy; case studies of transnational issues, such as population, food, energy, and terrorism.

Meets International Perspectives Requirement.

POL S 298. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; sophomore classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

POL S 301. Introduction to Empirical Political Science Research.

(3-0) Cr. 3. F.S.SS. *Prereq: 3 credits in political science; one statistics course required; sophomore classification*

Techniques of quantitative and qualitative political research and analysis. Development and analysis of concepts and theories. Methods of data collection, research design, and critical thinking. Applications of statistics to political research.

POL S 305. Political Behavior.

(3-0) Cr. 3. F. *Prereq: Sophomore classification*

Empirical theories and descriptions of political behavior, including decision-making, opinion, and attitudes, with an emphasis on groups and political elites.

POL S 306. Public Opinion and Voting Behavior.

(3-0) Cr. 3. S. *Prereq: 6 credits in political science or sophomore classification*

The formation of political opinions and attitudes, political participation, and voting behavior of the general public, and their influences on American politics; polling as a means of assessing public opinions and behaviors.

POL S 310. State and Local Government.

(3-0) Cr. 3. S. *Prereq: 3 credits in political science*

Role of state and local governments in the American federal system. Structures of participation: political parties, elections, interest groups. Major governmental institutions: legislative, executive, and judicial. Structure and functions of local governments.

POL S 311. Municipal Government and Politics.

(3-0) Cr. 3. F. *Prereq: POL S 215*

Legal position of municipal corporation; forms of organization; administration of municipal services; problem-solving in municipal government; urban and metropolitan political process; implications of federal urban policies.

POL S 312. Special Topics in American Government and Politics.

(3-0) Cr. 2. F.S.

Half-semester courses on selected topical issues in American government and politics. Designated repeat in Pol S 312 is not permitted. Use of Pol S 312 credit in Pol S major and minor is limited. See Undergraduate Study for information.

POL S 313. Special Topics in Theory and Methods.

(1.5-0) Cr. 2. F.S.

Half-semester course on selected topical issues in theory and methods in political science. Designated repeat in Pol S 313 is not permitted. Use of Pol S 313 credit in Pol S major and minor is limited. See Undergraduate Study for information.

POL S 314. Special Topics in Comparative Politics.

(1.5-0) Cr. 2. F.S.

Half-semester course on selected topical issues in comparative politics. Designated repeat in Pol S 314 is not permitted. Use of Pol S 314 credit in Pol S major and minor is limited. See Undergraduate Study for information.

POL S 315. Special Topics in International Relations.

(1.5-0) Cr. 2. F.S.

Half-semester course on selected topical issues in international relations. Designated repeat in Pol S 315 is not permitted. Use of Pol S 315 credit in Pol S major and minor is limited. See Undergraduate Study for information.
Meets International Perspectives Requirement.

POL S 318. Campaign and Elections.

(3-0) Cr. 3. Alt. F., offered even-numbered years.

Methods and techniques of political campaigns in general elections. Supervised participation in candidate and political party campaign activities required.

POL S 319. Law and Politics.

(3-0) Cr. 3. F.S. *Prereq: Sophomore standing; POL S 215 recommended*

An evaluation of the American judicial system as it relates to controversial topics emphasizing the relationship between law and politics. Primary emphasis on topics such as statutory construction, judicial review, the proper role of the judiciary, vagueness and ambiguity in law, competing constitutional philosophies, executive branch concerns, and relative power of different branches. Credit for both Pol S 319 and 230 may not be applied toward graduation.

POL S 320. American Judicial Process.

(Cross-listed with CJ ST). (3-0) Cr. 3. S. *Prereq: POL S 215*

An overview of the American judicial process. Emphasis on specific topics such as application of constitutional rights to the states (particularly the Fourth, Fifth, Sixth, and Fourteenth Amendments), mechanics of judicial opinions, constitutional philosophies of Supreme Court Justices, decisions of first impression, and the value and scope of precedent.

POL S 333. Democracy and Diversity in America.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: Sophomore classification.*

Examination of competing Americans' conceptions of democracy as strategies for responding to the racial, religious, ethnic, gender, and economic diversity of the inhabitants of America. Connections to contemporary debates about topics such as immigration, affirmative action, multicultural education, religion, and minority representation.

Meets U.S. Diversity Requirement

POL S 334. Politics and Society.

(Cross-listed with SOC). (3-0) Cr. 3. F. *Prereq: A course in political science or sociology*

The relationship between politics and society with emphasis on American society. Discussion of theories of inequality, power, social movements, elites, ruling classes, democracy, and capitalism.

POL S 335. Science, Technology, and Public Policy.

(3-0) Cr. 3. S.

Examines the history and political dynamics of public science and technology policies. Examines differences in political and technological orientations. Assessment of the roles of politics, media, engineering, science, and private business in the formation public policies that put heavy reliance on or seek to advance science and technology.

POL S 340. Politics of Developing Areas.

(3-0) Cr. 3. Alt. S., offered even-numbered years.

Examination of economic and political development as they relate to the political process of developing states. Impact of social and technological change on political systems of developing areas. Some case studies.

POL S 343. Latin American Government and Politics.

(Cross-listed with US LS). (3-0) Cr. 3.

Political institutions, processes, and contemporary issues. Selected countries examined intensively to illustrate generalizations. Role of parties, military, church, human rights, women, environmental issues, interest groups, ideology, and globalization.

POL S 344. Public Policy.

(3-0) Cr. 3. S.

How agendas come to be set in public policy, theories describing the policy-making process, forces molding policy choices and the impact of such choices.

POL S 345. Immigration Policy.(3-0) Cr. 3. *Prereq: Junior or Senior classification*

Political, economic, and social factors that affect immigration policy in the United States and abroad. Systematic analysis and implications of different types of immigration policies in countries sending and receiving immigrants.

POL S 346. European Politics.

(3-0) Cr. 3. S.

Comparative study of political institutions of Europe and the European Union; emphasis on parties, elections, and governmental structures. Substance and process of public policies in selected problem areas.

POL S 347. African Politics.

(3-0) Cr. 3. F.

Major trends in African politics over the last 150 years and current issues facing Africans today. Basic African geography. Topics include democratization, economic development, civil conflict, ethnic politics and foreign aid. Meets International Perspectives Requirement.

POL S 349. Politics of Russia and the Soviet Successor States.

(3-0) Cr. 3. Alt. F., offered even-numbered years.

Nation-states of the former Soviet Union. Analysis of Soviet Communist system 1917-85 and the politics and revolutionary conflict leading to the dissolution of the Soviet Union from 1985 through 1991. Problems of post-Soviet nation-states of Russia and Central Eurasia since 1991.

Meets International Perspectives Requirement.

POL S 350. Politics of the Middle East.

(3-0) Cr. 3. S.

Introduction to the Middle East as a region and to issues of political importance to the Middle East and its place in the world. Topics covered include Islam, regional conflicts and alliances, local leaders, economic issues, and gender and social relations.

Meets International Perspectives Requirement.

POL S 354. War and the Politics of Humanitarianism.(Cross-listed with ANTHR). (3-0) Cr. 3. S. *Prereq: Pol S 235, Pol S 251, or Anthr 230*

Humanitarianism as a system of thought and a system of intervention in conflict and post-conflict situations: role of humanitarian organizations and actors in addressing human suffering caused by conflict or war military action as a form of humanitarian intervention.

Meets International Perspectives Requirement.

POL S 356. Theories of International Politics.

(3-0) Cr. 3.

Introduction to essential theoretical concepts and approaches, both classical and contemporary on world politics including realism, empiricism, liberalism, and postpositivism; for example, war and conflict, peace and cooperation, political economy, crisis decision-making, systemic theory, dependence and interdependence.

POL S 357. International Security Policy.

(3-0) Cr. 3. F.

The major theoretical approaches in security policy -- strategy and deterrence, game theory, bargaining theory, compellence, and coercive diplomacy, and crisis diplomacy. Illustration of these various approaches through historical and contemporary cases.

POL S 358. United States Foreign Policy.(3-0) Cr. 3. F. *Prereq: POL S 215 or POL S 251, or HIST 467 or HIST 470 or HIST 471*

U.S. foreign policy since World War II with emphasis on changing American values in foreign policy, the role of the President, Congress, and the bureaucracy in policy making, and a survey of current foreign policy issues and problems.

POL S 359. Current Issues in American Foreign Policy.(3-0) Cr. 3. S. *Prereq: POL S 215, POL S 251, or POL S 358*

Examination of contemporary U.S. foreign policy issues (e.g., U.S. policy in the Middle East; defense budgeting in the post-Cold War era; conventional and nuclear arms control policy). The course will explore alternate methods to analyze policy, survey the evolution of each issue, and discuss different policy alternatives.

POL S 360. American Institutions: Congress.(3-0) Cr. 3. *Prereq: POL S 215*

Theory and practice of representation and deliberation in the legislative branch of the republic; operations of Congress in terms of its committees, leadership, legislative and oversight processes, partisan politics, electoral campaigns, service to local and special electoral campaigns, service to local and special interests, and interactions with the President.

POL S 361. American Institutions: The Presidency.(3-0) Cr. 3. F. *Prereq: POL S 215*

Creation and historical development of the office of chief executive; character and behavior of past chief executives; selection and control; powers, roles, functions; executive staff; relations with Congress, press, public opinion.

POL S 363. American Institutions: Media.(3-0) Cr. 3. *Prereq: Sophomore standing*

Course surveys the influence of mass media organizations, forms, techniques, and technologies on the practices and expectations of American politics.

Evaluates the role of media in the political process, exploring the extents to which media promotes or discourages political participation. Topics will examine the influence and political uses of news coverage, political advertising, political debates, talk radio, film, the Internet, and media spectacles.

POL S 364. Political Parties and Interest Groups.(3-0) Cr. 3. F. *Prereq: POL S 215; sophomore classification*

Nature of political parties and interest groups, their relation to each other, and their effects on American politics. Topics include party identification, party organization and mobilization, factionalism, lobbying, campaign contributions and financing, and the effects of special interests on public law.

POL S 370. Religion and Politics.(Cross-listed with RELIG). (3-0) Cr. 3. *Prereq: Sophomore classification.*

The interaction of religion and politics in the U.S. from both an historical and contemporary perspective, as well as the role of religion in politics internationally.

POL S 371. Introduction to Public Administration.(3-0) Cr. 3. F. *Prereq: Sophomore classification*

A survey of the historic and contemporary administrative realities that contribute to the unique challenges of public governance at the administrative and managerial levels of international, national, state, and local government. This introductory course explores the essential issues and competencies involved in the efficient, effective, and ethical provision of public goods and services. Critical topics addressed in the course include crisis management, intergovernmental relations, social equity, public-private partnerships, and privatization.

POL S 381. International Political Economy.

(3-0) Cr. 3. S.

Introduction to the theoretical perspectives on international political economy. Exploration of specific issues such as the changing international trade regime, international finance, and Third World development under conditions of globalization.

POL S 383. Environmental Politics and Policies.(Cross-listed with ENV S). (3-0) Cr. 3. F. *Prereq: sophomore classification*

Major ideologies relation to conservation and ecology. Processes, participants, and institutions involved in state, national, and global environmental policymaking. Case studies of environmental controversies and proposals for policy reform.

POL S 385. Women in Politics.

(Cross-listed with W S). (3-0) Cr. 3. S.

Examination of the entry and participation of women in politics in the United States and other countries including a focus on contemporary issues and strategies for change through the political process.

Meets U.S. Diversity Requirement

POL S 395. Advanced Writing in Political Science.

Cr. R. F.S.SS.

Taken in conjunction with 300- or 400-level Political Science courses. Offered on a satisfactory-fail basis only.

POL S 397. International Study and Travel.Cr. arr. SS. *Prereq: Permission of instructor.*

Supervised study in an aspect of discipline while traveling or located in a foreign country.

Meets International Perspectives Requirement.

POL S 398. Cooperative Education.Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; junior classification*

Required of all cooperative education students. Students must register for this course prior to commencing work period.

POL S 413. Intergovernmental Relations.

(Dual-listed with POL S 513). (3-0) Cr. 3. S. *Prereq: 6 credits in American government*

Theories and practices of the American federal system. Politics and policy making among federal, state, and local governments.

POL S 417. Campaign Rhetoric.

(Cross-listed with SP CM). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: SP CM 212*

Backgrounds of candidates for state and national elections; selected speeches and issues; persuasive strategies and techniques of individual speakers.

POL S 420. Constitutional Law.

(3-0) Cr. 3. F. *Prereq: POL S 215; junior classification*

Development of the United States Constitution through judicial action; influence of public law and judicial interpretations upon American government and society.

POL S 421. Constitutional Freedoms.

(3-0) Cr. 3. S. *Prereq: POL S 320 or POL S 420*

Leading Supreme Court cases interpreting the Bill of Rights and the Fourteenth Amendment. Emphasis on religion, speech, privacy, due process, and equal protection.

POL S 422. International Law.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: POL S 215 or POL S 251; junior classification*

Development of the principles of international law of peace and war; analysis of theories concerning its nature and fundamental conceptions; its relation to national law; problems of international legislation and codification.

POL S 430. Foundations of Western Political Thought.

(Cross-listed with CL ST). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European history*

Study of original texts in political thought ranging from the classical period to the renaissance. Topics such as justice, freedom, virtue, the allocation of political power, the meaning of democracy, human nature, and natural law.

POL S 431. Modern Political Thought.

(Dual-listed with POL S 531). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European history*

Study of original texts in political thought ranging from the Reformation to the French Revolution and its aftermath. Topics such as justice, freedom, rights, democracy, toleration, property, power, skepticism, and normative views of international politics.

POL S 442. The Policy and Politics of Coastal Areas.

(Dual-listed with POL S 542). (Cross-listed with ENV S). (3-0) Cr. 3. SS.

Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, trade-offs between conservation and jobs, the quality of coastal lifestyle, ways in which citizens participate in policy for coastal areas.

POL S 452. Comparative Foreign Policy.

(Dual-listed with POL S 552). (3-0) Cr. 3. S. *Prereq: POL S 251*

Various theoretical approaches to explain foreign policy making and behavior through the use of case studies of selected nations. Meets International Perspectives Requirement.

POL S 453. International Organizations.

(3-0) Cr. 3. S. *Prereq: POL S 251*

Private and public organizations such as the United Nations, other specialized agencies, and multinational organizations, and their influence on our daily lives.

POL S 470. Political Game Theory.

(3-0) Cr. 3. *Prereq: ECON 101*

Application of economics to political science in the study of nonmarket decision-making. Behavior of bureaucrats, elected officials, and voters. Market failure, collective action, representative democracies, direct democracies, logrolling, voter paradoxes, and game theory.

POL S 475. Management in the Public Sector.

(Dual-listed with POL S 575). (3-0) Cr. 3. F. *Prereq: POL S 371*

Literature and research on organizational behavior and management theory with emphasis on applied aspects of managing contemporary public sector organizations. Topics include distinctions between public and private organizations, leadership, productivity, employee motivation, organizational structure, and organizational change.

POL S 476. Administrative Law.

(Dual-listed with POL S 576). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: POL S 215; junior classification*

Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations.

POL S 477. Government, Business, and Society.

(Dual-listed with POL S 577). (3-0) Cr. 3. F. *Prereq: Graduate classification*

Diverse perspectives on the changing roles and relationships of business, government, and society so as to open the way for more effective policy decisions on corporate-government affairs. Topics may include the changing economy; transformation of workplace and community conditions; consumerism; social responsibilities of businesses; economic policies and regulations; and politics in the business-government relationship.

POL S 480. Ethics and Public Policy.

(Dual-listed with POL S 580). (3-0) Cr. 3. *Prereq: 6 credits in political science*

Study of decision making approaches and application to case studies. Topics such as the different roles of public officials, proper scope and use of administrative discretion, and the admissibility of religious, political, and philosophical commitments in governmental decision making.

POL S 485. Comparative Public Administration.

(Dual-listed with POL S 585). (3-0) Cr. 3. F.

Comparisons of government bureaucratic structures and processes in major world regions, trends and issues of administrative and management reforms, globalization and other contemporary challenges to state administrative structures and policies, skills needed to evaluate and implement public management reforms.

POL S 487. Electronic Democracy.

(Dual-listed with POL S 587). (3-0) Cr. 3. *Prereq: Sophomore standing or instructor approval*

The impact of computers, the Internet, and the World Wide Web on politics and policy. The positive and negative effects on information technology (IT) on selected topics such as freedom, power and control, privacy, civic participation, the sense of "community," "virtual cities," interest group behavior, the new media, campaigns, elections, and voting will be examined.

POL S 490. Independent Study.

Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq: 6 credits in political science*

Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. No more than 9 credits of Pol S 490 may be counted toward graduation.

POL S 490A. Independent Study: American Government and Politics.

Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq: 6 credits in political science*

Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. No more than 9 credits of Pol S 490 may be counted toward graduation.

POL S 490B. Independent Study: Theory and Method.

Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq: 6 credits in political science*

Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. No more than 9 credits of Pol S 490 may be counted toward graduation.

POL S 490C. Independent Study: Comparative Politics.

Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq: 6 credits in political science*

Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. No more than 9 credits of Pol S 490 may be counted toward graduation.

POL S 490D. Independent Study: International Relations.

Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq: 6 credits in political science*

Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. No more than 9 credits of Pol S 490 may be counted toward graduation.

POL S 490E. Independent Study: Extended credit.

Cr. 1-2. Repeatable, maximum of 9 credits. F.S. *Prereq: 6 credits in political science*

Extra study for any 300-Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. No more than 9 credits of Pol S 490 may be counted toward graduation.

POL S 490G. Independent Study: Catt Center Project.

Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq: 6 credits in political science*

Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. No more than 9 credits of Pol S 490 may be counted toward graduation.

POL S 490H. Independent Study: Honors.

Cr. arr. Repeatable, maximum of 9 credits. F.S. *Prereq: 6 credits in political science*

Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. No more than 9 credits of Pol S 490 may be counted toward graduation.

POL S 491. Senior Thesis.

Cr. 3. *Prereq: 21 credits of POL S and permission of instructor*
Written under the supervision of a Political Science faculty advisor.

POL S 496. Teaching Internship in Political Science.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. F.S. *Prereq: 12 credits in political science and permission of instructor*

Undergraduate teaching experience through assisting an instructor with an introductory course in political science. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. Offered on a satisfactory-fail basis only.

POL S 497. Research Internship in Political Science.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. F.S. *Prereq: 12 credits in political science and permission of instructor*

Undergraduate research experience through assisting on a scholarly project with an instructor in political science. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. Offered on a satisfactory-fail basis only.

POL S 498. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

POL S 499. Internship in Political Science.

Cr. arr. F.S.SS. *Prereq: 6 credits in political science; junior or senior classification; and permission of internship coordinator*

Work experience with a specific nongovernmental or governmental agency at the local, state, national, or international level, combined with academic work under faculty supervision. Use of credit in Pol S major and minor is limited. See Undergraduate Study for information. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:**POL S 502. Political Analysis and Research.**

(3-0) Cr. 3. F. *Prereq: 6 credits in political science*

Scope and methods of political science. Introduction to theoretical approaches and analytical reasoning in political science. Relationship of theory and data. Research design.

POL S 504. Proseminar in International Politics.

(3-0) Cr. 3. S. *Prereq: 6 credits in political science or graduate standing*

An overview of the major theoretical and empirical works in the study of international politics and foreign policy. Among the major theoretical approaches surveyed and applied to international politics are realism, neo-realism, liberalism, functionalism, rational choice theory, game theory, and decision-making theory. Seminal writings by leading scholars will be reviewed.

POL S 505. Proseminar in Comparative Politics.

(3-0) Cr. 3. F. *Prereq: 6 credits in political science or graduate standing*

Major theoretic approaches to the study of comparative politics -- varying concepts and definitions of society and policy, administrative traditions, institutional arrangements, political behavior, etc. Contrasting research method designs.

POL S 506. Proseminar in American Politics.

(3-0) Cr. 3. S. *Prereq: 6 credits in political science or graduate standing*

A presentation of the major theories and research on American government and politics. Substantive topics include modern democratic theory, institutional performance, and mass political behavior. A variety of research methodologies are examined, including normative theory, behavioralism, and rational choice analysis.

POL S 507. Proseminar in Public Policy.

(3-0) Cr. 3. F. *Prereq: Six credits in political science or graduate standing*

An overview of the major theoretical approaches and empirical methods relevant to the study of public policy. Emphasis is placed on agenda setting, policy formation, policy sustainability, and policy analysis. Seminal writings by leading scholars will be reviewed. Leading quantitative and qualitative methodological tools for analyzing policy are presented.

POL S 510. State Government and Politics.

(3-0) Cr. 3. Alt. F., offered even-numbered years. Alt. S., offered odd-numbered years. *Prereq: POL S 310*

Comparative analysis of state political systems. Role of interest groups, political parties, legislatures, courts, and governors in state politics. Possible determinants of public policy outputs at the state level.

POL S 513. Intergovernmental Relations.

(Dual-listed with POL S 413). (3-0) Cr. 3. S. *Prereq: 6 credits of American government*

Theories and practices of the American federal system. Politics and policy making among federal, state, and local governments.

POL S 515. Biorenewables Law and Policy.

(Cross-listed with BRT). (3-0) Cr. 3. F.

Evaluation of the biorenewables field as it relates to the areas of law and policy. Primary emphasis on the following topics: concerns that motivated the development and expansion of the biorenewables field, a history of the interactions between biorenewable pathways. U.S. law and policy and controversies that have arisen from these interactions and their effects.

POL S 516. International Biorenewables Law & Policy.

(Cross-listed with BRT). (3-0) Cr. 3. S.

Evaluation of the international biorenewables field as it relates to the areas of law and policy. Primary emphasis on the following topics: concerns that motivated the development and expansion of the field by adopting countries, a history of the interactions between biorenewable pathways. Law and policy in adopting countries and international controversies that have arisen from these interactions and their effects.

POL S 525. Mass Political Behavior.

(3-0) Cr. 3. *Prereq: 6 credits in Political Science or graduate standing*

An in-depth survey of the theoretical, empirical, and methodological works concerning mass political behavior in the United States. Substantive topics include political attitudes and ideologies, public opinion and voting behavior, and political psychology. Methods for studying mass behavior include survey research and experimental approaches.

POL S 531. Modern Political Thought.

(Dual-listed with POL S 431). (3-0) Cr. 3. *Prereq: 6 credits in political science, philosophy, or European history*

Study of original texts in political thought ranging from the Reformation to the French Revolution and its aftermath. Topics such as justice, freedom, rights, democracy, toleration, property, power, skepticism, and normative views of international politics.

POL S 533. E-government and Information Policy.

(3-0) Cr. 3. S.

Overview of the legal and policy context of E-government development.

Topics include the legal and regulatory policies on information management in governments, and public policies that use information technologies to address economic and social concerns and their impacts on citizens and governmental organizations.

POL S 534. Legal and Ethical Issues in Information Assurance.

(Cross-listed with CPR E, INFAS). (3-0) Cr. 3. S. *Prereq: Graduate classification; CPR E 531 or INFAS 531*

Legal and ethical issues in computer security. State and local codes and regulations. Privacy issues.

POL S 535. Contemporary Political Philosophy.

(Cross-listed with PHIL). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: 6 credits of philosophy or political science*

Examination of theories of justice proposed by contemporary political philosophers. Analysis of the philosophical foundations of perspectives such as liberalism, libertarianism, communitarianism, socialism, feminism. Normative assessments of socio-political institutions.

POL S 542. The Policy and Politics of Coastal Areas.

(Dual-listed with POL S 442). (3-0) Cr. 3. SS.

Exploration of political implications of coastal policy. Issues include: "Carrying capacity," zoning, regulation of human development activities, tradeoffs between conservation and jobs, the quality of coastal lifestyle, and ways in which citizens participate in policy for coastal areas.

POL S 544. Comparative Public Policy.(3-0) Cr. 3. Alt. F., offered even-numbered years. Alt. S., offered odd-numbered years. *Prereq: 6 credits in political science*

Examines how, why and to what effect governments deal with substantive policy problems differently. Environmental factors, ideologies, cultures, domestic policy making processes, and interest groups.

POL S 552. Comparative Foreign Policy.(Dual-listed with POL S 452). (3-0) Cr. 3. S. *Prereq: POL S 251*

Various theoretical approaches to explain foreign policy making and behavior through the use of case studies of selected nations.

Meets International Perspectives Requirement.

POL S 560. American Political Institutions.(3-0) Cr. 3. *Prereq: 6 credits in American government*

Examination of policy-making and governance in a separation of powers system. Interaction between the chief executive, the legislature, administrative agencies, and the public. How political and legal forces affect policy makers and are reflected in public policies and programs.

POL S 569. Foundations of Public Administration.(3-0) Cr. 3. F. *Prereq: Graduate classification*

An examination of the social, political, intellectual, and environmental factors contributing to the historical development and central issues of American Public Administration. Exploration of classic and contemporary texts of public administration emphasizing constitutional and civic roles of public servants, administrative responsibility in democratic governance and justice, and essential frameworks to identify managerial skills, perspectives, and resources for effective, equitable public service.

POL S 570. Politics and Management of Nonprofit Organizations.(3-0) Cr. 3. *Prereq: Graduate classification*

Discussion of contemporary issues and perspectives shaping the policy development and management of national and international nonprofit organizations. Topics include an historic overview of nonprofit and philanthropic perspectives; exploration of nonprofit organization roles in public service provision; review of the legal framework influencing nonprofit governance; and consideration of capacity building issues such as strategic planning, board development, fundraising, human resources, and volunteer management.

POL S 571. Organizational Theory in the Public Sector.(3-0) Cr. 3. F. *Prereq: Graduate classification*

Major theories of administrative organization, including motivations of administrators and organizations, comparisons of organizational arrangements, factors affecting organizational arrangements, and formal and informal decision-making structures.

POL S 572. Public Finance and Budgeting.(3-0) Cr. 3. S. *Prereq: Graduate classification*

Topics such as the fiscal role of government in a mixed economy; evaluation of sources of public revenue and credit; administrative, political, and institutional aspects of the budget and the budgetary process; alternative budget formats; skills required to analyze public revenue and spending. Spreadsheet use required.

POL S 573. Public Personnel Administration.(3-0) Cr. 3. S. *Prereq: Graduate classification*

Course discusses the history and development of high performance personnel administration in the public and nonprofit sectors regarding strategic planning, employee rights and responsibilities, performance assessment, collective bargaining, and civil service systems. Emphasized basic competencies in the essential human resource management tools in the areas of recruitment, retention, employee development, compensation, discipline, and conflict resolution.

POL S 574. Policy and Program Evaluation.(3-0) Cr. 3. F. *Prereq: Graduate classification*

Integration, application, and utilization of public administration and public policy concepts in the interpretation of results and effectiveness of public programs and the prediction of consequences for policymakers and administrators.

POL S 575. Management in the Public Sector.(Dual-listed with POL S 475). (3-0) Cr. 3. F. *Prereq: POL S 371*

Literature and research on organizational behavior and management theory with emphasis on applied aspects of managing contemporary public sector organizations. Topics include distinctions between public and private organizations, leadership, productivity, employee motivation, organizational structure, and organizational change.

POL S 576. Administrative Law.

(Dual-listed with POL S 476). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: POL S 215; junior classification

Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations.

POL S 577. Government, Business, and Society.(Dual-listed with POL S 477). (3-0) Cr. 3. F. *Prereq: Graduate classification*

Diverse perspectives on the changing roles and relationships of business, government, and society so as to open the way for more effective policy decisions on corporate-government affairs. Topics may include the changing economy; transformation of workplace and community conditions; consumerism; social responsibilities of businesses; economic policies and regulations; and politics in the business-government relationship.

POL S 580. Ethics and Public Policy.(Dual-listed with POL S 480). (3-0) Cr. 3. *Prereq: 6 credits in political science*

Study of decision making approaches and application to case studies. Topics such as the different roles of public officials, proper scope and use of administrative discretion, and the admissibility of religious, political, and philosophical commitments in governmental decision making.

POL S 581. International Political Economy.(3-0) Cr. 3. F. *Prereq: 6 credits in political science*

An overview of the international political economy since the end of World War II. Special emphasis on national (primarily U.S.) development assistance and agricultural/food politics and policies, and those of the international food organizations, the World Bank, and the regional development banks.

POL S 582. Environmental Politics and Policies.(3-0) Cr. 3. F. *Prereq: 3 credits in political science or 3 credits in Environmental Studies; graduate classification*

Major ideologies relating to conservation and ecology. Processes, participants, and institutions involved in state, national, and global environmental policymaking. Case studies of environmental controversies and proposals for policy reform.

POL S 585. Comparative Public Administration.

(Dual-listed with POL S 485). (3-0) Cr. 3. F.

Comparisons of government bureaucratic structures and processes in major world regions, trends and issues of administrative and management reforms, globalization and other contemporary challenges to state administrative structures and policies, skills needed to evaluate and implement public management reforms.

POL S 587. Electronic Democracy.(Dual-listed with POL S 487). (3-0) Cr. 3. *Prereq: Sophomore standing or instructor approval*

The impact of computers, the Internet, and the World Wide Web on politics and policy. The positive and negative effects on information technology (IT) on selected topics such as freedom, power and control, privacy, civic participation, the sense of "community," "virtual cities," interest group behavior, the new media, campaigns, elections, and voting will be examined.

POL S 590. Special Topics.Cr. 2-5. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor***POL S 590A. Special Topics: American Political Institutions.**Cr. 2-5. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor***POL S 590B. Special Topics: Public Law.**Cr. 2-5. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor***POL S 590C. Special Topics: Political Theory and Methodology.**Cr. 2-5. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor***POL S 590D. Special Topics: Comparative Government.**Cr. 2-5. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor***POL S 590E. Special Topics: International Relations.**Cr. 2-5. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor*

POL S 590F. Special Topics: Policy Process.

Cr. 2-5. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor*

POL S 590G. Special Topics: Public Administration and Public Policy.

Cr. 2-5. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor*

POL S 590I. Special Topics: Internship.

Cr. 2-5. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor*

POL S 590T. Special Topics: Teaching Preparation.

Cr. 2-5. Repeatable. F.S. *Prereq: 15 credits in political science, written permission of instructor*

POL S 598. Graduate Student Internship.

Cr. 3-6. Repeatable, maximum of 6 credits. F.S. *Prereq: 15 credits in political science, permission of the instructor*

Supervised internship with administrative agencies, legislative organizations, judicial branch offices, and nonprofit groups.

POL S 599. Creative Component.

Cr. arr.

Courses for graduate students:**POL S 610. Graduate Seminars.**

(3-0) Cr. 3. Repeatable. F.S. *Prereq: 15 credits in political science*

POL S 610A. Graduate Seminars: American Political Institutions.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: 15 credits in political science*

POL S 610B. Graduate Seminars: Public Law.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: 15 credits in political science*

POL S 610C. Graduate Seminars: Political Theory and Methodology.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: 15 credits in political science*

POL S 610D. Graduate Seminars: Comparative Government.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: 15 credits in political science*

POL S 610E. Graduate Seminars: International Relations.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: 15 credits in political science*

POL S 610F. Graduate Seminars: Policy Process.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: 15 credits in political science*

POL S 610G. Graduate Seminars: Public Administration and Public Policy.

(3-0) Cr. 3. Repeatable. F.S. *Prereq: 15 credits in political science*

POL S 699. Thesis.

Cr. arr. Repeatable.

Psychology (PSYCH)

Courses primarily for undergraduates:

PSYCH 101. Introduction to Psychology.

(3-0) Cr. 3. F.S.SS.

Fundamental psychological concepts derived from the application of the scientific method to the study of behavior and mental processes. Applications of psychology.

PSYCH 102. Laboratory in Introductory Psychology.

(0-2) Cr. 1. F.S. Prereq: Credit or enrollment in PSYCH 101

Laboratory to accompany 101.

PSYCH 111. Orientation to Psychology.

Cr. 0.5. F.S.

Program requirements and degree/career options. Required of psychology majors. Offered on a satisfactory-fail basis only.

PSYCH 112. Psychology Learning Community Seminar.

(1-0) Cr. 1. Repeatable, maximum of 2 credits. F.S. Prereq: Participation in Freshman Learning Community

Topics include orientation to academic program requirements, career awareness, strategies for successful transition to college, connections with other disciplines, and applying psychology via service learning opportunities. Offered on a satisfactory-fail basis only.

PSYCH 131. Academic Learning Skills.

(0-2) Cr. 1. F.S.

Efficient methods of time management, goal setting and motivation, and other learning strategies such as note-taking, reading, and test preparation. Offered on a satisfactory-fail basis only.

PSYCH 132. Motivation and Academic Learning Skills.

(0-2) Cr. 1. Repeatable. F.S. Prereq: PSYCH 131

Continued development of academic learning skills with an emphasis on motivation and application of learning strategies. Offered on a satisfactory-fail basis only.

PSYCH 230. Developmental Psychology.

(3-0) Cr. 3. F.S.SS.

Life-span development of physical traits, cognition, intelligence, language, social and emotional behavior, personality, and adjustment.

PSYCH 250. Psychology of the Workplace.

(3-0) Cr. 3.

Survey of theories and research methods of psychology applied to the workplace. Consideration of employee selection, training, performance evaluation, leadership, work groups, employee motivation, job attitudes and behaviors, organizational culture, organizational development, human factors, and job design from the scientist-practitioner approach.

PSYCH 280. Social Psychology.

(3-0) Cr. 3. F.S.SS.

Individual human behavior in social contexts. Emphasis on social judgments and decisions, attitudes, perceptions of others, social influence, aggression, stereotypes, and helping.

PSYCH 291. Introductory Research Experience.

Cr. 1-4. Repeatable, maximum of 4 credits. F.S. Prereq: PSYCH 101, sophomore classification, and permission of instructor.

Beginning level supervised research experience in a faculty laboratory. Offered on a satisfactory-fail basis only.

PSYCH 301. Research Design and Methodology.

(3-0) Cr. 3. F.S.SS. Prereq: STAT 101; 1 course in psychology

Overview of the principal research techniques used in psychology with an emphasis on the statistical analysis of psychological data.

PSYCH 302. Research Methods in Psychology.

(2-2) Cr. 3. F.S. Prereq: PSYCH 301, ENGL 250

Discussion of and experience in designing research studies, collecting and analyzing data, and preparing research reports in psychology.

PSYCH 310. Brain and Behavior.

(3-0) Cr. 3. F.S. Prereq: PSYCH 101

Survey of basic concepts in the neurosciences with emphasis on brain mechanisms mediating sensory processes, arousal, motivation, learning, and abnormal behavior.

PSYCH 312. Sensation and Perception.

(3-0) Cr. 3. F.S. Prereq: PSYCH 101

Survey of the physiology and psychology of human sensory systems including vision, audition, smell, taste, the skin senses, and the vestibular senses.

PSYCH 313. Learning and Memory.

(3-0) Cr. 3. F.S. Prereq: PSYCH 101

Survey of fundamental concepts and theories related to learning and memory derived from human and animal research.

PSYCH 314. Motivation.

(3-0) Cr. 3. F.S. Prereq: PSYCH 101

Theory and research on motivation at biological, environmental, and psychological levels. Topics include emotion, eating, sex, music, addictions, incentives, goal performance, personality, coping, self-determination and purpose.

PSYCH 315. Drugs and Behavior.

(3-0) Cr. 3. F.S. Prereq: PSYCH 101

Biologically based examination of the effects of drugs on behavior and social interactions, including recreational drugs and drugs used in the treatment of psychiatric and neurological disorders.

PSYCH 316. Cognitive Psychology.

(3-0) Cr. 3. F.S. Prereq: PSYCH 101

Overview of human cognition, including sensation and perception, attention, memory, education, language, and judgment and decision making.

PSYCH 318. Thinking and Decision Making.

(3-0) Cr. 3. F.S. Prereq: PSYCH 101; STAT 101 or MATH 104 or equivalent

Understanding human reasoning and decision making, including evaluating evidence, judging probabilities, emotional influences, and social dilemmas, with emphasis on the mechanisms that underlie decision making.

PSYCH 333. Educational Psychology.

(Cross-listed with C I). (3-0) Cr. 3. F.S. Prereq: PSYCH 230 or HD FS 102,

application to the teacher education program or major in psychology Classroom learning with emphasis on theories of learning and cognition, and instructional techniques. Major emphasis on measurement theory and the classroom assessment of learning outcomes.

PSYCH 335. Abnormal Psychology of Children and Adolescents.

(3-0) Cr. 3. F.S. Prereq: PSYCH 101; PSYCH 230 or HDFS 102

Psychopathology of children and adolescents, including childhood depression and anxiety disorders. Consideration of multiple probable causes and corresponding therapies.

PSYCH 346. Psychology of Women.

(Cross-listed with W S). (3-0) Cr. 3. S. Prereq: 2 courses in psychology including PSYCH 101

Survey of theory and research related to major biological, interpersonal, and cultural issues affecting girls' and women's psychological development and behavior.

Meets U.S. Diversity Requirement

PSYCH 347. U.S. Latino/a Psychology.

(Cross-listed with US LS). (3-0) Cr. 3. S. Prereq: Two courses in Psychology including PSYCH 101

Historical, political, and social contexts of psychological and mental health constructs in terms of their validity and utility for use in Latino/a people in the U.S. Unique aspects of psychological functioning particular to Latino/a peoples in the U.S.

Meets U.S. Diversity Requirement

PSYCH 348. Psychology of Religion.

(Cross-listed with RELIG). (3-0) Cr. 3. Prereq: Nine credits in psychology

Survey of psychological theory and research investigating religious and spiritual attitudes, beliefs and practices.

PSYCH 350. Human Factors in Technology.

(3-0) Cr. 3. F. Prereq: PSYCH 101; junior classification

Understanding human behavior and cognition in the context of modern technologies. Focus on emergent interactive technologies, human computer interaction, user centered design, usability analysis, and usability testing.

PSYCH 360. Personality Psychology.

(3-0) Cr. 3. F.S.SS. Prereq: PSYCH 101

Historical and contemporary theory and research on development and expression of personality with a focus on normal functioning.

PSYCH 380. Social Cognition.

(3-0) Cr. 3. Prereq: PSYCH 101 or PSYCH 280

How people understand themselves and others, including attribution, social categories and schemas, the self, social inference, stereotypes, and prejudice.

PSYCH 381. Social Psychology of Small Group Behavior.

(Cross-listed with SOC). (3-0) Cr. 3. S. *Prereq: SOC 305 or PSYCH 280*
A survey of small group theory and research from an interdisciplinary, social psychological perspective.

PSYCH 383. Psychology and Law.

(3-0) Cr. 3. F.S. *Prereq: PSYCH 101 or PSYCH 280*
Survey of topics in the interface between psychology and the legal system including but not limited to Miranda warning, confessions, police interrogation, lie detection, juries, eyewitness identification, false memories, and the death penalty.

PSYCH 386. Media Psychology.

Cr. 3. F.S.SS. *Prereq: PSYCH 101 or PSYCH 230 or PSYCH 280*
Theories and research on the psychological mechanisms (e.g., attitudes, perceptions, emotions, arousal) by which media influence children and adults. Topics include media violence, educational media, advertising, music, video games, media literacy, and ratings.

PSYCH 401. History of Psychology.

(3-0) Cr. 3. F.S. *Prereq: 4 courses in psychology*
Philosophy and science backgrounds of psychology. Development of theories and causes of events in academic and applied psychology.

PSYCH 410. Behavioral Neurology.

(Dual-listed with PSYCH 510). (3-0) Cr. 3. F. *Prereq: PSYCH 101; PSYCH 310 or equivalent.*
Examination of the neuroanatomical foundation of cognition, affect, and action from a neurological perspective. Focus on basic and applied research with neurological patients.

PSYCH 411. Evolutionary Psychology.

(3-0) Cr. 3. S. *Prereq: Junior classification, three courses in psychology; one course in biology*
Examination of the application of the principles of evolutionary biology to the understanding of human behavior. Evolutionary perspectives on brain development, cognition, language, mating behavior, sex differences, altruism, artistic behavior, and criminal behavior are explored. Arguments by those critical of the evolutionary approach to psychology are also examined.

PSYCH 413. Psychology of Language.

(Cross-listed with LING). (3-0) Cr. 3. *Prereq: PSYCH 101*
Introduction to psycholinguistics. Topics may include origin of language, speech perception, language comprehension, reading, bilingualism, brain bases of language, and computational modeling of language processes.

PSYCH 422. Counseling Theories and Techniques.

(3-0) Cr. 3. F. *Prereq: 3 courses in psychology*
Overview of the major counseling theories and techniques, with emphasis on the key concepts of each theory, the role of the counselor, therapeutic goals, and the main techniques derived from each theory.

PSYCH 422L. Laboratory in Counseling Theory and Techniques.

(0-2) Cr. 1. F. *Prereq: Three classes in psychology and credit or enrollment in PSYCH 422.*
Learn basic counseling skills such as active listening, reflecting feelings, empathy, confrontation, immediacy and self-disclosure. Supervised practice using basic counseling skills.

PSYCH 440. Psychological Measurement I.

(2-2) Cr. 3. F.S.SS. *Prereq: PSYCH 301 and 9 credits in psychology, STAT 101*
Principles of psychological measurement, including concepts of reliability and validity; interpretation of scores; factors influencing performance; construction and use of measures of ability, achievement, and personality.

PSYCH 450. Industrial Psychology.

(3-0) Cr. 3. F.S. *Prereq: 2 courses in psychology including PSYCH 101, STAT 101*
Theory, content and methods of industrial psychology related to the effective operation of organizations. Application of psychology principles to topics including different approaches used to select employees, how to conduct performance appraisals, and how to train and keep employees safe. Work attitudes and behaviors of employees as well as relevant legal issues. Statistics including regression and correlation are used.

PSYCH 460. Abnormal Psychology.

(3-0) Cr. 3. F.S.SS. *Prereq: 3 courses in psychology including PSYCH 101*
Description of major forms of maladaptation including anxiety, mood disorders, personality disorders, substance dependence, and schizophrenia. Factors in the development of behavior deviations. Research pertinent to the description, development, and maintenance of abnormal behavior.

PSYCH 470. Seminar in Psychology.

(1-0) Cr. 1-3. Repeatable. *Prereq: 12 credits in psychology*
Current topics in psychological research and practice in the following areas.

PSYCH 470A. Seminar in Psychology: Counseling.

(1-0) Cr. 1-3. Repeatable. *Prereq: 12 credits in psychology*

PSYCH 470B. Seminar in Psychology: Experimental.

(1-0) Cr. 1-3. Repeatable. *Prereq: 12 credits in psychology*

PSYCH 470C. Seminar in Psychology: Individual Differences.

(1-0) Cr. 1-3. Repeatable. *Prereq: 12 credits in psychology*

PSYCH 470D. Seminar in Psychology: Social.

(1-0) Cr. 1-3. Repeatable. *Prereq: 12 credits in psychology*

PSYCH 484. Psychology of Close Relationships.

(3-0) Cr. 3. *Prereq: 9 credits in psychology including PSYCH 280*
Theories and research concerning the functions, development, and deterioration of close relationships. Influence of psychological processes on friendship, romantic, marital, and family relationships. Topics include mate selection, interdependence, trust and commitment, power and dominance in relationships, sexuality, divorce, gender roles, and family interaction.

PSYCH 485. Health Psychology.

(3-0) Cr. 3. F. *Prereq: Junior classification, 6 credits in psychology*
Application of psychological theory and research methods to issues in physical health. Psychological factors in illness prevention, health maintenance, treatment of illness, recovery from injury and illness, and adjustment to chronic illness.

PSYCH 487. Human Aggression.

(3-0) Cr. 3. S. *Prereq: PSYCH 230 or PSYCH 280; PSYCH 301; PSYCH 313, PSYCH 316, PSYCH 318, PSYCH 360, or PSYCH 380*
Theory and research on development and occurrence of human aggression; implications for prevention and treatment.

PSYCH 488. Cultural Psychology.

(3-0) Cr. 3. *Prereq: PSYCH 280 and PSYCH 301; junior classification*
Examination of the ways that cultural beliefs, values, and affordances shape cognitive, developmental, social and other psychological phenomena, as well as the forces that shape and change culture.
Meets International Perspectives Requirement.

PSYCH 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Junior classification, 6 credits in psychology, and permission of instructor*
Supervised reading in an area of psychology. Writing requirement. No more than 9 credits of Psych 490 may be counted toward a degree in psychology.

PSYCH 491. Research Practicum.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Junior classification, permission of instructor, and credit or enrollment in PSYCH 301*
Supervised research in an area of psychology. Primarily for students intending to pursue graduate education. No more than 9 credits of Psych 491 may be counted toward a degree in psychology.

PSYCH 492. Fieldwork Practicum.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Junior classification, 12 credits in psychology, and permission of instructor*
Supervised fieldwork in one of the following applied psychology settings. Offered on a satisfactory-fail basis only. No more than 9 credits of Psych 492 may be counted toward a degree in psychology.

PSYCH 492A. Fieldwork Practicum: Human Services.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Junior classification, 12 credits in psychology and permission of instructor*
Offered on a satisfactory-fail basis only.

PSYCH 492B. Fieldwork Practicum: I/O Psychology.

Cr. arr. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Junior classification, 12 credits in psychology including PSYCH 450 or PSYCH 250 and enrollment in PSYCH 450, and permission of instructor.*
Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:**PSYCH 501. Foundations of Behavioral Research.**

(3-0) Cr. 3. F.S. *Prereq: STAT 401 or equivalent*
Ethical issues, research design, sampling design, measurement issues, power and precision analysis, interpretation of statistical results in non-experimental, quasi-experimental, and experimental research, use of statistical packages.

PSYCH 508. Research Methods in Applied Psychology.

(3-0) Cr. 3. *Prereq: PSYCH 440 and PSYCH 501 or STAT 401*
Methods and issues in applied psychological research. Role of theory in research, fidelity of measurement, selection of subjects, sampling, ethical issues, experimenter bias, data collection methods, power analysis, and professional standards for writing research articles. Emphasis on research methodological issues, not statistical issues.

PSYCH 510. Behavioral Neurology.

(Dual-listed with PSYCH 410). (3-0) Cr. 3. F. *Prereq: PSYCH 101; PSYCH 310 or equivalent.*

Examination of the neuroanatomical foundation of cognition, affect, and action from a neurological perspective. Focus on basic and applied research with neurological patients.

PSYCH 516. Advanced Cognition.

(3-0) Cr. 3. F.S. *Prereq: PSYCH 316*

Theoretical models and empirical research in human cognition including perception, attention, memory, concepts/categorization, imagery, and judgment and decision making.

PSYCH 517. Psychopharmacology.

(3-0) Cr. 3. *Prereq: PSYCH 310, PSYCH 315, or equivalent and permission of instructor*

Fundamentals of drug-behavior interactions with emphasis on psychoactive drugs and their use in experimental, therapeutic, and social settings.

PSYCH 519. Cognitive Neuropsychology.

(3-0) Cr. 3. *Prereq: PSYCH 310 and PSYCH 316 or PSYCH 313; graduate classification or permission of instructor*

Psychological models and related neurological substrates underlying cognition in normal and brain-damaged individuals.

PSYCH 521. Cognitive Psychology of Human Computer Interaction.

(Cross-listed with HCI). (3-0) Cr. 3. *Prereq: Graduate classification or instructor approval*

Biological, behavioral, perceptual, cognitive and social issues relevant to human computer interactions.

PSYCH 522. Scientific Methods in Human Computer Interaction.

(Cross-listed with HCI). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: PSYCH 521 and STAT 101 or equivalent*

Basics of hypothesis testing, experimental design, analysis and interpretation of data, and the ethical principles of human research as they apply to research in human computer interaction.

PSYCH 533. Educational Psychology of Learning, Cognition, and Memory.

(Cross-listed with C I). (3-0) Cr. 3. F.

Learning, cognition, and memory in educational/training settings.

PSYCH 538. Developmental Disabilities.

(Cross-listed with HD FS). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: 9 credits in human development and family studies or psychology or permission of instructor

Theories, research, and current issues regarding the intersection of development and disabilities. Investigation of interventions with individuals and families. (on-line course offering via Distance Education).

PSYCH 542. Applied Psychological Measurement.

(3-0) Cr. 3. F. *Prereq: PSYCH 440*

Principles of psychological measurement, including concepts of reliability and validity; interpretation of scores; factors influencing performance; test construction and use of measures of intelligence, ability, achievement, vocational interest, and personality. Ethical and multicultural issues in measurement.

PSYCH 544. Practicum in Assessment.

(2-1) Cr. 2. F.S. *Prereq: PSYCH 542 and admission into the PhD program in counseling psychology*

Supervised practice in designing and implementing observational systems and in administering, scoring, interpreting, and reporting individual tests.

PSYCH 560. Advanced Personality Psychology.

(3-0) Cr. 3. *Prereq: 4 courses in psychology, including PSYCH 360*

Advanced analysis of contemporary theory and research on personality measurement, development, heritability, and social expression.

PSYCH 561. Psychopathology and Behavior Deviations.

(3-0) Cr. 3. *Prereq: PSYCH 460*

Examination of theoretical perspectives and current research pertinent to the major forms of adult dysfunction including: adjustment, anxiety, mood, somatoform, dissociative, sexual and gender identity, personality, schizophrenic, eating, and substance abuse disorders.

PSYCH 562. Personality Assessment.

(3-0) Cr. 3. *Prereq: PSYCH 360, PSYCH 440, PSYCH 542, and PSYCH 501 or STAT 401 and admission to the PhD program in counseling psychology*

Principles, concepts, and methods of personality assessment. Though not a practicum course, exposure is given to a variety of objective, projective, and situational tests.

PSYCH 580. Advanced Social Psychology: Psychological Perspectives.

(3-0) Cr. 3. *Prereq: 4 courses in psychology, including PSYCH 280*

Current theories, methods, and research in social psychology with an emphasis on cognitive and interpersonal processes such as attribution, social cognition, attitude change, attraction, aggression, and social comparison.

PSYCH 590. Special Topics.

Cr. arr. Repeatable. *Prereq: 12 credits in psychology, and permission of instructor* Guided reading on special topics or individual research projects in the following areas.

PSYCH 590A. Special Topics: Counseling.

Cr. arr. Repeatable. *Prereq: 12 credits in psychology, and permission of instructor*

PSYCH 590Q. Special Topics: Cognitive.

Cr. arr. Repeatable. *Prereq: 12 credits in psychology, and permission of instructor*

PSYCH 590R. Special Topics: Social.

Cr. arr. Repeatable. *Prereq: 12 credits in psychology, and permission of instructor*

PSYCH 590Z. Special Topics: General.

Cr. arr. Repeatable. *Prereq: 12 credits in psychology, and permission of instructor*

PSYCH 592. Seminar in Psychology.

(1-0) Cr. 1-3. Repeatable. *Prereq: 12 hours in psychology or graduate classification.*

Seminar in the following areas.

PSYCH 592C. Seminar in Psychology: Developmental.

(1-0) Cr. 1-3. Repeatable. F.S. *Prereq: 12 hours in psychology or graduate classification.*

PSYCH 592P. Seminar in Psychology: Research Methods and Psychometrics.

(1-0) Cr. 1-3. Repeatable. *Prereq: 12 hours in psychology or graduate classification.*

PSYCH 592Z. Seminar in Psychology: General.

(1-0) Cr. 1-3. Repeatable. *Prereq: 12 hours in psychology or graduate classification.*

PSYCH 594. Quantitative Behavioral Methods.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

Specialized quantitative methods for social and behavioral research problems in the following areas.

PSYCH 594A. Quantitative Behavioral Methods: Classical psychometric theory.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

PSYCH 594B. Quantitative Behavioral Methods: Modern psychometric methods.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

PSYCH 594C. Quantitative Behavioral Methods: Construct validation.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

PSYCH 594D. Quantitative Behavioral Methods: Multi-dimensional scaling.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

PSYCH 594E. Quantitative Behavioral Methods: Cluster Analysis.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

PSYCH 594F. Quantitative Behavioral Methods: Meta-analysis.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

PSYCH 594G. Quantitative Behavioral Methods: Longitudinal analysis.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

PSYCH 594I. Quantitative Behavioral Methods: Focus Groups.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

PSYCH 594K. Quantitative Behavioral Methods: Mediation and Moderation.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

Specialized quantitative methods for social and behavioral research problems.

PSYCH 594L. Quantitative Behavioral Methods: Missing Data.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent.*

Specialized quantitative methods for social and behavioral research problems.

PSYCH 594M. Quantitative Behavioral Methods: Power Analysis.

(1-0) Cr. 1. F.S. *Prereq: PSYCH 501 or equivalent*

Specialized quantitative methods for social and behavioral research problems.

PSYCH 595. Seminar in Social Psychology.

Cr. 1-3. Repeatable. F.S. *Prereq: 12 credits in Psychology*

Seminar in the following areas in social psychology.

PSYCH 595A. Seminar in Social Psychology: Social Cognition.

Cr. 1-3. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 595B. Seminar in Social Psychology: Aggression.

Cr. 1-3. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 595C. Seminar in Social Psychology: Culture.

Cr. 1-3. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 595D. Seminar in Social Psychology: Attitudes and Attitude Change.

Cr. 1-3. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 595E. Seminar in Social Psychology: Psychology and Law.

Cr. 1-3. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 595G. Seminar in Social Psychology: Close Relationships.

Cr. 1-3. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 595I. Seminar in Social Psychology: General.

Cr. arr. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 596. Seminar in Counseling Psychology.

Cr. arr. Repeatable. F.S. *Prereq: 12 credits in Psychology*

Seminar in the following areas in counseling psychology.

PSYCH 596A. Seminar in Counseling Psychology: Supervision.

Cr. arr. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 596B. Seminar in Counseling Psychology: Research.

Cr. arr. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 596C. Seminar in Counseling Psychology: Multicultural.

Cr. arr. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 596D. Seminar in Counseling Psychology: Professional Issues and Ethics.

Cr. arr. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 596E. Seminar in Counseling Psychology: General.

Cr. arr. Repeatable. F.S. *Prereq: 12 credits in Psychology*

PSYCH 597. Internship in Psychology.

Cr. R. *Prereq: M.S. degree candidacy; permission of instructor*

Full-time, non-clinical, supervised experience in a setting relevant to psychology.

Intended for master's degree level internships.

PSYCH 598. Seminar in Cognitive Psychology.

Cr. 0. Repeatable. F.S. *Prereq: PSYCH 516, PSYCH 501 or STAT 401.*

Seminar in the following areas in cognitive psychology.

PSYCH 598A. Seminar in Cognitive Psychology: Attention and Perception.

Cr. arr. Repeatable. F.S. *Prereq: PSYCH 516, PSYCH 501 or STAT 401*

PSYCH 598B. Seminar in Cognitive Psychology: Memory.

Cr. arr. Repeatable. F.S. *Prereq: PSYCH 516, PSYCH 501 or STAT 401*

PSYCH 598C. Seminar in Cognitive Psychology: Cognitive Neuroscience.

Cr. arr. Repeatable. F.S. *Prereq: PSYCH 516, PSYCH 501 or STAT 401*

PSYCH 598D. Seminar in Cognitive Psychology: Judgment and Decision Making.

Cr. arr. Repeatable. F.S. *Prereq: PSYCH 516, PSYCH 501 or STAT 401*

PSYCH 598E. Seminar in Cognitive Psychology: Evolution.

Cr. arr. Repeatable. F.S. *Prereq: PSYCH 516, PSYCH 501 or STAT 401*

PSYCH 598F. Seminar in Cognitive Psychology: Language.

Cr. arr. Repeatable. F.S. *Prereq: PSYCH 516, PSYCH 501 or STAT 401*

PSYCH 598G. Seminar in Cognitive Psychology: Applied.

Cr. arr. Repeatable. F.S. *Prereq: PSYCH 516, PSYCH 501 or STAT 401*

PSYCH 598I. Seminar in Cognitive Psychology: General.

Cr. arr. Repeatable. F.S. *Prereq: PSYCH 516, PSYCH 501 or STAT 401*

PSYCH 599. Creative Component.

Cr. arr.

Offered on a satisfactory-fail basis only.

Courses for graduate students:**PSYCH 601. History of Philosophy of Psychology.**

(3-0) Cr. 3. *Prereq: 4 courses in psychology*

Origins of psychology in philosophical, medical, and related thought. Development as an independent discipline in the nineteenth and twentieth centuries as a science and as a practice including traditional and contemporary theory and philosophy.

PSYCH 605. Multi-level Modeling.

(Cross-listed with HD FS). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: HD FS 503 and HD FS 505 or STAT 404 or permission of instructor

Rationale for and interpretation of random coefficient models. Strategies for the analysis of multi-level and panel data including models for random intercepts, random slopes, and growth curves. Applications including HLM, SAS, PROC MIX, and MPLUS.

PSYCH 621. Psychological Counseling -Theory and Process.

(3-0) Cr. 3. F. *Prereq: 3 courses in psychology and permission of instructor*

Overview of major counseling theories with emphases upon: key concepts of theories, the role of the counselor, and applications of theory in fostering client change.

PSYCH 621L. Psychological Counseling -Theory and Process: Techniques in Counseling.

(0-6) Cr. 3. F. *Prereq: permission of instructor required*

Development of basic counseling skills and techniques through observation, role-playing, case studies, and supervised counseling sessions.

PSYCH 623. Vocational Behavior.

(3-0) Cr. 3. *Prereq: 3 courses in psychology or graduate classification*

Theoretical views, research, and issues in career development through the life span. Methods of career counseling, including appraisal interviewing, assessment, test interpretation, and use of information sources.

PSYCH 626. Group Counseling.

(2-2) Cr. 3. *Prereq: Graduate classification*

Theory, research, ethical issues, and therapeutic considerations relevant to group counseling. Participation in lab exercises for development of group counseling skills and observation of ongoing groups.

PSYCH 633. Teaching of Psychology.

(3-0) Cr. 3. *Prereq: Enrollment in doctoral degree program in psychology,*

completion of at least 1 year of graduate study, permission of instructor

Orientation to teaching of psychology at college level: academic issues and problems, instructional and evaluative techniques.

PSYCH 691. Practicum in Psychology.

Cr. arr. F.S. *Prereq: Prereq: Permission of instructor*

Supervised practice and experience in the following fields of specialization in applied psychology.

PSYCH 691A. Practicum in Psychology: Counseling (Beginning).

Cr. 1-3. Repeatable, maximum of 6 credits. F.S. *Prereq: PSYCH 621L*

PSYCH 691B. Practicum in Psychology: Counseling (Intermediate).

Cr. 1-3. Repeatable, maximum of 6 credits. F.S. *Prereq: Permission of instructor, PSYCH 691A*

PSYCH 691C. Practicum in Psychology: Counseling (Advanced).

Cr. 1-3. Repeatable, maximum of 6 credits. F.S. *Prereq: Permission of instructor, PSYCH 691A, PSYCH 691B*

PSYCH 691D. Practicum in Psychology: Counseling (Advanced External Practicum).

Cr. 1-3. Repeatable, maximum of 6 credits. F.S. *Prereq: Permission of instructor, PSYCH 691A, PSYCH 691B*

PSYCH 691G. Practicum in Psychology: Group Counseling.

Cr. 1-3. F.S. *Prereq: Prereq: Permission of instructor, PSYCH 626, PSYCH 691A*

PSYCH 691S. Practicum in Psychology: Supervision.

Cr. 1-3. F.S. *Prereq: Permission of instructor, PSYCH 592A, PSYCH 621L*

PSYCH 691T. Practicum in Psychology: Teaching.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S. *Prereq: Permission of instructor, PSYCH 633*

Offered on a satisfactory-fail basis only.

PSYCH 691Z. Practicum in Psychology: General.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S. *Prereq: Permission of instructor*

PSYCH 692. Research Seminar.

(1-0) Cr. 1-3. Repeatable. *Prereq: Permission of instructor*

Research seminar in the following areas.

PSYCH 692A. Research Seminar: Counseling.

(1-0) Cr. 1-3. Repeatable. *Prereq: Permission of instructor*

PSYCH 692Q. Research Seminar: Cognitive.

(1-0) Cr. 1-3. Repeatable. *Prereq: Permission of instructor*

PSYCH 692R. Research Seminar: Social.

(1-0) Cr. 1-3. Repeatable. *Prereq: Permission of instructor*

PSYCH 692Z. Research Seminar: General.

(1-0) Cr. 1-3. Repeatable. *Prereq: Permission of instructor*

PSYCH 697. Internship in Counseling Psychology.

Cr. R. Prereq: *Ph.D. candidacy in the Counseling Psychology program, approved dissertation proposal, and permission of instructor*

Full time supervised predoctoral internship experience in a setting relevant to counseling psychology.

PSYCH 699. Research.

Cr. arr. Repeatable.

Offered on a satisfactory-fail basis only.

Public Relations (P R)

Courses primarily for undergraduates:

P R 220. Principles of Public Relations.

(3-0) Cr. 3. F.S.

Introduction to public relations in business, government and non-profit organizations; functions, processes, and management; ethics, public opinion and theory.

P R 301. Research and Strategic Planning for Advertising and Public Relations.

(Cross-listed with ADVRT). (3-0) Cr. 3. F.S. *Prereq: ADVRT 230 or P R 220; Sophomore classification*

The use of primary and secondary research for situations, organizations and the public. Formation and development of strategic plans for public relations and advertising students.

P R 305. Publicity Methods.

(3-0) Cr. 3. F.S. *Prereq: ENGL 250, Sophomore classification*

Communication and publicity fundamentals and the use of media for publicity purposes. Not available to Greenlee School majors.

P R 321. Public Relations Writing.

(2-3) Cr. 3. F.S. *Prereq: Minimum of C+ in JL MC 201; ADVRT/P R 301.*

Recommended: JL MC 242 and JL MC 316 or computer design proficiency. Developing and writing public relations materials with an emphasis on media relations and news. Techniques addressed include media kits, brochures, newsletters and speeches.

P R 390. Professional Skills Development.

(Cross-listed with ADVRT, JL MC). Cr. 1-3. Repeatable, maximum of 6 credits.

F.S. *Prereq: Minimum of C+ in JL MC 201; other vary by topic. Instructor permission for non-majors.*

Check with Greenlee School for course availability.

P R 424. Public Relations Campaigns.

(3-0) Cr. 3. F.S. *Prereq: Minimum of C+ in P R 321; junior classification.*

Developing public relations and public information campaigns for business and social institutions.

P R 490. Independent Study in Communication.

Cr. arr. *Prereq: Junior classification and contract with supervising professor to register.*

Independent studies are research-based. Students may study problems associated with a medium, a professional specialization, a philosophical or practical concern, a reportorial method or writing technique, or a special topic in their field. Credit is not given for working on student or professional media without an accompanying research component.

P R 497. Special Topics in Communication.

(Cross-listed with ADVRT, JL MC). Cr. 1-3. Repeatable, maximum of 6 credits.

F.S.

Seminars or one-time classes on topics of relevance to students in communication.

P R 499. Professional Media Internship.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: JL MC majors: minimum of C+ in JL MC 202 or JL MC 206 or P R 321; ADVRT majors: minimum of C+ in JL MC 201 and ADVRT 301; P R majors: minimum of C+ in P R 321. All students, junior classification, formal faculty adviser approval.*

Required of all Greenlee School majors. A 400-hour (for 3 credits) internship in the student's journalism and mass communication or advertising or public relations specialization. Assessment based on employer evaluations, student reports and faculty reviews. Available only to Greenlee School majors. Offered on a satisfactory-fail basis only.

Religious Studies (RELIG)

Courses primarily for undergraduates:

RELIG 205. Introduction to World Religions.

(3-0) Cr. 3. F.S.SS.

An introduction to the academic study of religions, including myths, beliefs, rituals, values, social forms. Examples chosen from oral cultures and major religions of the world.

Meets International Perspectives Requirement.

RELIG 210. Religion in America.

(3-0) Cr. 3. F.S.SS.

Introductory study of the major beliefs, practices, and institutions of American Judaism, Catholicism, Protestantism, and Islam with emphasis on the diversity of religion in America, and attention to issues of gender, race, and class.

Meets U.S. Diversity Requirement

RELIG 220. Introduction to the Bible.

(3-0) Cr. 3. F.S.

Basic overview of the contents of the Old and New Testament in light of their ancient socio-historical background, and with attention to a variety of interpretations and relevance to modern American society.

RELIG 242. History of Christianity: Beginnings to the Reformation.

(3-0) Cr. 3. F.S.SS.

A survey of the major historical developments in Christian thought and practice that shaped Christianity from the time of Jesus through the late medieval period. Attention given to significant persons and major events, including those involving relations with Judaism and Islam.

Meets International Perspectives Requirement.

RELIG 243. History of Christianity: The Reformation to the Present.

(3-0) Cr. 3. F.S.SS.

A survey of the major events, issues, and persons that contributed to the Protestant Reformation, the Catholic Counter-Reformation, and the proliferation of Christian denominations. Attention to selected responses of churches to major sixteenth-early twenty-first century developments.

RELIG 280. Introduction to Catholicism.

(3-0) Cr. 3. F.

An explanation of the beliefs, spirit, and practices of Roman Catholicism, including its understanding of God, sacramentality, the human person, and community, and its relationship to other forms of Christianity and other world religions.

RELIG 321. Old Testament.

(3-0) Cr. 3. F.

An in-depth study of the literature and religion of ancient Israel in light of recent archaeological discoveries, research about the ancient Near East, and a variety of interpretations.

RELIG 322. New Testament.

(3-0) Cr. 3. S.

A detailed survey of the sacred scriptures of Christianity in light of recent archaeological discoveries and historical research about their Greco-Roman and Jewish background.

RELIG 323. Science and Religion.

(Cross-listed with HIST). (3-0) Cr. 3. *Prereq: Sophomore classification*

History of changing interplay of science and religion in our understanding nature, from the trial of Galileo to the reception of Darwin.

Meets International Perspectives Requirement.

RELIG 324. Christianity and Science.

(3-0) Cr. 3. S. *Prereq: BIOL 101, or another science course taught at IU*

Examines major challenges to Christianity's understandings of creation posed by the sciences; attention given to the relations of Christianity and science, and to Christianity's responses to ecological issues.

RELIG 328. American Indian Religions.

(Cross-listed with AM IN). (3-0) Cr. 3.

An introduction to the beliefs and rituals of Native American religious traditions, with attention to cultural and historical contexts and implications.

Meets U.S. Diversity Requirement

RELIG 333. Introduction to Judaism.

(3-0) Cr. 3.

An introduction to basic Judaism. Special attention is given to Jewish sacred texts, rituals, social practices, and modern forms.

Meets International Perspectives Requirement.

RELIG 334. African American Religious Experience.

(Cross-listed with AF AM). (3-0) Cr. 3. F. *Prereq: Prior course work in Religious Studies or African American Studies recommended*

Examination of African-American experience from the perspective of black religion with attention to political, economic, social, theological and artistic expressions, including music, that serve the life of African-American communities."

Meets U.S. Diversity Requirement

RELIG 336. Women and Religion.

(Cross-listed with W S). (3-0) Cr. 3. F. *Prereq: RELIG 205, RELIG 210 or W S 201 recommended*

Examines the status of women in various religions, feminist critiques of religious structures and belief systems, and contemporary women's spirituality movements.

Meets U.S. Diversity Requirement

RELIG 340. Magic, Witchcraft, and Religion.

(Dual-listed with RELIG 540). (Cross-listed with ANTHR). (3-0) Cr. 3. S. *Prereq: ANTHR 201 or ANTHR 306*

Survey of global religious belief and practice from an anthropological perspective. Emphasis on myth and ritual, shamanism, magic, witchcraft, beliefs in spirits, conceptions of the soul, mind and body relationships, and healing and therapeutic practices. Discussion of religious response to dramatic political and social change; effects of globalization on religious practice.

Meets International Perspectives Requirement.

RELIG 342. Religion and U.S. Latino/a Literature.

(Cross-listed with US LS). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

A study of the religious behavior and attitudes expressed in the literature of Mexican Americans, Puerto Ricans, Cuban Americans and other groups of people living in the U.S. who trace their ancestry to the Spanish-speaking countries of Latin America.

Meets U.S. Diversity Requirement

RELIG 348. Psychology of Religion.

(Cross-listed with PSYCH). (3-0) Cr. 3. *Prereq: Nine credits in psychology*

Survey of psychological theory and research investigating religious and spiritual attitudes, beliefs and practices.

RELIG 350. Philosophy of Religion.

(Cross-listed with PHIL). (3-0) Cr. 3. F. *Prereq: PHIL 201*

The value and truth of religious life and belief. Mystical experience; religious faith and language; arguments for God's existence; the problem of evil; miracles; and religion and morality. Historical and contemporary readings.

RELIG 352. Religious Traditions of India.

(3-0) Cr. 3. *Prereq: Prior course work in World Religions or Anthropology required.*

Study of texts, practices, beliefs, historical development, and mutual influence of a variety of the religious traditions of India. Emphasis on Vedic religion and the diversity of traditions of Classical Hinduism; survey of Buddhist, Jain, Sikh, and South Asian Islamic traditions. Meets International Perspectives Requirement.

Meets International Perspectives Requirement.

RELIG 355. Religious Traditions of China.

(3-0) Cr. 3. F.

The Religious Traditions of China. Chinese religious traditions in ancient and modern expression; indigenous forms of religious practice; development of high/deep traditions of Confucianism and Taoism; impact of religions such as Buddhism, Islam, and Christianity. Religious influences and changes in contemporary China.

Meets International Perspectives Requirement.

RELIG 356. African Religions.

(3-0) Cr. 3. *Prereq: Prior course work in African, African-American or Religious Studies or Anthropology required*

An introduction to the teachings, practices, and history of the religions that originated in Africa and other religions that have gained substantial followings among African peoples.

Meets International Perspectives Requirement.

RELIG 358. Introduction to Islam.

(3-0) Cr. 3.

An introduction to Islamic religion, culture, and society from 700 to the present.

Meets International Perspectives Requirement.

RELIG 360. Religious Ethics.

(3-0) Cr. 3.

Investigates different religious ethical theories and traditions of reasoning about practical moral issues (e.g., abortion, the just distribution of wealth, environmental ethics). Explores in detail the relationship between religious beliefs and moral practice.

RELIG 367. Christianity in the Roman Empire.

(Cross-listed with CL ST). (3-0) Cr. 3.

An historical introduction to the rise of Christianity in the Roman empire, with special attention to the impact of Greco-Roman culture on the thought and practice of Christians and the interaction of early Christians with their contemporaries.

RELIG 370. Religion and Politics.(Cross-listed with POL S). (3-0) Cr. 3. *Prereq: Sophomore classification.*

The interaction of religion and politics in the U.S. from both an historical and contemporary perspective, as well as the role of religion in politics internationally.

RELIG 376. Classical Archaeology.

(Cross-listed with ANTHR, CL ST). (3-0) Cr. 3. S.

Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored. Meets International Perspectives Requirement.

RELIG 376A. Classical Archeology: Bronze Age and Early Iron Age Greece.

(Cross-listed with ANTHR, CL ST). (3-0) Cr. 3. S.

Bronze Age (Minoan and Mycenaean palatial cultures) and Early Iron Age Greece. (ca 3000-700 BCE). Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored.

Meets International Perspectives Requirement.

RELIG 376B. Classical Archeology: Archaic through Hellenistic Greece (ca 700-30 BCE).

(Cross-listed with ANTHR, CL ST). (3-0) Cr. 3. S.

Chronological survey of the material culture of the ancient Greece-Roman world and the role of archaeological context in understanding the varied aspects of ancient Greek or Roman culture. Among other topics, economy, architecture, arts and crafts, trade and exchange, religion and burial customs will be explored. Meets International Perspectives Requirement.

RELIG 377. Social Dimensions of Religion.(Cross-listed with SOC). (3-0) Cr. 3. *Prereq: Prior course work in Religious Studies recommended.*

The influence of religion in society, both as a conservator of values and as a force for social change.

RELIG 380. Catholic Social Thought.

(3-0) Cr. 3. S.

Examines biblical roots of and major developments in Catholic social thought. Contemporary issues such as human rights, economic justice, the environment, and war and peace will be treated using principles of Catholic ethics, social analysis, official church documents, and contributions of notable theologians and activists.

Meets U.S. Diversity Requirement

RELIG 384. Religion and Ecology.

(Cross-listed with ENV S). (3-0) Cr. 3.

Introduction to concepts of religion and ecology as they appear in different religious traditions, from both a historical and contemporary perspective. Special attention to religious response to contemporary environmental issues.

Meets International Perspectives Requirement.

RELIG 439. Goddess Religions.(Cross-listed with W S). (3-0) Cr. 3. *Prereq: RELIG 205 recommended*

Exploration of the foundational myths of Goddess spirituality, including historical and cross-cultural female images of the divine and their modern usage by American women.

RELIG 453. Buddhism.

(3-0) Cr. 3. S.

The various Buddhist paths to realize enlightenment and freedom. Special attention to meditation and yoga and their relationship to altered states of consciousness and to social contexts.

Meets International Perspectives Requirement.

RELIG 475. Seminar: Issues in the Study of Religion.(3-0) Cr. 3. Repeatable, maximum of 6 times. *Prereq: 6 credits in religious studies* Topic changes each time offered. Closed to freshmen. Sophomores must have approval of instructor.**RELIG 485. Theory and Method in Religious Studies.**(3-0) Cr. 3. *Prereq: 6 credits in Religious Studies or permission of instructor*

Examines the variety of theories and methods employed in the study of religion. Application of these methods to various religions of the world.

RELIG 490. Independent Study.Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in religious studies and permission of instructor, approval of chairman.*

Guided reading and research on special topics selected to meet the needs of advanced students. No more than 9 credits of Relig 490 may be counted toward graduation.

RELIG 490H. Independent Study: Honors.Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in religious studies and permission of instructor, approval of chairman.*

Guided reading and research on special topics selected to meet the needs of advanced students. No more than 9 credits of Relig 490 may be counted toward graduation.

RELIG 491. Senior Thesis.

Cr. 3.

Written under the supervision of a Religious Studies faculty advisor.

RELIG 494. Special Studies in Religious Research Languages.Cr. 2-3. Repeatable. *Prereq: 6 credits in Religious Studies and permission of instructor***Courses primarily for graduate students, open to qualified undergraduates:****RELIG 540. Magic, Witchcraft, and Religion.**(Dual-listed with RELIG 340). (Cross-listed with ANTHR). (3-0) Cr. 3. S. *Prereq: ANTHR 201 or ANTHR 306*

Survey of global religious belief and practice from an anthropological perspective. Emphasis on myth and ritual, shamanism, magic, witchcraft, beliefs in spirits, conceptions of the soul, mind and body relationships, and healing and therapeutic practices. Discussion of religious response to dramatic political and social change; effects of globalization on religious practice.

Meets International Perspectives Requirement.

RELIG 590. Special Topics in Religious Studies.Cr. 1-3. Repeatable. *Prereq: Permission of instructor, 9 credits in religious studies*

Research and Evaluation (RESEV)

Courses primarily for graduate students, open to qualified undergraduates:

RESEV 550. Introduction to Educational Research.

(3-0) Cr. 3. F.S.SS.

Understanding the nature of quantitative and qualitative research; reviewing the literature; developing research problems and questions; research designs; data collection and analysis issues; evaluating research studies.

RESEV 552. Basic Educational Statistics.

(3-0) Cr. 3. F.

Statistical concepts and procedures for analyzing educational data; descriptive statistics, correlation, t tests, and chi square with computer applications.

RESEV 553. Intermediate Educational Statistics.

(3-0) Cr. 3. *Prereq: RESEV 552 or STAT 401*

A continuation of statistical concepts and procedures for analyzing educational data, using multiple regression and logistic regression.

RESEV 554. Intermediate Research Methods.

(3-0) Cr. 3. SS. *Prereq: RESEV 553 or STAT 404*

Intermediate quantitative research methodology in preparation for carrying out thesis and dissertation research, with an emphasis on the estimation of causal effects using observational data.

RESEV 570. Surveys in Educational Research.

(3-0) Cr. 3. S. *Prereq: RESEV 552 or equivalent*

Examination of survey design and administration in educational research. Designing surveys; developing, evaluating, and asking survey questions; survey sampling; measuring survey reliability and validity; administering mail and web surveys; decreasing survey nonresponse; conducting post-collection survey data processing; conducting survey research with integrity.

RESEV 580. Introduction to Qualitative Research Methodology.

(3-0) Cr. 3.

Qualitative research in the human sciences, emphasizing education; principles of qualitative inquiry, including theoretical foundations, research design, and fieldwork.

RESEV 590. Special Topics.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate standing*

Guided reading and in research and evaluation study on special topic.

RESEV 591. Supervised Field Experience.

Cr. 2-4. Repeatable. *Prereq: RESEV 553 or RESEV 680*

Supervised on the job field experience.

RESEV 593. Workshop.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate standing*

Intensive, concentrated exposure to a special educational research or evaluation problem.

RESEV 597. Program Assessment and Evaluation.

(3-0) Cr. 3. S. *Prereq: RESEV 550*

Evaluation models and professional standards. Techniques of evaluating educational programs. Emphasis on both theory and practical applications.

Courses for graduate students:

RESEV 615. Current Topics in Research and Evaluation.

Cr. 1-3. Repeatable.

RESEV 620. College Access in Policy, Practice, and Research.

(4-0) Cr. 1-3. SS.

Exploration of the plurality of frameworks used to conceptualize college access as a social problem (for research, policy, and practice). Development of application of understandings of college access frameworks to policy, practice, and research.

RESEV 680. Critical Issues in Qualitative Inquiry.

(3-0) Cr. 3. S. *Prereq: RESEV 580*

An intensive reading and discussion course focusing on contemporary methodological theory for qualitative inquiry; examines epistemological, ontological, axiological and theoretical assumptions and their consequences for qualitative inquiry in the human sciences; interrogates core concepts of qualitative inquiry such as fieldwork, data, validity and representation.

RESEV 681. Analytical Approaches in Qualitative Inquiry.

(3-0) Cr. 3. F. *Prereq: RESEV 580 or equivalent*

Conceptions of data and analysis in qualitative methodologies; focus on applied topics in qualitative data analysis, such as narrative analysis, ethnographic analysis, life history analysis, postmodern analyses, discourse analysis, arts-based analytical strategies, constructing data; combination format of reading and discussion seminars and classroom workshops focusing on individual research projects (not for thesis or dissertation).

RESEV 690. Advanced Special Topics.

Cr. 1-3. Repeatable. *Prereq: Graduate standing*

Guided reading and/or study on special topics of an advanced nature.

RESEV 699. Research.

Cr. arr. Repeatable. F.S.SS.

Russian (RUS)

Courses primarily for undergraduates:

RUS 101. Elementary Russian I.

(4-0) Cr. 4. F.

Introduction to the Russian language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Russian culture.

RUS 102. Elementary Russian II.

(4-0) Cr. 4. S. *Prereq: RUS 101*

Introduction to the Russian language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Russian culture.

Meets International Perspectives Requirement.

RUS 195. Study Abroad.

Cr. 1-10. Repeatable. SS.

Supervised intensive instruction in Russian language and culture; formal class instruction at level appropriate to students' training, augmented by practical living experiences. Consult with department regarding equivalence with Rus 101 and 102. Acceptable for LAS General Education Requirement credit in the II group.

RUS 201. Intermediate Russian I.

(4-0) Cr. 4. F. *Prereq: RUS 102*

Thorough review of grammar and growth of vocabulary. Selected readings. Continued use of the four basic skills.

Meets International Perspectives Requirement.

RUS 202. Intermediate Russian II.

(4-0) Cr. 4. S. *Prereq: RUS 201*

Thorough review of grammar and growth of vocabulary. Selected readings. Continued use of the four basic skills.

Meets International Perspectives Requirement.

RUS 295. Study Abroad.

Cr. 1-10. Repeatable. SS. *Prereq: RUS 102 or equivalent*

Supervised intensive instruction in Russian language and culture; formal class instruction at level appropriate to students' training, augmented by practical living experiences. Consult with department regarding equivalence with Rus 201 and 202. Acceptable for LAS General Education Requirement credit in the II group.

RUS 301. Composition and Conversation.

(3-0) Cr. 3. F. *Prereq: RUS 202*

Thorough study of the Russian language, with emphasis on strengthening proficiency in writing, speaking, reading, and listening. Increased focus on syntax and word formation.

Meets International Perspectives Requirement.

RUS 304. Russian for Business and Professions.

(3-0) Cr. 3. F. *Prereq: RUS 102*

Communication in business and professional contexts in Russian-speaking countries. Development of effective communication strategies and project management in the workplace. Cultural contexts of business and professional practice.

Meets International Perspectives Requirement.

RUS 314. Reading Russian Literary and Cultural Texts.

(3-0) Cr. 3. Repeatable. *Prereq: RUS 102*

Selected readings in Russian literature and culture. Emphasis on techniques of reading and analysis of literary and cultural texts.

Meets International Perspectives Requirement.

RUS 370. Russian Studies in English Translation.

(3-0) Cr. 3. Repeatable.

Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English.

Meets International Perspectives Requirement.

RUS 370R. Russian Studies in English Translation: Russian topics on women or feminism.

(Cross-listed with W S). (3-0) Cr. 3. Repeatable.

Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English.

Meets International Perspectives Requirement.

RUS 375. Russia Today.

(3-0) Cr. 3. Repeatable.

A survey of social, political, economic, and cultural topics relevant to contemporary Russia. Readings, discussions and papers in English.

Meets International Perspectives Requirement.

RUS 378. Russian Film Studies in English.

(3-0) Cr. 3.

Analysis and interpretation of cinema in Russia and the Soviet Union. Topics vary according to faculty interest. Film directors, genres, movements, historical survey, aesthetics, and cinematography. Readings, discussions and papers in English.

Meets International Perspectives Requirement.

RUS 395. Study Abroad.

Cr. 1-6.

Supervised instruction in language and culture of Russia; formal class instruction at level appropriate to student's training, augmented by practical living experience. Meets International Perspectives Requirement.

RUS 490. Independent Study.

Cr. 1-6. Repeatable. *Prereq: 6 credits in Russian and permission of department chair*

Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 9 credits of Rus 490 may be counted toward graduation.

RUS 499. Internship in Russian.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 9 credits of Russian at the 300 level; permission of advisor and WLC Internship Coordinator*

Work experience using Russian language skills in the public or private sector combined with academic work under faculty supervision. Available only to majors and minors. No more than 3 credits may be applied to the major.

Courses primarily for graduate students, open to qualified undergraduates:

RUS 590. Special Topics in Russian.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Russian*

RUS 590A. Special Topics in Russian: Literature or Literary Criticism.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Russian*

RUS 590B. Special Topics in Russian: Linguistics.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Russian*

RUS 590C. Special Topics in Russian: Language Pedagogy.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Russian*

RUS 590D. Special Topics in Russian: Civilization.

Cr. 2-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Russian*

Seed Technology and Business (STB)

Courses primarily for graduate students, open to qualified undergraduates:

STB 501. Strategic Management.

(Cross-listed with BUSAD). (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor* Critical analysis of current practice and case studies in strategic management with an emphasis on integrative decision making. Strategy formulation and implementation will be investigated in the context of complex business environments.

STB 503. Information Systems.

(Cross-listed with BUSAD). (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor* Introduction to a broad variety of information systems (IS) topics, including current and emerging developments in information technology (IT), IT strategy in the context of corporate strategy, and IS planning and development of enterprise architectures. Cases, reading, and discussions highlight the techniques and tactics used by managers to cope with strategic issues within an increasingly technical and data-driven competitive environment.

STB 504. Marketing and Logistics.

(Cross-listed with BUSAD). (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor* Integration of the business functions concerned with the marketing and movement of goods along the supply chain with the primary goal of creating value for the ultimate customer. Coordination of marketing, production, and logistics activities within the firm and with outside suppliers and customers in the supply chain.

STB 507. Organizational Behavior.

(Cross-listed with BUSAD). (2-0) Cr. 2. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor* Understanding human behavior in organizations, and the nature of organizations from a managerial perspective. Special emphasis on how individual differences, such as perceptions, personality, and motivation, influence individual and group behavior in organizations and on how behavior can be influenced by job design, leadership, groups, and the structure of organizations.

STB 508. Accounting and Finance.

(Cross-listed with BUSAD). (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor* Survey of fundamental topics in accounting and finance. Financial statement reporting and analysis for agriculture firms, corporate governance issues related to financial reporting, (e.g., Sarbanes-Oxley). Basic tools and techniques used in financial management, including stock and bond valuation. How to assess and use capital budgeting methods to evaluate proposed firm investments.

STB 509. Seed Trade, Policy and Regulation.

(Cross-listed with BUSAD). (3-0) Cr. 3. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor* Cultural, financial, economic, political, legal/regulatory environments shaping an organization's international business strategy. Topics include entry (and repatriation) of people, firms, goods, services, and capital. Special attention to the institutions of seed regulation and policy. Ethical issues facing managers operating in an international context.

STB 510. Crop Improvement.

(Cross-listed with AGRON). (3-0) Cr. 3. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor* A study of the basic principles and methods in the genetic improvement of crop plants. Methods used in manipulating genomes through the use of biotechnology. Methods of cultivar development. Quantitative procedures for describing response to selection. Analysis of the relationship of reproductive characters and growth characteristics to response to selection.

STB 534. Seed and Variety, Testing and Technology.

(Cross-listed with AGRON). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor* The components of seed quality and how they are assessed in the laboratory, including traits derived from modern biotechnology. The impact of new technologies on seed quality testing. Variety maintenance procedures and breeder seed. Variety identification: phenotype and grow-out trials, isozyme testing, and DNA marker testing. Procedures for evaluating varieties. The variance tests appropriate for fixed effects analysis of variance. Statistical inference and stratification for yield trials. Use of strip plot testing.

STB 535. Introduction to the Seed Industry.

(Cross-listed with AGRON). Cr. 1. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor* An analysis of the defining characteristics of the seed industry and introduction to the Master in Seed Technology and Business curriculum. The tasks of crop improvement and seed production will be analytically related to basic management functions and classifications of management activities that are used in the study of business administration. Management tasks and roles will be analyzed in related to the public policy issues that shape the seed industry, including ethical and economical approaches to biotechnology, intellectual property, and corporate responsibility.

STB 536. Quantitative Methods for Seed.

(Cross-listed with AGRON). (1-0) Cr. 1. F. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor* Quantitative Methods for analyzing and interpreting agronomic and business information for the seed industry. Principles of experimental design and hypothesis testing, regression, correlation and graphical representation of data. Use of spreadsheets for manipulating, analyzing and presenting data.

STB 539. Seed Conditioning and Storage.

(Cross-listed with AGRON). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor* The technical operations which may be carried out on a seed lot from harvest until it is ready for marketing and use. The opportunities for quality improvement and the risks of deterioration which are present during that time. Analysis of the costs of and benefits of operations. Evaluation of equipment based on benefits to the customer and producer. Interpretation of the role of the conditioning plant and store as a focal points within the overall operations of a seed company.

STB 543. Seed Physiology.

(Cross-listed with HORT). (2-0) Cr. 2. Alt. F., offered even-numbered years. *Prereq: Admission to the Graduate Seed Technology and Business Program or approval of the instructor* Brief introduction to plant physiology. Physiological aspects of seed development, maturation, longevity, dormancy and germination. Links between physiology and seed quality.

STB 547. Seed Production.

(Cross-listed with AGRON). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor* Survey of crop production; including management of soil fertility, planting dates, populations, weed control, and insect control. Analysis of the principles of seed multiplication and the key practices which are used to ensure high quality in the products. Field inspection procedures and production aspects that differ from other crop production. Foundation seed production. Analysis of the typical organization of field production tasks. Resources and capabilities required. Survey of differences in seed production strategies between crops and impact of differences on management of seed production.

STB 592. Seed Health Management.

(Cross-listed with PL P). (2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: Admission to the Graduate Program in Seed Technology and Business/Consent of instructor* Munkvold. Occurrence and management of diseases during seed production, harvest, conditioning, storage, and planting. Emphasis on epidemiology, disease management in the field, seed treatment, effects of conditioning on seed health, and seed health testing. Credit may not be obtained for both PI P/STB 592 and PI P 594.

STB 595. Seed Quality, Production, and Research Management.

(Cross-listed with AGRON). (3-0) Cr. 3. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor* Advanced survey of the organization, staff capabilities and management characteristics typical in seed production and crop improvement in seed enterprises. Analysis of the use of quality information in the management of seed operations and sales. Process management applications for seed. Production planning for existing capacity. Analysis of the manager's tasks in the annual cycle and how the tasks of these managers relate to the general categories of business management roles. Difference in management strategies used with different situations and groups of employees.

STB 599. Creative Component.

Cr. 3-4. *Prereq: Admission to the Master's in Seed Technology and Business degree program and permission of the instructor* A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

Sociology (SOC)

Courses primarily for undergraduates:

SOC 110. Orientation to Public Service and Administration in Agriculture.
Cr. R. F.

Survey of public service and administration in agriculture. Exploration of career tracks and career planning. Recommended during first semester of freshman year or as soon as possible after transfer into the department.

SOC 115. Orientation to Sociology.

(1-0) Cr. 1. F.S.

Orientation to sociology. A familiarization with University and LAS College requirements and procedures. Occupational tracks and career options open to sociology; introduction to career planning. Recommended during first semester of freshman year, or as soon as possible after transfer into the department. Offered on a satisfactory-fail basis only.

SOC 134. Introduction to Sociology.

(3-0) Cr. 3. F.S.SS.

Social interaction and group behavior with emphasis on the scientific study of contemporary U.S. society, including issues relating to socialization, inequality, and changing rural and urban communities. Analysis of relationships among the institutions of family, religion, political participation, work, and leisure.

SOC 134H. Introduction to Sociology: Honors..

(3-0) Cr. 3. F.S.SS.

Social interaction and group behavior with emphasis on the scientific study of contemporary U.S. society, including issues relating to socialization, inequality, and changing rural and urban communities. Analysis of relationships among the institutions of family, religion, political participation, work, and leisure.

SOC 219. Sociology of Intimate Relationships.

(3-0) Cr. 3. F.S.SS. *Prereq:* SOC 134

Analysis of intimate relationships among couples using a sociological perspective. Attention is given to singlehood; dating and courtship; sexuality; mate selection, cohabitation, and marriage. Relationship quality, communication, conflict and dissolution of these types of relationship will also be explored.

SOC 220. Global Sustainability.

(Cross-listed with ANTHR, ENV S, GLOBE, M E, MAT E, T SC). (3-0) Cr. 3. F.S.

An introduction to the key global issues in sustainability. Focuses on interconnected roles of energy, materials, human resources, economics, and technology in building and maintaining sustainable systems. Applications discussed will include challenges in both the developed and developing world and will examine the role of technology in a resource-constrained world. Cannot be used for technical elective credit in any engineering department. Meets International Perspectives Requirement.

SOC 230. Rural Society in Transition.

(3-0) Cr. 3. F.S.

Introduction to the causes and consequences of social and economic change affecting rural people and places. Uses a sociological perspective to examine social structures, social change, and social relationships within rural society. Topics include community, population change, inequality, rural economy, structure of agriculture, social and environmental impacts of resource extraction.

SOC 235. Social Problems and American Values.

(3-0) Cr. 3. F.S. *Prereq:* SOC 134

Sociological concepts, theories and methods to analyze the causes and consequences of social problems. Social problems discussed may include crime, substance abuse, income inequalities, discrimination, poverty, race relations, health care, family issues, and the environment. How American culture and values shape societal conditions, public discourse and policy. Meets U.S. Diversity Requirement

SOC 241. Youth and Crime.

(Cross-listed with CJ ST). (3-0) Cr. 3. F. *Prereq:* SOC 134

An examination of delinquency that focuses on the relationship between youth as victims and as offenders, social and etiological features of delinquency, the role of the criminal justice system, delinquents' rights, and traditional and alternative ways of dealing with juvenile crime.

SOC 302. Research Methods for the Social Sciences.

(3-0) Cr. 3. F.S. *Prereq:* SOC 134; STAT 101; or concurrent enrollment in STAT 101

Introduction to the principal research methods used in sociology, including survey research, interviewing, content analysis, experiments, ethnographies, focus groups, historical analysis, and analysis of secondary data. Instruction on sampling and the principles of validity and reliability underlying quantitative and qualitative methods. Training in data analysis using statistical software packages.

SOC 305. Social Psychology: A Sociological Perspective.

(3-0) Cr. 3. F.S.SS. *Prereq:* SOC 134

Examination of human behavior in a social environment with emphasis on development of the self, interpersonal relations, attitudes, and small groups.

SOC 310. Community.

(3-0) Cr. 3. F.S. *Prereq:* SOC 134

Analysis of evolving theory and research of community as an ideal type, an ecological system, a political economy, and an interactional field; examination of the impact of economic, cultural, social and political infrastructures on community power structures and change processes in a global era.

SOC 325. Transition in Agriculture.

(3-0) Cr. 3. S.

The impacts of agricultural changes on farm families, rural communities, and consumers. Past, present, and future trends in family farms and their social implications.

SOC 327. Sex and Gender in Society.

(Cross-listed with W S). (3-0) Cr. 3. F.S.SS. *Prereq:* SOC 134

How the biological fact of sex is transformed into a system of gender stratification. The demographics and social positions of women and men in the family, education, media, politics, and the economy. Theories of the social-psychological and sociological bases for behavior and attitudes of women and men. The relationship between gender, class, and race.

Meets U.S. Diversity Requirement

SOC 328. Sociology of Masculinities and Manhood.

(Cross-listed with W S). (3-0) Cr. 3. S. *Prereq:* SOC 134 or W S 201

Examination of socially constructed and idealized images of manhood, the nature of social hierarchies and relations constructed on the basis of imagery, ideologies, and norms of masculinity. Theories on gender (sociological, psychological, and biological). Particular attention given to theory and research on gender variations among men by race, class, ethnicity, sexual orientation, physical ability and age.

Meets U.S. Diversity Requirement

SOC 330. Ethnic and Race Relations.

(Cross-listed with AF AM). (3-0) Cr. 3. F.S.SS. *Prereq:* SOC 134

Analysis of ethnic and race relations, particularly in America; emphasis on the sociology and psychology of race and ethnic relations.

Meets U.S. Diversity Requirement

SOC 331. Social Class and Inequality.

(3-0) Cr. 3. F.S.SS. *Prereq:* SOC 134

Social stratification and processes resulting in social and economic inequalities; implications of status, class, and poverty for people of different races, ethnicities, and gender.

Meets U.S. Diversity Requirement

SOC 332. The Latino/Latina Experience in U.S. Society.

(Cross-listed with US LS). (3-0) Cr. 3. F. *Prereq:* SOC 134

Examination of the social, historical, economic and political experience of varied Latino ethnic groups in the U.S. - primarily focusing on Mexican, Puerto Ricans, and Cubans.

Meets U.S. Diversity Requirement

SOC 334. Politics and Society.

(Cross-listed with POL S). (3-0) Cr. 3. F. *Prereq:* A course in political science or sociology

The relationship between politics and society with emphasis on American society. Discussion of theories of inequality, power, social movements, elites, ruling classes, democracy, and capitalism.

SOC 340. Deviant and Criminal Behavior.

(Cross-listed with CJ ST). (3-0) Cr. 3. S.SS. *Prereq:* SOC 134

Theory and research on the etiology of types of social deviance; issues relating to crime, antisocial behavior and social policies designed to control deviant behavior.

SOC 341. Criminology.

(Cross-listed with CJ ST). (3-0) Cr. 3. F. *Prereq:* SOC 134

The nature of crime and criminology; the concept of crime; statistics and theories of criminality; major forms of crime; official responses to crime and control of crime.

SOC 345. Population and Society.

(Cross-listed with ENV S). (3-0) Cr. 3. F. *Prereq:* SOC 134

Human population growth and structure; impact on food, environment, and resources; gender issues; trends of births, deaths, and migration; projecting future population; population policies and laws; comparison of the United States with other societies throughout the world.

Meets International Perspectives Requirement.

SOC 348. Global Poverty, Resources and Sustainable Development.

Cr. 3. Prereq: Soc 134

Trends in hunger, poverty, resource use and development. Assessment of theories, policies, and programs to promote sustainable livelihoods, resource management, and development at local and national levels. Examine solutions through institutional efforts and grassroots social movements. Meets International Perspectives Requirement.

SOC 351. Police and Society.

(Cross-listed with CJ ST). (3-0) Cr. 3. F.S. Prereq: SOC 241 or CJ ST 240

Introduction and overview of law enforcement in the United States. Theory and research on police history, function, and organization; constitutional issues of policing; and critical topics, such as community policing, officer discretion and decision-making, corruption, use of force, and racial profiling. The course illustrates the interconnections between communities, police organizations, citizens, and criminal offenders.

SOC 352. Punishment, Corrections, and Society.

(Cross-listed with CJ ST). (3-0) Cr. 3. F.S. Prereq: SOC 241 or CJ ST 240

Introduction and overview of corrections in the United States. Theory and research on probation, parole, intermediate sanctions, prison, inmate society, inmate behavior and misconduct, capital punishment, recidivism, correctional treatment, rehabilitation, and offender reintegration into society.

SOC 362. Applied Ethics in Agriculture.

(Cross-listed with ECON). (3-0) Cr. 3. Prereq: ECON 101 or SOC 134, junior or senior status in the College of Agriculture

Identify major ethical issues and dilemmas in the conduct of agricultural and agribusiness management and decision making. Discuss and debate proper ethical behavior in these issues and situations and the relationship between business and personal ethical behavior.

SOC 377. Social Dimensions of Religion.

(Cross-listed with RELIG). (3-0) Cr. 3. Prereq: Prior course work in Religious Studies recommended.

The influence of religion in society, both as a conservator of values and as a force for social change.

SOC 380. Sociology of Work.

(3-0) Cr. 3. F.S. Prereq: SOC 134

Inequalities (gender, race, class) related to jobs, occupations, firms, and industries. Satisfactions, rewards, alienation, discrimination, and other topics of importance to workers are examined.

SOC 381. Social Psychology of Small Group Behavior.

(Cross-listed with PSYCH). (3-0) Cr. 3. S. Prereq: SOC 305 or PSYCH 280

A survey of small group theory and research from an interdisciplinary, social psychological perspective.

SOC 382. Environmental Sociology.

(Cross-listed with ENV S). (3-0) Cr. 3. F.S. Prereq: Soc 134 or 3 credits of ENV S

Environment-society relations; social construction of nature and the environment; social and environmental impacts of resource extraction, production, and consumption; environmental inequality; environmental mobilization and movements; U.S. and international examples.

SOC 401. Contemporary Sociological Theories.

(3-0) Cr. 3. F.S.SS. Prereq: 9 credits in sociology

Both historical and modern social theories as applied to understanding and researching the social world.

SOC 402. White-Collar Crime.

(Cross-listed with CJ ST). (3-0) Cr. 3. S. Prereq: SOC 241 or CJ ST 240

Introduction and overview of white-collar crime as a form of deviance. Theory and research on occupational, corporate, and organizational offending; prevalence, costs, and consequences of white-collar crime; predictors and correlates of white-collar crime; and political, business, and public policy responses to white-collar crime.

SOC 411. Social Change in Developing Countries.

(3-0) Cr. 3. S. Prereq: SOC 134 plus 3 credits in social sciences

Social change and development in developing countries; international interdependence; causes and consequences of persistent problems in agriculture, city growth, employment, gender equality, basic needs; local and worldwide efforts to foster social change and international development. Meets International Perspectives Requirement.

SOC 412. Senior Seminar on Career Development.

(1-0) Cr. 1. F. Prereq: Most of major core courses, senior classification

Transition from student to professional. Career development procedures including self-assessment, short- and long-term goals, strategies for the job search, development of contacts and sources, resumes and interviews. Enrollment preferred in first semester as senior. Offered on a satisfactory-fail basis only.

SOC 415. Dynamics of Social Change.

(3-0) Cr. 3. F. Prereq: SOC 134 plus 3 credits in social sciences

Examination of public responses to complex and controversial innovations, such as environmentalism, feminism, stem-cell research, same-sex marriage, large-scale hog lots, and others. Strategies for gaining adoption/rejection of controversial innovations. Applications to topics in agriculture, development, business, and marketing. Credit for only Soc 415 or 515 may be applied toward graduation.

SOC 420. Complex Organizations.

(3-0) Cr. 3. F.SS. Prereq: SOC 134 plus 3 credits in social sciences

Study of bureaucracies and other large organizations as social systems through the perspective of basis social processes and structural variables. Incorporates topics of organizational effectiveness, power and change.

SOC 435. Urban Society.

(3-0) Cr. 3. Alt. S., offered even-numbered years. Prereq: SOC 134 plus 3 credits in social sciences

Development of cities and urban systems; human and spatial ecology; urban transformation, decline, and revitalization; poverty; immigration; homelessness; residential segregation; housing policy; urban social movements; local governance; alternative solutions and planning for cities; international comparisons.

SOC 460. Criminal and Juvenile Justice Practicum.

(Cross-listed with CJ ST). Cr. 3-12. Repeatable, maximum of 12 credits. F.S.SS.

Prereq: Junior or senior classification; permission of criminal justice studies coordinator; major or minor in sociology, or criminal justice studies minor

Study of the criminal and juvenile justice systems and social control processes. Supervised placement in a police department, prosecutor's office, court, probation and parole department, penitentiary, juvenile correctional institution, community-based rehabilitation program, or related agency. Offered on a satisfactory-fail basis only. Not more than a total of 12 credits of field experience (Soc 454 and 460) may be counted toward graduation. No credits in Soc 460 may be used to satisfy minimum sociology requirements for sociology majors.

SOC 464. Strategies for Community Engagement.

(3-0) Cr. 3. S.SS. Prereq: 6 credits in sociology

Project-focused engagement in community issues and initiatives. A broad range of strategies will be addressed, including popular education, applied research, network analysis and mapping, policy focused work, action research, curriculum development, community organizing, and organizational development.

SOC 484. Topical Studies in Criminal and Juvenile Justice.

(Cross-listed with CJ ST). (3-0) Cr. 3. Repeatable, maximum of 9 credits. Prereq: 6 credits in sociology and permission from instructor

Thematic or topical issues and studies dealing with the sociology of police, judiciary, institutional and community-based corrections, gender/ethnicity and crime/delinquency, criminal and delinquent gangs, and crime and delinquency prevention.

SOC 485. Sociology of the Family.

(3-0) Cr. 3. S. Prereq: 6 credits in sociology

The contemporary family in developing, industrial, and post-industrial societies. Effects of modernization, cultural change, and family policies on family dynamics, structures, and functions.

SOC 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 6 credits. Prereq: 6 credits in sociology and permission of instructor

Students in the College of Agriculture must be of junior or senior classification and may use no more than 6 credits of Soc 490 toward the total of 128 credits required for graduation. Students in the College of Liberal Arts and Sciences may count no more than 9 credits of 490 toward graduation.

SOC 490A. Independent Study: General Sociology.

Cr. 1-3. Repeatable, maximum of 6 credits. Prereq: 6 credits in sociology and permission of instructor

Students in the College of Agriculture must be of junior or senior classification and may use no more than 6 credits of Soc 490 toward the total of 128 credits required for graduation. Students in the College of Liberal Arts and Sciences may count no more than 9 credits of 490 toward graduation.

SOC 490B. Independent Study: Rural Sociology.

Cr. 1-3. Repeatable, maximum of 6 credits. Prereq: 6 credits in sociology and permission of instructor

Students in the College of Agriculture must be of junior or senior classification and may use no more than 6 credits of Soc 490 toward the total of 128 credits required for graduation. Students in the College of Liberal Arts and Sciences may count no more than 9 credits of 490 toward graduation.

SOC 490E. Independent Study: Senior Seminar.

Cr. 1-3. Repeatable, maximum of 6 credits. *Prereq: 6 credits in sociology and permission of instructor*

Students in the College of Agriculture must be of junior or senior classification and may use no more than 6 credits of Soc 490 toward the total of 128 credits required for graduation. Students in the College of Liberal Arts and Sciences may count no more than 9 credits of 490 toward graduation.

SOC 490H. Independent Study: Honors.

Cr. 1-3. Repeatable, maximum of 6 credits. *Prereq: 6 credits in sociology and permission of instructor*

Students in the College of Agriculture must be of junior or senior classification and may use no more than 6 credits of Soc 490 toward the total of 128 credits required for graduation. Students in the College of Liberal Arts and Sciences may count no more than 9 credits of 490 toward graduation.

Courses primarily for graduate students, open to qualified undergraduates:

SOC 506. Classical Sociological Theory.

(3-0) Cr. 3. S. *Prereq: SOC 401 or SOC 505*

The origins of the canonical works of sociology in the mid-Industrial Revolution period including Karl Marx, Max Weber, Emile Durkheim and others.

SOC 509. Agroecosystems Analysis.

(Cross-listed with AGRON, SUSAG). (3-4) Cr. 4. F. *Prereq: Senior or above classification*

Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecological, social, etc), and scales of operation.

SOC 511. Research Methodology for the Social Sciences.

(3-0) Cr. 3. S. *Prereq: SOC 302 and STAT 401*

Covers the philosophy and the techniques of research methods in sociology and other social sciences, including the ethics and politics of social science, validity issues, conceptualization and operationalization, sampling strategies, appropriate research designs for different questions, survey construction, and various data collection and analysis techniques.

SOC 512. Applied Multivariate Statistics for Social and Behavioral Research.

(3-0) Cr. 3. F. *Prereq: STAT 404 or with instructor's permission*

Applied techniques of multivariate analysis including cluster analysis, principal components and factor analysis, multivariate analysis of variance and covariance binomial and multinomial regression, multi-level random coefficient models, and spatial regression. Conceptual and mathematical grounding for nonstatisticians. Instruction in Mplus and SAS.

SOC 513. Qualitative Research Methods.

(3-0) Cr. 3. F. *Prereq: SOC 511*

Applied qualitative research methods in sociology. Design and implementation of a course-based research project including data collection, analysis, and presentation of results. Qualitative data gathering techniques using observational, historical, in-depth interviewing or content analysis approaches. Laboratory emphasis on completion of data gathering, analysis, and report writing.

SOC 515. Sociology of Technology.

(3-0) Cr. 3. *Prereq: 6 hours of social science*

Off campus and non majors only - offered as demand warrants. Linkages among science, technology, and society. Physical, life, and social science approaches to technology evaluation. Public responses to complex and controversial technologies. Strategies for gaining adoption/rejection of technology. Required in the Master of Agriculture program. Only one of Soc 415 or 515 may be counted toward graduation credits.

SOC 520. Social Psychology: A Sociological Perspective.

(3-0) Cr. 3. F. *Prereq: SOC 305 or PSYCH 280*

Examination of cognitive, symbolic interaction, exchange, role-reference group, and dramaturgical approaches. Assessment of contemporary issues in social psychology.

SOC 525. Seminar in Social Psychology.

(3-0) Cr. 3. *Prereq: SOC 305 or PSYCH 280*

SOC 525A. Seminar in Social Psychology: Small Groups.

(3-0) Cr. 3. *Prereq: SOC 305 or PSYCH 280*

SOC 525B. Seminar in Social Psychology: Attitudes and Attitude Change.

(3-0) Cr. 3. *Prereq: SOC 305 or PSYCH 280*

SOC 525C. Seminar in Social Psychology: Symbolic interactionism.

(3-0) Cr. 3. *Prereq: SOC 305 or PSYCH 280*

SOC 525D. Seminar in Social Psychology: Self and Identity.

(3-0) Cr. 3. *Prereq: SOC 305 or PSYCH 280*

SOC 527. Seminar in Social Inequality.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: 6 credits in sociology*
Analysis of racial and ethnic inequality in the United States and the world; focus on the implications of the changing world social and economic order for differences in racial and ethnic groups relative to wealth, status, and power; a critical examination of majority-group domination of minority groups in various societies.

SOC 527A. Seminar in Social Inequality: Sociology of Race and Ethnicity.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: 6 credits in sociology*
Analysis of racial and ethnic inequality in the United States and the world; focus on the implications of the changing world social and economic order for differences in racial and ethnic groups relative to wealth, status, and power; a critical examination of majority-group domination of minority groups in various societies.

SOC 527B. Seminar in Social Inequality: Sociology of Gender.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: 6 credits in sociology*
Analysis of racial and ethnic inequality in the United States and the world; focus on the implications of the changing world social and economic order for differences in racial and ethnic groups relative to wealth, status, and power; a critical examination of majority-group domination of minority groups in various societies.

SOC 533. Models of Community.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: 6 credits in sociology*
Emphasis on different models or frames of reference used in community analysis. Theoretical and methodological tools, current views of community problems, and explanation of social and cultural change are presented for each model.

SOC 534. Race, Class and Gender Inequality.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: 6 credits in sociology*
Critical examination of the causes and consequences of social stratification and inequality; classical theories, contemporary frameworks, and recent empirical studies; international stratification patterns.

SOC 536. Strategies for Community Engagement in Food and Farming Systems.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: 6 credits in sociology*
Project-focused community practice using diverse approaches and perspectives.

SOC 540. Comparative Social Change.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: 6 graduate credits in sociology*

Contemporary theories of social change, modernization, dependency, and development are critically examined; methodological issues identified; supporting research explored; applicability of theoretical models, concepts, and strategies to current national and international needs are evaluated.

SOC 543. Seminar in Social Change and Development.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 6 credits in sociology*

SOC 543A. Seminar in Social Change and Development: Strategies of Community Engagement.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 6 credits in sociology*

SOC 543B. Seminar in Social Change and Development: Sociology of Adoption and Diffusion.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 6 credits in sociology*

SOC 543C. Seminar in Social Change and Development: Technological Innovation, Social Change and Development.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 6 credits in sociology*

SOC 544. Sociology of Food and Agricultural Systems.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: 6 credits in sociology*
Social organization of food and fiber production, processing, and distribution systems. Sociological comparison of conventional and alternative production systems; gender roles in agriculture and food systems; local, national and global food systems; perspectives on food and agricultural research and policy.

SOC 549. Sociology of the Environment.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: 6 credits in sociology*
Social causes and social consequences of environmental problems.

Interrelationship between social inequality and environmental inequality. Social construction and social experience of the environment. Contemporary developments in the social theory of the environment. International and domestic implications.

SOC 550. Sociology of Economic Life.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* 6 credits in sociology
Social construction of economic activity in non-industrial and industrial societies with special attention on variations of industrial societies (capitalism and socialism), economic globalization, and economic development. Interaction of economic systems with human values, ideology, organizations, work and individual welfare.

SOC 551. Seminar in Economy, Organization, and Work.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* 6 credits in sociology

SOC 551A. Seminar in Economy, Organization, and Work: Sociology of Work.

(3-0) Cr. 3. F. *Prereq:* 6 credits in sociology

SOC 551B. Seminar in Economy, Organization, and Work: Complex Organizations.

(3-0) Cr. 3. F. *Prereq:* 6 credits in sociology

SOC 582. Theories of Social Deviance.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* 6 credits in sociology
Theory and research regarding causes of and reactions to deviant behavior. Mental illness, homicide, family violence, and property crime are among the types of deviant behavior considered.

SOC 584. Current Issues in Crime and Justice.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* 6 credits in sociology
Discussion of current research and theory in crime and delinquency; topics include the purpose and role of law in social life; emerging theoretical directions in criminology; recent work on specific forms of criminality; controversies in the criminal justice system.

SOC 585. Current Research in Family Sociology.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* 6 credits in sociology
Course presents a general overview of the field of family sociology. Topics to be covered include demographic trends, family theory and empirical research, as well as current debates in the discipline.

SOC 590. Special Topics.

Cr. 1-3. Repeatable. *Prereq:* 6 credits in sociology; senior or graduate classification

SOC 590A. Special Topics: General Sociology.

Cr. 1-3. Repeatable. *Prereq:* 6 credits in sociology; senior or graduate classification

SOC 590B. Special Topics: Rural Sociology.

Cr. 1-3. Repeatable. *Prereq:* 6 credits in sociology; senior or graduate classification

SOC 591. Orientation to Sociology.

(1-0) Cr. 1. F. *Prereq:* Formal admission into the sociology graduate program
Introduction to the department, current graduate student policies at department and university levels, departmental administrative procedures. Required of graduate students. Offered on a satisfactory-fail basis only.

SOC 599. Research for Master's Thesis.

Cr. 1-6. Repeatable.

SOC 599A. Research for Master's Thesis: General Sociology.

Cr. 1-6. Repeatable.

SOC 599B. Research for Master's Thesis: Rural Sociology.

Cr. 1-6. Repeatable.

Courses for graduate students:**SOC 607. Contemporary Sociological Theory.**

(3-0) Cr. 3. S. *Prereq:* 6 graduate credits in sociology
Provides a review of modern sociological thought, issues, and controversies as they affect current research and discourse in the discipline.

SOC 610. Foundations of Sustainable Agriculture.

(Cross-listed with A B E, AGRON, ANTHR, SUSAG). (3-0) Cr. 3. F. *Prereq:* Graduate classification, permission of instructor
Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging agricultural systems in terms of the core concepts of sustainability and their theoretical contexts.

SOC 613. Structural Equation Models for Social and Behavioral Research.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* SOC 512 and STAT 404, or with instructors permission.
Specification, identification, and interpretation of structural equation models. Techniques include structural or path models, measurement or confirmatory factor models, structural models with latent variables, and multi-level structural models. Conceptual and mathematical grounding for non-statisticians. Instruction in AMOS, MPLUS, and SAS.

SOC 675. Current Topics in Family Sociology.

(3-0) Cr. 3. Repeatable. Alt. S., offered odd-numbered years.
Current developments in a selected field in the sociology of family and the life course.

SOC 698. Seminars in Sociology.

(3-0) Cr. 3.

SOC 698L. Seminars in Sociology: Community Studies and Development.

(3-0) Cr. 3.

SOC 698M. Seminars in Sociology: Criminology.

(3-0) Cr. 3.

SOC 698N. Seminars in Sociology: The Economy, Organizations, and Work.

(3-0) Cr. 3.

SOC 698O. Seminars in Sociology: Food Systems, Agriculture, and the Environment.

(3-0) Cr. 3.

SOC 698P. Seminars in Sociology: Methodology.

(3-0) Cr. 3.

SOC 698Q. Seminars in Sociology: Social Change and Development.

(3-0) Cr. 3.

SOC 698R. Seminars in Sociology: Social Inequality.

(3-0) Cr. 3.

SOC 698S. Seminars in Sociology: Social Psychology.

(3-0) Cr. 3.

SOC 698T. Seminars in Sociology: Sociology of Families.

(3-0) Cr. 3.

SOC 698U. Seminars in Sociology: Theory.

(3-0) Cr. 3.

SOC 699. Dissertation Research.

Cr. 1-8. Repeatable.

SOC 699A. Dissertation Research: General Sociology.

Cr. 1-8. Repeatable.

SOC 699B. Dissertation Research: Rural Sociology.

Cr. 1-8. Repeatable.

Software Engineering (S E)

Courses primarily for undergraduates:

S E 101. Software Engineering Orientation.

Cr. R.

Introduction to the procedures, policies, and resources of Iowa State University and the department of Computer Science and Electrical and Computer Engineering. Information on engineering and computer-based professions.

S E 166. Careers in Software Engineering.

Cr. R.

Overview of the nature and scope of the software engineering profession. Relationship of coursework to careers. Departmental rules, student services operations, degree requirements, program of study planning, career options, and student organizations.

S E 185. Problem Solving in Software Engineering.

(3-1) Cr. 3. *Prereq: Credit or enrollment in MATH 142*

Introduction to software engineering and computer programming. Systematic thinking process for problem solving in the context of software engineering. Group problem solving. Solving software engineering problems and presenting solutions through computer programs, written documents and oral presentations. Introduction to principles of programming, software design, and extensive practice in design, writing, running, debugging, and reasoning about programs.

S E 298. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department and Career Services*

First professional work period in the cooperative education program. Students must register for this course before commencing work.

S E 319. Software Construction and User Interfaces.

(Cross-listed with COM S). (3-0) Cr. 3. F. *Prereq: COM S 228*

Basic theory of grammars, parsing. Language paradigms. State transition and table-based software design. Review of principles of object orientation, object oriented analysis using UML. Frameworks and APIs. User interface architecture, evaluation of user interface. Design of windows, menus, and commands. Introduction to formal specification and model-based software design. Introduction to domain-specific software engineering.

S E 329. Software Project Management.

(Cross-listed with CPR E). (3-0) Cr. 3. *Prereq: COM S 309*

Process-based software development. Capability Maturity Model (CMM). Project planning, cost estimation, and scheduling. Project management tools. Factors influencing productivity and success. Productivity metrics. Analysis of options and risks. Version control and configuration management. Inspections and reviews. Managing the testing process. Software quality metrics. Modern software engineering techniques and practices.

S E 339. Software Architecture and Design.

(Cross-listed with CPR E). (3-0) Cr. 3. *Prereq: S E 319*

Modeling and design of software at the architectural level. Architectural styles. Basics of model-driven architecture. Object-oriented design and analysis. Iterative development and unified process. Design patterns. Design by contract. Component based design. Product families. Measurement theory and appropriate use of metrics in design. Designing for qualities such as performance, safety, security, reliability, reusability, etc. Analysis and evaluation of software architectures. Introduction to architecture definition languages. Basics of software evolution, reengineering, and reverse engineering. Case studies. Introduction to distributed system software.

S E 342. Principles of Programming Languages.

(Cross-listed with COM S). (3-1) Cr. 3. F.S. *Prereq: Minimum of C- in COM S 228, COM S 330 or CPR E 310*

Study of concepts in programming languages and major programming paradigms, especially functional programming. Special emphasis on design tradeoffs that enable students to make sound choices of programming languages for a given software development task. Programming projects.

S E 388. Embedded Systems II: Mobile Platforms.

(Cross-listed with CPR E). (3-2) Cr. 4. *Prereq: CPR E 288*

Contemporary programming techniques for event driven systems. Mobile platforms and operating systems. Location and motion sensors based user interfaces. Threading and scheduling. Resource management - measurement and control techniques - for memory and energy. Client-server application design. Distributed applications. Laboratory includes exercises based on a mobile platform.

S E 396. Summer Internship.

Cr. R. Repeatable. SS. *Prereq: Permission of department and Career Services*
Summer professional work period.

S E 397. Software Engineering Internship.

Cr. R. Repeatable. F.S. *Prereq: Permission of department and Career Services*
One semester maximum per academic year professional work period.

S E 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq: S E 298, permission of department and Career Services*
Second professional work period in the cooperative education program. Students must register for this course before commencing work.

S E 409. Software Requirements Engineering.

(Cross-listed with COM S). (3-0) Cr. 3. F. *Prereq: COM S 309*

The requirements engineering process including identification of stakeholders requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required.

S E 412. Formal Methods in Software Engineering.

(Cross-listed with COM S, CPR E). (3-0) Cr. 3. S. *Prereq: COM S 330 or CPR E 310; COM S 311, STAT 330*

A study of formal techniques for model-based specification and verification of software systems. Topics include logics, formalisms, graph theory, numerical computations, algorithms, and tools for automatic analysis of systems. Graduate credit requires in-depth study of concepts.

S E 416. Software Evolution and Maintenance.

(Cross-listed with CPR E). (3-0) Cr. 3. *Prereq: COM S 309*

Practical importance of software evolution and maintenance, systematic defect analysis and debugging techniques, tracing and understanding large software, impact analysis, program migration and transformation, refactoring, tools for software evolution and maintenance, experimental studies and quantitative measurements of software evolution. Written reports and oral presentation.

S E 417. Software Testing.

(Cross-listed with COM S). (3-0) Cr. 3. S. *Prereq: COM S 309; COM S 330 or CPR E 310; ENGL 250, SP CM 212*

Comprehensive study of software testing, principles, methodologies, management strategies and techniques. Test models, test design techniques (black box and white box testing techniques), test adequacy criteria, integration, regression, system testing methods, and software testing tools.

S E 419. Software Tools for Large Scale Data Analysis.

(Cross-listed with CPR E). (3-3) Cr. 4. *Prereq: CPR E 308 or COM S 352, COM S 309*

Software tools for managing and manipulating large volumes of data, external memory processing, large scale parallelism, and stream processing, data interchange formats. Weekly programming labs that involve the use of a parallel computing cluster.

S E 490. Independent Study.

Cr. arr. Repeatable. *Prereq: Senior classification in software engineering*
Investigation of an approved topic.

S E 491. Senior Design Project I and Professionalism.

(2-3) Cr. 3. *Prereq: S E 329, completion of 29 credits in the S E core professional program, ENGL 314*

Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; project poster. First of two-semester team-oriented, project design and implementation experience.

S E 492. Senior Design Project II.

(1-3) Cr. 2. *Prereq: S E 491*

Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in S E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements.

S E 494. Software Engineering Portfolio Development.

Cr. R. F.S. *Prereq: Credit or enrollment in S E 491*

Portfolio assessment for Software Engineers. Guidelines and Advice to improve software engineering portfolios and to better use portfolios as a tool to enhance career opportunities.

S E 498. Cooperative Education.

Cr. R. Repeatable. F.S.SS. *Prereq: S E 398, permission of department and Career Services*

Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Spanish (SPAN)

Courses primarily for undergraduates:

SPAN 097. Accelerated Spanish Review.

(3-2) Cr. 0. F.S. *Prereq:* Two years but less than three years of high-school Spanish

For students who require additional review at the first year (101-102) level. Course components include a compact review of 101 and the essential elements of 102. Course completed with a passing grade fulfills the LAS foreign language requirement. Not recommended for students who wish to continue language at the second year (201-202) level without completing 102.

SPAN 101. Elementary Spanish I.

(4-0) Cr. 4. F.SS.

A communicative approach to grammar and vocabulary within the context of Hispanic culture.

SPAN 102. Elementary Spanish II.

(4-0) Cr. 4. S.SS. *Prereq:* SPAN 101, SPAN 97 or placement by departmental exam

Continuation of Spanish 101. A communicative approach to grammar and vocabulary within the context of Hispanic culture.

Meets International Perspectives Requirement.

SPAN 195. Study Abroad.

Cr. 3. SS.

Supervised instruction in Spanish and Hispanic culture; formal class instruction at level appropriate to student's training, augmented by practical living experience. Taught in Spanish. Consult the department regarding equivalency with SPAN 101 or 102.

Meets International Perspectives Requirement.

SPAN 201. Intermediate Spanish I.

(4-0) Cr. 4. F. *Prereq:* SPAN 102 or placement by departmental exam

Intensive review of basic grammar and conversation. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature.

Meets International Perspectives Requirement.

SPAN 202. Intermediate Spanish II.

(4-0) Cr. 4. S. *Prereq:* SPAN 201 or placement by departmental exam

Continuation of Spanish 201. Intensive review of basic grammar. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature.

Meets International Perspectives Requirement.

SPAN 295. Study Abroad.

Cr. 3. SS. *Prereq:* SPAN 102 or equivalent

Supervised instruction in Spanish and Hispanic culture; formal class instruction at level appropriate to student's training, augmented by practical living experience. Taught in Spanish. Consult the department regarding equivalency with Span 201 or 202.

Meets International Perspectives Requirement.

SPAN 297. Intensive Intermediate Spanish.

(4-0) Cr. 4. F.S. *Prereq:* 4 years of high school Spanish, two years of Spanish at a community college, Spanish 201, or equivalent by placement

Bridge course between 200- and 300-level Spanish courses to prepare students for 300 level courses. Focus on application of advanced grammatical concepts within the context of Hispanic culture. Designed for students who want to continue at the 300 level. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 301. Spanish Grammar and Composition.

(3-0) Cr. 3. F.S. *Prereq:* SPAN 202 or placement by departmental exam

Review and application of grammar concepts in the development of writing skills within the context of Hispanic culture. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 303. Spanish Grammar and Conversation.

(3-0) Cr. 3. F.S. *Prereq:* SPAN 202 or placement by departmental exam

Intensive oral practice and improvement of oral proficiency. Application of specific grammatical concepts for development of conversational skills within the context of Hispanic culture. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 303A. Spanish Grammar and Conversation: Conversation through Culture.

(3-0) Cr. 3. F.S. *Prereq:* SPAN 202 or placement by departmental exam

Intensive oral practice and improvement of oral proficiency. Application of specific grammatical concepts for development of conversational skills within the context of Hispanic culture. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 303B. Spanish Grammar and Conversation: Conversation for Professionals.

(3-0) Cr. 3. F.S. *Prereq:* SPAN 202 or placement by departmental exam

Intensive oral practice and improvement of oral proficiency. Application of specific grammatical concepts for development of conversational skills within the context of Hispanic culture. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 304. Spanish for Business and Professions.

(3-0) Cr. 3. F.S. *Prereq:* SPAN 202 or placement by departmental exam (SPAN 301 recommended)

Introduction to professional communication within a cultural context. Grammar review as needed. Individual projects will focus on special interests. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 314. Introduction to Reading Hispanic Texts.

(3-0) Cr. 3. F.S. *Prereq:* SPAN 301

Critical reading of Hispanic literary and cultural texts. Presentation of techniques and terminology of literary criticism. Study of basic genres such as: narrative, poetry, drama, essay. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 321. Spanish Civilization.

(3-0) Cr. 3. *Prereq:* One course at the 300 level

A survey of the social, political, religious, and cultural history of Spain. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 322. Latin American Civilization.

(3-0) Cr. 3. *Prereq:* One course at the 300 level

A survey of the social, political, religious, and cultural history of Spanish America. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 323. Spain Today.

(3-0) Cr. 3. *Prereq:* One course at the 300 level

A survey of social, political, economic, and cultural topics relevant to contemporary Spain. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 324. Latin America Today.

(3-0) Cr. 3. *Prereq:* One course at the 300 level

A survey of social, political, economic, and cultural topics relevant to contemporary Latin America. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 326. Studies in Hispanic Art or Film.

(Dual-listed with SPAN 526). (3-0) Cr. 3. *Prereq:* One course at the 300 level

Survey of major currents and figures in Spanish and Latin American art and/or film. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 330. Studies in Spanish Literature to 1700.

(3-0) Cr. 3. *Prereq:* SPAN 314

Introduction to Spanish literature from the earliest times through the Golden Age; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 331. Studies in Spanish Literature from 1700 to the Present.

(3-0) Cr. 3. *Prereq:* SPAN 314

Introduction to Spanish literature from the eighteenth century to the present; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 332. Studies in Latin American Literature from Pre-Columbian Times through the Nineteenth Century.

(3-0) Cr. 3. *Prereq:* SPAN 314

Introduction to Latin American literature from the earliest times to circa 1900; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 333. Studies in Latin American Literature from the Twentieth Century to the Present.(3-0) Cr. 3. *Prereq:* SPAN 314

Introduction to Latin American literature from the twentieth century to the present; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 351. Introduction to Spanish-English Translation.(3-0) Cr. 3. F.S. *Prereq:* SPAN 301, SPAN 303 or SPAN 304

Introduction to the theory, methods, techniques, and problems of translation. Consideration of material from business, literature, and the social sciences. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 352. Introduction to Spanish Phonology.(Cross-listed with LING). (3-0) Cr. 3. F.S. *Prereq:* SPAN 301, SPAN 303 or SPAN 304

An introductory study of the articulation, classification, distribution, and regional variations of the sounds of the Spanish language. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 354. Introduction to Spanish-English Interpretation.(Dual-listed with SPAN 554). (Cross-listed with LING). (3-0) Cr. 3. F.S. *Prereq:* SPAN 351

Introduction to the theory, methods, techniques, and problems of consecutive and simultaneous interpretation. Consideration of material from business, agriculture, law, design, medicine, literature, advertisement, and sports. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 370. Hispanic Topics in English Translation.

(3-0) Cr. 3. Repeatable, maximum of 6 credits.

Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English. May not be counted as a prerequisite.

Meets International Perspectives Requirement.

SPAN 370A. Hispanic Topics in English Translation: Agriculture.

(3-0) Cr. 3. Repeatable, maximum of 6 credits.

Topics vary according to faculty interest. Knowledge and understanding of major cultural, ethical, sociopolitical and economic issues directly related to agriculture and agribusiness in Latin America, Spain, and/or Equatorial Guinea. Readings, discussions, and papers in English. May not be counted as a prerequisite.

SPAN 370S. Hispanic Topics in English Translation: Hispanic Topics on Women or Feminism.

(Cross-listed with W S). (3-0) Cr. 3. Repeatable, maximum of 6 credits.

Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English. May not be counted as a prerequisite.

Meets International Perspectives Requirement.

SPAN 395. Study Abroad.Cr. 1-10. *Prereq:* 2 years university-level Spanish or equivalent

Supervised instruction in Spanish and Hispanic culture; formal class instruction at level appropriate to students' training, enhanced by practical living experience.

Meets International Perspectives Requirement.

SPAN 401. Advanced Composition and Grammar.(Dual-listed with SPAN 501). (3-0) Cr. 3. F. *Prereq:* SPAN 314 and one course at the 320-level or above

Advanced study of Spanish grammar and syntax. Students' writing of compositions incorporates an advanced understanding of grammar, syntax, and principles of organization of thought and ideas. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 440. Seminar on the Literatures and Cultures of Spain.

(Dual-listed with SPAN 540). (3-0) Cr. 3. Repeatable, maximum of 6 credits.

Prereq: SPAN 330, SPAN 331, SPAN 332, or SPAN 333. (Recommended SPAN 330 and SPAN 331)

Discussion and analysis of selected topics in Spanish literature and culture from the Middle Ages to the Present. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 441. Seminar on Cervantes and the Golden Age.

(Dual-listed with SPAN 541). (3-0) Cr. 3. Repeatable, maximum of 6 credits.

Prereq: SPAN 330, SPAN 331, SPAN 332, or SPAN 333. (SPAN 330 recommended)

Discussion and analysis of selected works of Cervantes within the social and cultural context of the Golden Age. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 445. Seminar on the Literatures and Cultures of Latin America.

(Dual-listed with SPAN 545). (3-0) Cr. 3. Repeatable, maximum of 6 credits.

Prereq: SPAN 330, SPAN 331, SPAN 332, SPAN or SPAN 333. (SPAN 332 and SPAN 333 recommended)

Discussion and analysis of selected topics in Latin American literature and culture from Pre-Colonial times to the Present. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 462. Contrastive Analysis of Spanish/ English for Translators.(Cross-listed with LING). (3-0) Cr. 3. *Prereq:* SPAN 351

Linguistic study of the major differences between the Spanish and English grammatical systems and their applications in the translation of Spanish to English. Taught in Spanish.

SPAN 463. Hispanic Dialectology.(Cross-listed with LING). (3-0) Cr. 3. *Prereq:* SPAN 352

Intensive study of the phonology, morphosyntax and lexicon of the Hispanic dialects of Spain and Latin America in their historical context. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 490. Independent Study.Cr. 1-6. Repeatable, maximum of 6 credits. *Prereq:* 6 credits in Spanish and permission of department chair

Designed to meet the needs of students in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. No more than 6 credits in Span 490 may be counted toward graduation.

SPAN 499. Internship in Spanish.Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq:* 9 credits of Spanish at the 300 level; permission of advisor and WLC Internship Coordinator

Work experience using Spanish language skills in the public or private sector, combined with academic work under faculty supervision. Up to 3 credits may apply toward the major. Available only to majors and minors.

Courses primarily for graduate students, open to qualified undergraduates:**SPAN 501. Advanced Composition and Grammar.**(Dual-listed with SPAN 401). (3-0) Cr. 3. F. *Prereq:* SPAN 314 and one course at the 320-level or above

Advanced study of Spanish grammar and syntax. Students' writing of compositions incorporates an advanced understanding of grammar, syntax, and principles of organization of thought and ideas. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 526. Studies in Hispanic Art or Film.(Dual-listed with SPAN 326). (3-0) Cr. 3. *Prereq:* 6 credits in Spanish literature or culture at 400 level

Survey of major currents and figures in Spanish and Latin American art and/or film.

SPAN 540. Seminar on the Literatures and Cultures of Spain.

(Dual-listed with SPAN 440). (3-0) Cr. 3. Repeatable, maximum of 6 credits.

Prereq: SPAN 330, SPAN 331, SPAN 332, or SPAN 333. (Recommended SPAN 330 and SPAN 331)

Discussion and analysis of selected topics in Spanish literature and culture from the Middle Ages to the Present. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 541. Seminar on Cervantes and the Golden Age.

(Dual-listed with SPAN 441). (3-0) Cr. 3. Repeatable, maximum of 6 credits.

Prereq: SPAN 330, SPAN 331, SPAN 332, or SPAN 333. (SPAN 330 recommended)

Discussion and analysis of selected works of Cervantes within the social and cultural context of the Golden Age. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 545. Seminar on the Literatures and Cultures of Latin America.

(Dual-listed with SPAN 445). (3-0) Cr. 3. Repeatable, maximum of 6 credits.

Prereq: SPAN 330, SPAN 331, SPAN 332, SPAN or SPAN 333. (SPAN 332 and SPAN 333 recommended)

Discussion and analysis of selected topics in Latin American literature and culture from Pre-Colonial times to the Present. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 554. Introduction to Spanish-English Interpretation.(Dual-listed with SPAN 354). (Cross-listed with LING). (3-0) Cr. 3. F.S. *Prereq:* SPAN 351

Introduction to the theory, methods, techniques, and problems of consecutive and simultaneous interpretation. Consideration of material from business, agriculture, law, design, medicine, literature, advertisement, and sports. Taught in Spanish.

Meets International Perspectives Requirement.

SPAN 590. Special Topics in Spanish.

Cr. 1-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Spanish*

SPAN 590A. Special Topics in Spanish: Literature or Literary Criticism.

Cr. 1-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Spanish*

SPAN 590B. Special Topics in Spanish: Linguistics.

Cr. 1-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Spanish*

SPAN 590C. Special Topics in Spanish: Language Pedagogy.

Cr. 1-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Spanish*

SPAN 590D. Special Topics in Spanish: Civilization.

Cr. 1-4. Repeatable. *Prereq: Permission of instructor; 6 credits of 400 level Spanish*

Special Education (SP ED)

Courses primarily for undergraduates:

SP ED 250. Education of the Exceptional Learner in a Diverse Society.

(3-0) Cr. 3. F.S. Prereq: C I 204

An overview of students with diverse learning needs, including legal foundations. Emphasis on early identification; educational programming, services and strategies; and preparation for community living in a heterogeneous society. Meets U.S. Diversity Requirement

SP ED 330. Introduction to Instruction for Students with Mild/Moderate Disabilities.

(3-0) Cr. 3. F. Prereq: SP ED 250, concurrent enrollment in C I 280I, C I 377

Educational services and programming for students with mild/moderate disabilities examined from an historical perspective. Current trends, issues, impact of federal and state laws, and identification procedures. Characteristics of students with mild/moderate disabilities.

SP ED 334. Teaching Exceptional Learners in the General Classroom.

(3-0) Cr. 3. F. Prereq: Concurrent enrollment in SP ED 330

Evidence-based teaching strategies and instructional accommodations for inclusive education. Emphasis on managing challenging behavior.

SP ED 355. Classroom Assessment in Inclusive Primary Settings.

(2-0) Cr. 2. F.S. Prereq: Concurrent enrollment in SP ED 455; C I 433, C I 439, C I 468I

Examination and application of strategies for determining special educational needs, planning and evaluating instructional programs, and monitoring student progress.

SP ED 365. Classroom Assessment for Special Education.

(3-0) Cr. 3. S. Prereq: SP ED 330; C I 377

Formal and informal diagnostic instruments. Determination of special education needs. Planning, adaptation, and formative evaluation of instructional programs for students with mild/moderate disabilities.

SP ED 368. Teaching in Inclusive Primary Settings.

(1-0) Cr. 1. F.S. Prereq: Concurrent enrollment in C I 377, C I 438, C I 468F, C I 468G

Federal and state law. Service delivery models. Issues related to providing instruction that meets the needs of diverse learners in inclusive primary settings.

SP ED 401. Teaching Secondary Students with Exceptionalities in General Education.

(2-2) Cr. 3. F.S.

Overview of characteristics and needs of exceptional children/youth and appropriate service delivery options. Legal foundations for special education. Emphasis on co-teaching models, differentiated instruction, accommodations for instruction and assessment, and collaboration among professionals and parents.

SP ED 416. Supervised Student Teaching.

Cr. arr. F.S. Prereq: Full admission to teacher education, senior classification, elementary education major; SP ED 330, SP ED 334, SP ED 365, SP ED 436, SP ED 439, C I 280I, C I 452

Reservation required.

SP ED 436. Instructional Methods for Students with Mild/Moderate Disabilities.

(3-0) Cr. 3. S. Prereq: C I 245, concurrent enrollment in SP ED 365

Evidence-based instructional strategies/techniques in academic areas and materials for individual instruction and classroom management for elementary students with mild/moderate disabilities.

SP ED 455. Instructional Methods for Inclusive Primary Settings.

(2-0) Cr. 2. F.S. Prereq: Concurrent enrollment in SP ED 355; C I 433, C I 439, C I 468I

Evidence-based instructional strategies and techniques in academic areas that support the learning of students with diverse learning needs. Emphasis on accommodations and alternative teaching strategies to meet individual student needs.

SP ED 459. Pre-Student Teaching Experience III: Mild/Moderate Disabilities.

(0-2) Cr. 1. F. Prereq: SP ED 330, SP ED 339, SP ED 365, SP ED 436; admission to teacher education.

Observation and involvement with students with mild/moderate disabilities in school settings. Concurrent enrollment in Sp Ed 460. 1/2 day of time needed. Clinical Experience Level 3. Offered on a satisfactory-fail basis only.

SP ED 460. Special Education Seminar.

(1-0) Cr. 1. F. Prereq: SP ED 436, concurrent enrollment in SP ED 459

Application of evidence-based instructional strategies/techniques in academic and behavioral areas with students who have mild/moderate disabilities. Discussion of professional practices.

SP ED 464. Collaborative Partnerships in Special Education.

(3-0) Cr. 3. F. Prereq: SP ED 365, SP ED 436

Collaborative skills used in education of students with mild/moderate disabilities. Includes collaboration between general and special education teachers, parents, paraeducators, and other education professionals and agencies.

SP ED 490. Independent Study.

Cr. 1-5. F.S. Prereq: 12 credits in elementary education, permission of department chair

Courses primarily for graduate students, open to qualified undergraduates:

SP ED 501. Teaching Secondary Students with Exceptionalities in General Education.

(3-0) Cr. 3. SS. Prereq: Baccalaureate degree

Overview of characteristics and needs of exceptional children/youth and appropriate service delivery options. Legal foundations for special education. Emphasis on co-teaching models, differentiated instruction, accommodations for instruction and assessment, and collaboration among professionals and parents. Students complete a literature review on a topic related to students with exceptionalities and their content area.

SP ED 510. Foundations in Mild/Moderate Disabilities.

(3-0) Cr. 3. S. Prereq: SP ED 501 or equivalent

Historical and legal foundations for special education. Characteristics, prevalence, and etiology of mild/moderate disabilities. Historical and contemporary models of programming for students with disabilities.

SP ED 511. Foundations of Behavior Disorders and Learning Disabilities.

(3-0) Cr. 3. S. Prereq: Sp Ed 501 or equivalent

Study of theory, characteristics, and special education service delivery models to students with moderate/severe behavior/learning disabilities in the public schools and residential settings.

SP ED 515. Assessment of Children and Youth with Disabilities.

(3-0) Cr. 3. F. Prereq: SP ED 510 or SP ED 511

Formal and informal methods of assessment for identification/eligibility, IEP development, and progress monitoring. Formative evaluation of academic and behavioral skills, including curriculum-based measurement and functional behavioral assessment.

SP ED 517. Research Review.

(2-0) Cr. 2. SS. Prereq: RESEV 550, SP ED 515

Critical review of recent research in education and related behavioral sciences as applied to education of students with disabilities. Examination of multiple research methodologies.

SP ED 520. Evidence-based Practices for Mild/Moderate Disabilities.

(3-0) Cr. 3. Prereq: SP ED 510, SP ED 515

Evidence-based instructional methods for meeting the academic and behavioral needs of students with mild/moderate disabilities. Includes methods, strategies, and behavior management techniques appropriate for students with mild or moderate disabilities.

SP ED 530. Evidence-based Practices in Behavior Disorders.

(3-0) Cr. 3. S. Prereq: SP ED 511, SP ED 515

Current research on evidence-based interventions designed to improve the behavior and social skills of students with moderate/severe behavior disorders. Particular emphasis on positive behavioral supports and behavior change strategies.

SP ED 540. Evidence-based Practices in Learning Disabilities.

(3-0) Cr. 3. S. Prereq: SP ED 511, SP ED 515

Current research on evidence-based interventions designed to improve the academic performance of students with moderate/severe learning disabilities. Particular emphasis on methods for improving reading, written expression, and mathematics, as well as performance in content-area instruction.

SP ED 553. Teaching Struggling Adolescent Readers.

(Cross-listed with C I). (3-0) Cr. 3. SS. Prereq: Teaching license

Instructional strategies for enhancing the fluency, vocabulary and comprehension of struggling adolescent readers. Attention to content-area reading materials and strategies.

SP ED 555. Career Education and Transition for Youth with Disabilities.

(2-0) Cr. 2. SS. *Prereq: SP ED 510 or SP ED 511*

Examination of the academic, personal, social, employability, and daily living skills needed for a satisfactory adult life. Exploration of curricula, programs, and services to meet these needs.

SP ED 560. Classroom Management/Behavior Support.

(3-0) Cr. 3. F. *Prereq: Teaching license*

Emphasis on positive behavioral supports and understanding behavior and its context through a functional behavioral approach. Design and development of carefully planned behavioral intervention programs for groups and individual students in general and special education settings.

SP ED 564. Collaborative Consultation.

(3-0) Cr. 3. F. *Prereq: SP ED 515, SP ED 520 or SP ED 530 or SP ED 540*

Models of consultation. Characteristics and methods to promote effective collaboration with families, paraprofessionals, other school personnel, and representatives of other agencies. Includes specific attention to IEP development as a collaborative process.

SP ED 565. Role of the Consultant.

(1-0) Cr. 1. *Prereq: SP ED 564*

Explore role of the educational consultant in different settings (state department, area education agency, school district, private). Examine roles in relationship to models (mental health, collaborative, organization).

SP ED 567. Teaching Mathematics to Struggling Secondary Learners.

(Cross-listed with C I). (3-0) Cr. 3. *Prereq: Secondary teaching experience*

Instructional methods and assessment techniques for secondary students struggling to learn mathematics. Particular emphasis on current research, practices, and trends in mathematics interventions for at-risk students and students with disabilities.

SP ED 570. Systems-level Supports for Youth with Behavior and Learning Disabilities.

(3-0) Cr. 3. SS. *Prereq: SP ED 511*

Overview of support systems (education, juvenile justice, mental health, communities) that serve students with special education needs. Working with and supporting families.

SP ED 590. Special Topics.

Cr. 1-5. F.S. *Prereq: 15 credits in education, permission of department chair*

SP ED 591. Supervised Field Experience.

(0-2) Cr. 1-6. F.S. *Prereq: 15 graduate credits in special area, admission to the graduate program in special education*

Supervised on-the-job field experience in special areas.

SP ED 591G. Supervised Field Experience: Mild/Moderate Disabilities, K-8.

(0-2) Cr. 1-6. F.S. *Prereq: 15 graduate credits in special area, admission to the graduate program in special education*

Supervised on-the-job field experience in special areas.

SP ED 591H. Supervised Field Experience: Mild/Moderate Disabilities, 5-12.

(0-2) Cr. 1-6. F.S. *Prereq: 15 graduate credits in special area, admission to the graduate program in special education*

Supervised on-the-job field experience in special areas.

SP ED 591K. Supervised Field Experience: Behavior Disorders/Learning Disabilities, Ages 5-21.

(0-2) Cr. 1-6. F.S. *Prereq: 15 graduate credits in special area, admission to the graduate program in special education*

Supervised on-the-job field experience in special areas.

SP ED 591L. Supervised Field Experience: Special Education, Non-licensure.

Cr. 1-6. F.S. *Prereq: 15 graduate credits in special area, admission to the graduate program in special education*

Supervised on-the-job field experience in special areas.

SP ED 599. Creative Component.

Cr. 1-5. F.S.SS. *Prereq: 15 credits in education*

Courses for graduate students:**SP ED 615. Seminar.**

(1-0) Cr. 1. Repeatable, maximum of 2 credits.

Selected topics in special education. Analysis of current special education research. Evaluation of impact upon the profession. Implications for additional research.

SP ED 699. Research.

Cr. arr. *Prereq: 15 credits in education*

Speech Communication (SP CM)

Courses primarily for undergraduates:

SP CM 110. Listening.

(3-0) Cr. 3. F.S.

Theory, principles, and competency development in comprehensive, therapeutic, critical, consumer, and appreciative listening. The impact of listening in relationships and partnerships.

SP CM 212. Fundamentals of Public Speaking.

(3-0) Cr. 3. F.S.SS.

Theory and practice of basic speech communication principles applied to public speaking. Practice in the preparation and delivery of extemporaneous speeches.

SP CM 216. Great Speakers and Speeches.

Cr. 3.

Survey of great speeches examined within their political and cultural contexts. Analysis of the rhetorical strategies of diverse speakers with an emphasis on texts from social movements in the United States. Meets U.S. Diversity Requirement

SP CM 223. Intercollegiate Debate and Forensics.

Cr. 1. Repeatable, maximum of 6 credits. F.S. *Prereq: Permission of instructor*
Participation in intramural and intercollegiate debate and other forensic events.

SP CM 275. Analysis of Popular Culture Texts.

(Cross-listed with ENGL). (3-0) Cr. 3. F.S. *Prereq: Credit in or equivalent of 250*
Analysis of how information and entertainment forms persuade and manipulate audiences. Study of several forms that may include newspapers, speeches, television, film, advertising, fiction, and magazines. Special attention to verbal and visual devices.

SP CM 290. Special Projects.

Cr. 1-2. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: 3 credits in speech communication; permission of program director*

SP CM 305. Language, Thought and Action.

(Cross-listed with LING). (3-0) Cr. 3. *Prereq: ENGL 250*

The study of symbolic processes and how meaning is conveyed in words, sentences, and utterances; discussion of modern theories of meaning; and an exploration of relationships among language, thought and action.

SP CM 312. Business and Professional Speaking.

(3-0) Cr. 3. F.S. *Prereq: SP CM 212*

Theory, principles, and competency development in the creation of coherent, articulate business and professional oral presentations.

SP CM 313. Communication in Classrooms and Workshops.

(3-0) Cr. 3. *Prereq: SP CM 212*

Principles of communicating information: training in classroom and workshop-oriented communication activities; use of recording for analysis of presentations.

SP CM 322. Argumentation, Debate, and Critical Thinking.

(2-2) Cr. 3. *Prereq: SP CM 212*

Practice in preparing and presenting arguments and debates; emphasis on critical thinking and ethical and logical duties of the advocate; analysis, evidence, reasoning, attack, defense, research, case construction, and judging.

SP CM 323. Gender and Communication.

(Cross-listed with W S). (3-0) Cr. 3.

Examines how understanding and enactment of gender identity is shaped by communication. Verbal and nonverbal communication across various contexts including personal relationships and the media. Explores discourse of social movements aiming to transform cultural definitions of gender. Meets U.S. Diversity Requirement

SP CM 324. Legal Communication.

(3-0) Cr. 3. *Prereq: SP CM 212*

Speech communication in the legal system inside and outside the trial process: interviewing and counseling, negotiating and bargaining, voir dire, opening statements, examination of witnesses, closing arguments, judge's instructions, jury behavior, and appellate advocacy.

SP CM 327. Persuasion.

(3-0) Cr. 3. F.S.SS. *Prereq: SP CM 212*

Examination of persuasive theories, strategies and research in persuasion. Emphasis on application and analysis; logical, emotional, and ethical proofs.

SP CM 350. Rhetorical Traditions.

(Cross-listed with CL ST, ENGL). (3-0) Cr. 3. S. *Prereq: ENGL 250*
Ideas about the relationship between rhetoric and society in contemporary and historical contexts. An exploration of classical and contemporary rhetorical theories in relation to selected topics that may include politics, gender, race, ethics, education, science, or technology.

SP CM 404. Seminar.

(Dual-listed with SP CM 504). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Junior or above classification*
Seminar on topics central to the field of speech communication.

SP CM 404A. Speech Communication.

Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 15 credits in speech communication*

SP CM 404B. Speech Education.

Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 15 credits in speech communication*

SP CM 412. Rhetorical Criticism.

(3-0) Cr. 3. S. *Prereq: SP CM 212 and 6 credits in speech communication*
Development of rhetorical theory and practice from Corax to modern times. Application of principles of criticism to current public speaking practices.

SP CM 416. History of American Public Address.

(3-0) Cr. 3. S. *Prereq: SP CM 212*

Relationship between public discourse and social change; selected speakers and discourse as linked with political or historical events.

SP CM 417. Campaign Rhetoric.

(Cross-listed with POL S). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: SP CM 212*

Backgrounds of candidates for state and national elections; selected speeches and issues; persuasive strategies and techniques of individual speakers.

SP CM 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 18 credits in speech communication, junior classification, permission of program director*
Only one independent study enrollment is permitted within the department per semester.

SP CM 495A. Independent Study: Directing Speech Activities.

(1-0) Cr. 1. S. *Prereq: C I 301; 9 credits in speech communication; minimum GPA of 2.5 in speech communication courses*
Problems, methods, and materials related to directing speech activities in secondary schools.

SP CM 495B. Independent Study: Teaching Speech.

(Cross-listed with C I). (3-0) Cr. 3. F. *Prereq: C I 301; 9 credits in speech communication; minimum GPA of 2.5 in speech communication courses*
Problems, methods, and materials related to teaching speech, theatre, and media in secondary schools.

SP CM 497. Capstone Seminar.

(3-0) Cr. 3. *Prereq: 15 credits in speech communication; junior or senior classification*

Students synthesize relevant theory and research about contemporary communication practice.

SP CM 499. Communication Internship.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: 18 credits in speech communication courses, other courses deemed appropriate by faculty adviser; 2nd semester junior or senior standing; minimum GPA of 2.5 and minimum GPA of 3.0 in speech communication courses; and permission of the internship committee*
Applications should be submitted in the term prior to the term in which the internship is desired. Supervised application of speech communication in professional settings.

Courses primarily for graduate students, open to qualified undergraduates:

SP CM 504. Seminar.

(Dual-listed with SP CM 404). (3-0) Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Junior or above classification*
Seminar on topics central to the field of speech communication.

SP CM 504A. Seminar: Speech Communication.

(3-0) Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Graduate classification*
Topics may include the following.

SP CM 504B. Seminar: Speech Education.

(3-0) Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: Graduate classification*

Topics may include the following.

SP CM 513. Proseminar: Teaching Fundamentals of Public Speaking.

(1-0) Cr. 1. Repeatable, maximum of 3 credits. F. *Prereq: Permission of instructor*
Required of all new SP CM 212 teaching assistants. Introduction to the teaching of public speaking. Support and supervision of teaching assistants of SP CM 212. Discussion of lesson planning, teaching methods, development of speaking assignments, and evaluation of student speaking.

SP CM 547. The History of Rhetorical Theory I: From Plato to Bacon.

(Cross-listed with ENGL). (3-0) Cr. 3. *Prereq: 6 credits in English*

Rhetorical theory from the classical period of ancient Greece and Rome through the Middle Ages to the early Renaissance; attention to its relation to the nature of knowledge, communication, practice, and pedagogy.

SP CM 548. The History of Rhetorical Theory II: From Bacon to the Present.

(Cross-listed with ENGL). (3-0) Cr. 3. *Prereq: 6 credits in English*

Rhetorical theory from the early modern period (Bacon, Descartes, and Locke) to the present; attention to its relation to the nature of knowledge, communication practice, and pedagogy.

SP CM 582. Advanced Rhetorical Analysis.

(Cross-listed with ENGL). (3-0) Cr. 3.

Extended practice in close textual analysis of various kinds of rhetorical artifacts. Attention to important theoretical concepts used in rhetorical analysis and to historical controversies over the scope and function of rhetorical analysis.

SP CM 590. Special Topics.

Cr. 1-4. Repeatable, maximum of 12 credits. *Prereq: Permission of program chair*

SP CM 592. Core Studies in Rhetoric and Professional Communication.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 12 credits in rhetoric, linguistics, or literature, excluding ENGL 150 and ENGL 250*
Seminar on topics central to the fields of rhetoric and professional communication or composition.

SP CM 592A. Core Studies in Rhetoric and Professional Communication: Rhetoric of Science and Technology.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 12 credits in rhetoric, linguistics, or literature, excluding ENGL 150 and ENGL 250*
Seminar on topics central to the fields of rhetoric and professional communication or composition.

SP CM 592B. Core Studies in Rhetoric and Professional Communication: Visual Rhetoric.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 12 credits in rhetoric, linguistics, or literature, excluding ENGL 150 and ENGL 250*
Seminar on topics central to the fields of rhetoric and professional communication or composition.

SP CM 592C. Core Studies in Rhetoric and Professional Communication: Multimodal Theory and Pedagogy.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 12 credits in rhetoric, linguistics, or literature, excluding ENGL 150 and ENGL 250*
Seminar on topics central to the fields of rhetoric and professional communication or composition.

SP CM 592D. Core Studies in Rhetoric and Professional Communication: Critical Cultural Rhetorics.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable, maximum of 9 credits. *Prereq: 12 credits in rhetoric, linguistics, or literature, excluding ENGL 150 and ENGL 250*
Seminar on topics central to the fields of rhetoric and professional communication or composition.

Statistics (STAT)

Courses primarily for undergraduates:

STAT 100. Orientation in Statistics.

(1-0) Cr. R. F.

Opportunities, challenges, and the scope of the curriculum in statistics. For students planning or considering a career in this area.

STAT 101. Principles of Statistics.

(3-2) Cr. 4. F.S.SS. *Prereq:* 1 1/2 years of high school algebra

Statistical concepts in modern society; descriptive statistics and graphical displays of data; the normal distribution; data collection (sampling and designing experiments); elementary probability; elements of statistical inference; estimation and hypothesis testing; linear regression and correlation; contingency tables.

Credit for only one of the following courses may be applied toward graduation:

STAT 101, STAT 104, STAT 105, STAT 201, or STAT 226.

STAT 104. Introduction to Statistics.

(2-2) Cr. 3. F.S.SS. *Prereq:* 1 1/2 years of high school algebra

Statistical concepts and their use in science; collecting, organizing and drawing conclusions from data; elementary probability; binomial and normal distributions; regression; estimation and hypothesis testing. For students in the agricultural and biological sciences. Credit for only one of the following courses may be applied toward graduation: STAT 101, STAT 104, STAT 105, STAT 201, or STAT 226.

STAT 105. Introduction to Statistics for Engineers.

(3-0) Cr. 3. F.S. *Prereq:* MATH 165 (or MATH 165H)

Statistical concepts with emphasis on engineering applications. Data collection; descriptive statistics; probability distributions and their properties; elements of statistical inference; regression; statistical quality control charts; use of statistical software; team project involving data collection, description and analysis. Credit for only one of the following courses may be applied toward graduation: STAT 101, STAT 104, STAT 105, STAT 201, or STAT 226. Credit for both STAT 105 and STAT 305 may not be applied for graduation.

STAT 201. Introduction to Statistical Concepts and Methods.

(3-2) Cr. 4. S. *Prereq:* Credit or enrollment in MATH 165

Statistical thinking and applications of statistical concepts and methods in modern society. Display and summary of categorical and numerical data. Exploring relationships between variables, association, correlation, and regression. Observational studies and experiments. Probability concepts, random variables, discrete and continuous distributions. Elements of statistical inference; estimation and hypothesis testing. Credit for only one of the following courses may be applied toward graduation: STAT 101, STAT 104, STAT 105, STAT 201, or STAT 226.

STAT 226. Introduction to Business Statistics I.

(3-0) Cr. 3. F.S.SS. *Prereq:* MATH 150 or MATH 165

Obtaining, presenting, and organizing statistical data; measures of location and dispersion; the Normal distribution; sampling and sampling distributions; elements of statistical inference; estimation and confidence intervals; hypothesis testing; inference for simple linear regression analysis; use of computers to visualize and analyze data. Credit for only one of the following courses may be applied toward graduation: STAT 101, STAT 104, STAT 105, STAT 201, or STAT 226.

STAT 231. Probability and Statistical Inference for Engineers.

(4-0) Cr. 4. F.S. *Prereq:* Credit or enrollment in MATH 265

Emphasis on engineering applications. Basic probability; random variables and probability distributions; joint and sampling distributions. Descriptive statistics; confidence intervals; hypothesis testing; simple linear regression; multiple linear regression; one way analysis of variance; use of statistical software.

STAT 301. Intermediate Statistical Concepts and Methods.

(3-2) Cr. 4. F.S. *Prereq:* STAT 101 or STAT 104 or STAT 105 or STAT 201

Statistical concepts and methods used in the analysis of data. Statistical models. Analysis of single sample, two sample and paired sample data. Simple and multiple linear regression including polynomial regression. Analysis of residuals. Regression diagnostics. Model building. Regression with indicator variables. Credit for only one of the following courses may be applied toward graduation: STAT 301, STAT 326, or STAT 401

STAT 305. Engineering Statistics.

(3-0) Cr. 3. F.S.SS. *Prereq:* MATH 165 (or MATH 165H)

Statistics for engineering problem solving. Principles of engineering data collection; descriptive statistics; elementary probability distributions; principles of experimentation; confidence intervals and significance tests; one-, two-, and multi-sample studies; regression analysis; use of statistical software; team project involving engineering experimentation and data analysis. Credit for both Stat 105 and 305 may not be applied for graduation.

STAT 322. Probabilistic Methods for Electrical Engineers.

(Cross-listed with E E). (3-0) Cr. 3. F.S. *Prereq:* E E 224

Introduction to probability with applications to electrical engineering. Sets and events, probability space, conditional probability, total probability and Bayes' rule. Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, moments, moment generating functions, multiple random variables, functions of random variables. Elements of statistics, hypothesis testing, confidence intervals, least squares. Introduction to random processes.

STAT 326. Introduction to Business Statistics II.

(2-2) Cr. 3. F.S. *Prereq:* STAT 226

Multiple regression analysis; regression diagnostics; model building; applications in analysis of variance and time series; random variables; distributions; conditional probability; statistical process control methods; use of computers to visualize and analyze data. Credit for only one of the following courses may be applied toward graduation: STAT 301, STAT 326 or STAT 401.

STAT 330. Probability and Statistics for Computer Science.

(3-0) Cr. 3. F.S. *Prereq:* MATH 166

Topics from probability and statistics applicable to computer science. Basic probability; Random variables and their distributions; Stochastic processes including Markov chains; Queuing models; Basic statistical inference; Introduction to regression.

STAT 332. Visual Communication of Quantitative Information.

(Cross-listed with ENGL). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: STAT 101, STAT 104, STAT 201 or STAT 226; ENGL 250

Communicating quantitative information using visual displays; visualizing data; interactive and dynamic data displays; evaluating current examples in the media; color, perception, and representation in graphs; interpreting data displays.

STAT 341. Introduction to the Theory of Probability and Statistics I.

(Cross-listed with MATH). (3-0) Cr. 3. F.S. *Prereq:* MATH 265 (or MATH 265H)

Probability; distribution functions and their properties; classical discrete and continuous distribution functions; multivariate probability distributions and their properties; moment generating functions; simulation of random variables and use of the R statistical package. Credit for both STAT 341 and STAT 447 may not be applied toward graduation.

STAT 342. Introduction to the Theory of Probability and Statistics II.

(Cross-listed with MATH). (3-0) Cr. 3. F.S. *Prereq:* STAT 341; MATH 207 or MATH 317

Transformations of random variables; sampling distributions; confidence intervals and hypothesis testing; theory of estimation and hypothesis tests; linear model theory; use of the R statistical package for simulation and data analysis.

STAT 361. Statistical Quality Assurance.

(Cross-listed with I E). (2-2) Cr. 3. F.S. *Prereq:* STAT 231, STAT 301, STAT 326 or STAT 401

Statistical methods for process improvement. Simple quality assurance principles and tools. Measurement system precision and accuracy assessment. Control charts. Process capability assessment. Experimental design and analysis for process improvement. Significant external project in process improvement.

STAT 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq:* Permission of department chair

Off-campus work periods for undergraduate students in a field of statistics.

STAT 401. Statistical Methods for Research Workers.

(3-2) Cr. 4. F.S.SS. *Prereq:* STAT 101 or STAT 104 or STAT 105 or STAT 201 or STAT 226

Graduate students without an equivalent course should contact the department. Methods of analyzing and interpreting experimental and survey data. Statistical concepts and models; estimation; hypothesis tests with continuous and discrete data; simple and multiple linear regression and correlation; introduction to analysis of variance and blocking. Credit for only one of the following courses may be applied toward graduation: STAT 301, STAT 326, or STAT 401.

STAT 402. Statistical Design and the Analysis of Experiments.

(3-0) Cr. 3. F.S. *Prereq:* STAT 301 or STAT 326 or STAT 401

The role of statistics in research and the principles of experimental design. Experimental units, randomization, replication, blocking, subdividing and repeatedly measuring experimental units; factorial treatment designs and confounding; extensions of the analysis of variance to cover general crossed and nested classifications and models that include both classificatory and continuous factors. Determining sample size.

STAT 404. Regression for Social and Behavioral Research.

(2-2) Cr. 3. F.S. *Prereq:* STAT 301 or STAT 326 or STAT 401
Lorenz. Applications of generalized linear regression models to social science data. Assumptions of regression; diagnostics and transformations; analysis of variance and covariance; path analysis; logistic, multinomial and Poisson regression.

STAT 406. Statistical Methods for Spatial Data.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* Six hours of statistics at the 400-level

The analysis of spatial data; geostatistical methods and spatial prediction; discrete index random fields and Markov random field models; models for spatial point processes. Emphasis on application and practical use of spatial statistical analysis.

STAT 407. Methods of Multivariate Analysis.

(2-2) Cr. 3. F. *Prereq:* STAT 301 or STAT 326 or STAT 401, knowledge of matrix algebra

Techniques for displaying and analyzing multivariate data including plotting high-dimensional data using interactive graphics, comparing group mean vectors using Hotelling's T², multivariate analysis of variance, reducing variable dimension with principal components, grouping/classifying observations with cluster analysis and discriminant analysis. Imputation of missing multivariate observations.

STAT 410. Statistical Methods for Mathematics Teachers.

(6-0) Cr. 6. Alt. SS., offered odd-numbered years. *Prereq:* STAT 341 or equivalent

Descriptive statistics; data collection through experimentation and sampling; univariate statistical inference; contingency tables; design of experiments and ANOVA; simple linear regression; logistic regression; multiple linear regression; statistics pedagogy.

STAT 415. Advanced Statistical Methods for Research Workers.

(1-0) Cr. 1. Repeatable, maximum of 3 credits. S. *Prereq:* STAT 301 or STAT 326 or STAT 401

Advanced statistical methods for modeling and analyzing data. Taught as separate 1 cr. sections, each of 5 weeks. Three sections taught in one semester. Areas covered: Logistic and Poisson regression; Structural equation modeling; Smoothing and nonparametric regression; Nonparametric and distribution free methods; Bootstrapping and randomization tests; Visualization of high dimensional data; Analysis of species composition data; Missing data and measurement error.

STAT 416. Statistical Design and Analysis of Gene Expression Experiments.

(3-0) Cr. 3. S. *Prereq:* STAT 301 or STAT 326 or STAT 401

Introduction to high-throughput technologies for gene expression studies (especially RNA-sequencing technology): the role of blocking, randomization, and biological and technical replication in the design of gene expression experiments; normalization methods; methods for identifying differentially expressed genes including mixed linear model analysis, generalized linear model analysis, generalized linear mixed model analysis, quasi-likelihood methods, empirical Bayes analysis, and resampling based approaches; procedures for controlling false discovery rate for multiple testing; clustering and classification problems for gene expression data; testing gene categories; emphasis on practical use of methods.

STAT 421. Survey Sampling Techniques.

(2-2) Cr. 3. S. *Prereq:* STAT 301 or STAT 326 or STAT 401

Concepts of sample surveys and the survey process; methods of designing sample surveys, including: simple random, stratified, and multistage sampling designs; methods of analyzing sample surveys including ratio, regression, domain estimation and nonresponse.

STAT 430. Empirical Methods for the Computational Sciences.

(3-0) Cr. 3. F. *Prereq:* STAT 330 or an equivalent course, MATH 166, knowledge of linear algebra.

Statistical methods for research involving computers; exploratory data analysis; selected topics from analysis of designed experiments - analysis of variance, hypothesis testing, interaction among variables; linear regression, logistic regression, Poisson regression; parameter estimation, prediction, confidence regions, dimension reduction techniques, model diagnostics and sensitivity analysis; Markov chains and processes; simulation techniques and bootstrap methods; applications to computer science, bioinformatics, computer engineering - programs, models and systems as objects of empirical study; communicating results of empirical studies. Statistical software: R.

STAT 432. Applied Probability Models.

(3-0) Cr. 3. F. *Prereq:* STAT 231 or STAT 341 or STAT 447

Probabilistic models in biological, engineering and the physical sciences. Markov chains; Poisson, birth-and-death, renewal, branching and queuing processes; applications to bioinformatics and other quantitative problems.

STAT 444. Bayesian Data Analysis.

(2-2) Cr. 3. S. *Prereq:* STAT 301 or STAT 326 or STAT 401; STAT 342 or STAT 447.

Probability models and prior distributions; updating priors through the likelihood function. Computational and simulation-based methods for deriving posterior distributions and for estimating parameters. Basic statistical and hierarchical models. Model adequacy and posterior predictive checks. Markov Chain Monte Carlo methods and introduction to WinBUGS or similar software. Emphasis on applications and examples from the social, biological and physical sciences.

STAT 447. Statistical Theory for Research Workers.

(4-0) Cr. 4. F.S.SS. *Prereq:* MATH 151 and permission of instructor, or MATH 265

Primarily for graduate students not majoring in statistics. Emphasis on aspects of the theory underlying statistical methods. Probability, probability density and mass functions, distribution functions, moment generating functions, sampling distributions, point and interval estimation, maximum likelihood and likelihood ratio tests, linear model theory, conditional expectation and minimum mean square error estimation, introduction to posterior distributions and Bayesian analysis, use of simulation to verify and extend theory. Credit for both STAT 341 and STAT 447 may not be applied toward graduation.

STAT 451. Applied Time Series.

(3-0) Cr. 3. S. *Prereq:* STAT 301 or STAT 326 or STAT 401

Meeker. Methods for analyzing data collected over time; review of multiple regression analysis. Elementary forecasting methods: moving averages and exponential smoothing. Autoregressive-moving average (Box-Jenkins) models: identification, estimation, diagnostic checking, and forecasting. Transfer function models and intervention analysis. Introduction to multivariate time series methods.

STAT 457. Applied Categorical Data Analysis.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* STAT 301 or STAT 326 or STAT 401

Statistical methods for the analysis of categorical data: estimation of proportions, chi-square tests, sample size determination, measures of association and relative risk, measures of agreement, logistic regression, Poisson regression and log-linear models, matched-pair and repeated measures designs, conditional inference. Applications to social, behavioral, and health sciences.

STAT 479. Computer Processing of Statistical Data.

(3-0) Cr. 3. F. *Prereq:* STAT 301 or STAT 326 or STAT 401

Structure, content and programming aspects of the Statistical Analysis System (SAS) software package. Advanced techniques in the use of SAS for data analysis including statistical graphics, regression diagnostics, and complex analysis of variance models. The SAS graphical interfaces Enterprise Guide and Enterprise Miner will be introduced.

STAT 480. Statistical Computing Applications.

(3-0) Cr. 3. S. *Prereq:* STAT 301 or STAT 326 or STAT 401

Modern statistical computing. Data management; spread sheets, verifying data accuracy, transferring data between software packages. Data and graphical analysis with statistical software packages. Algorithmic programming concepts and applications. Simulation. Software reliability.

STAT 490. Independent Study.

Cr. arr. Repeatable, maximum of 9 credits. *Prereq:* 10 credits in statistics
No more than 9 credits in Stat 490 may be counted toward graduation.

STAT 490H. Independent Study: Honors.

Cr. arr. Repeatable, maximum of 9 credits. *Prereq:* 10 credits in statistics
No more than 9 credits in Stat 490 may be counted toward graduation.

STAT 495. Applied Statistics for Industry I.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* STAT 101 or STAT 104 or STAT 105 or STAT 201 or STAT 226; MATH 166 (or MATH 166H)

Graduate students without an equivalent course should consult the department. Statistical thinking applied to industrial processes. Assessing, monitoring and improving processes using statistical methods. Analytic/enumerative studies; graphical displays of data; fundamentals of six sigma; process monitoring; control charts; capability analysis.

STAT 496. Applied Statistics for Industry II.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* STAT 495

Statistical design and analysis of industrial experiments. Concepts of control, randomization and replication. Simple and multiple regression; factorial and fractional factorial experiments; application of ideas of six sigma; reliability; analysis of lifetime data.

Courses primarily for graduate students, open to qualified undergraduates:

STAT 500. Statistical Methods I.

(3-2) Cr. 3. S. *Prereq:* STAT 447 or current enrollment in STAT 542; knowledge of matrix algebra.

Analysis of data from designed experiments and observational studies. Randomization-based inference; inference on group means; nonparametric bootstrap; pairing/blocking and other uses of restricted randomization. Use of linear models to analyze data; least squares estimation; estimability; sampling distributions of estimators; general linear tests; inference for parameters and contrasts. Model assessment and diagnostics; remedial measures; alternative approaches based on ranks.

STAT 501. Multivariate Statistical Methods.

(3-0) Cr. 3. S. *Prereq:* STAT 500 or STAT 402; STAT 447 or STAT 542; STAT 579 or equivalent; knowledge of matrix algebra.

Statistical methods for analyzing and displaying multivariate data; the multivariate normal distribution; inference in multivariate populations, simultaneous analysis of multiple responses, multivariate analysis of variance; summarizing high dimensional data with principal components, factor analysis, canonical correlations, classification methods, clustering, multidimensional scaling; introduction to basic nonparametric multivariate methods. Statistical software: SAS or R.

STAT 503. Exploratory Methods and Data Mining.

(2-2) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* STAT 301 or STAT 326 or STAT 401; STAT 341 or STAT 447 or STAT 542; STAT 480 or STAT 579

Approaches to finding the unexpected in data; exploratory data analysis; pattern recognition; dimension reduction; supervised and unsupervised classification; interactive and dynamic graphical methods; computer-intensive statistical techniques for large or high dimensional data and visual inference. Emphasis is on problem solving, topical problems, and learning how so-called black-box methods actually work.

STAT 505. Environmental Statistics.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* STAT 341 or STAT 447; STAT 401

Statistical methods and models for environmental applications. Emphasis on environmental toxicology. Analysis of data with below detection-limit values. Dose-response curve modeling, including overdispersion and estimation of safe doses. Trend analysis; analysis of autocorrelated data. Equivalence testing.

STAT 506. Statistical Methods for Spatial Data.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* STAT 447 or STAT 542

The analysis of spatial data; geostatistical methods and spatial prediction; discrete index random fields and Markov random field models; models for spatial point processes.

STAT 510. Statistical Methods II.

(3-0) Cr. 3. S. *Prereq:* STAT 500, STAT 447 or credit/enrollment in STAT 543

Model selection and collinearity in linear regression. Likelihood analysis for general models and models with non-normal random components; linear model results in the context of likelihood; linear mixed models and their application; estimation, inference, and prediction. Computational issues in iterative algorithms; expectation-maximization algorithm and its use in mixed models. Case studies of applications including problem formulation, exploratory analysis, model development, estimation and inference, and model assessment.

STAT 512. Design of Experiments.

(3-0) Cr. 3. F. *Prereq:* STAT 511

Basic techniques of experimental design developed in the context of the general linear model; completely randomized, randomized complete block, and Latin Square designs; factorial experiments, confounding, fractional replication; split-plot and incomplete block designs.

STAT 513. Response Surface Methodology.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* STAT 402 or STAT 512,

knowledge of elementary matrix theory and matrix formulation of regression Analysis techniques for locating optimum and near-optimum operating conditions: standard experimental designs for first- and second-order response surface models; design performance criteria; use of data transformations; mixture experiments; optimization for multiple-response problems. Requires use of statistical software with matrix functions.

STAT 515. Theory and Applications of Nonlinear Models.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* STAT 447 or STAT 543; STAT 510

Construction of nonlinear statistical models; random and systematic model components, additive error nonlinear regression with constant and non-constant error variances, generalized linear models, transform both sides models. Iterative algorithms for estimation and asymptotic inference. Basic random parameter models, beta-binomial and gamma-Poisson mixtures. Requires use of instructor-supplied and student-written R functions.

STAT 516. Statistical Design and Analysis of Gene Expression Experiments.

(3-0) Cr. 3. S. *Prereq:* STAT 500; STAT 447 or STAT 542

Introduction to high-throughput technologies for gene expression studies (especially RNA-sequencing technology); the role of blocking, randomization, and biological and technical replication in the design of gene expression experiments; normalization methods; methods for identifying differentially expressed genes including mixed linear model analysis, generalized linear model analysis, generalized linear mixed model analysis, quasi-likelihood methods, empirical Bayes analysis, and resampling based approaches; procedures for controlling false discovery rate for multiple testing; clustering and classification problems for gene expression data; testing gene categories; emphasis on current research topics for statistical analysis of high dimensional gene expression data.

STAT 520. Statistical Methods III.

(3-0) Cr. 3. F. *Prereq:* STAT 510, STAT 447 or STAT 543

Nonlinear regression; generalized least squares; asymptotic inference. Generalized linear models; exponential dispersion families; maximum likelihood and inference. Designing Monte Carlo studies; bootstrap; cross-validation. Fundamentals of Bayesian analysis; data models, priors and posteriors; posterior prediction; credible intervals; Bayes Factors; types of priors; simulation of posteriors; introduction to hierarchical models and Markov Chain Monte Carlo methods.

STAT 521. Theory and Applications of Sample Surveys.

(3-0) Cr. 3. S. *Prereq:* STAT 401; STAT 447 or STAT 542

Practical aspects and basic theory of design and estimation in sample surveys for finite populations. Simple random, systematic, stratified, cluster multistage and unequal-probability sampling. Horvitz-Thompson estimation of totals and functions of totals: means, proportions, regression coefficients. Linearization technique for variance estimation. Model-assisted ratio and regression estimation. Two-phase sampling and sampling on two occasions. Non-response effects. Imputation.

STAT 522. Advanced Applied Survey Sampling.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* STAT 521 or both STAT 421 and STAT 447

Advanced topics in survey sampling and methodology: clustering and stratification in practice, adjustments and imputation for missing data, variance estimation in complex surveys, methods of panel and/or longitudinal surveys, procedures to increase response rates, and computing. Examples are taken from large, well-known surveys in various subject areas. Prior exposure to mathematical statistics, probability, and at least one course in survey sampling theory is assumed.

STAT 531. Quality Control and Engineering Statistics.

(Cross-listed with I E). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* STAT 401; STAT 342 or STAT 447

Statistical methods and theory applicable to problems of industrial process monitoring and improvement. Statistical issues in industrial measurement; Shewhart, CUSUM, and other control charts; feedback control; process characterization studies; estimation of product and process characteristics; acceptance sampling, continuous sampling and sequential sampling; economic and decision theoretic arguments in industrial statistics.

STAT 533. Reliability.

(Cross-listed with I E). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* STAT 342 or STAT 432 or STAT 447

Probabilistic modeling and inference in engineering reliability; lifetime models, product limit estimator, probability plotting, maximum likelihood estimation for censored data, Bayesian methods in reliability, system reliability models, competing risk analysis, acceleration models and analysis of accelerated test data; analysis of recurrence data; planning studies to obtain reliability data.

STAT 534. Ecological Statistics.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* STAT 447 or STAT 542

Statistical methods for non-standard problems, illustrated using questions and data from ecological field studies. Estimation of abundance and survival from mark-recapture studies, deterministic and stochastic matrix models of population trends, integral projection models, and hierarchical modeling, especially of population dynamics. Additional topics vary based on student interest.

STAT 536. Statistical Genetics.

(Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* STAT 401, STAT 447; GEN 320 or BIOL 313

Statistical models and methods for genetics covering models of population processes: selection, mutation, migration, population structure, and linkage disequilibrium, and inference techniques: genetic mapping, linkage analysis, and quantitative trait analysis. Applications include genetic map construction, gene mapping, genome-wide association studies (GWAS), inference about population structure, phylogenetic tree construction, and forensic and paternity identification.

STAT 542. Theory of Probability and Statistics I.(4-0) Cr. 4. F. *Prereq: MATH 414.*

Sample spaces, basic probability results, conditional probability. Random variables, univariate distributions, moment generating functions. Joint distributions, conditional distributions and independence, correlation and covariance. Probability laws and transformations. Introduction to the multivariate normal distribution. Sampling distributions, normal theory, sums and order statistics. Convergence concepts, the law of large numbers, the central limit theorem and delta method. Basics of stochastic simulation.

STAT 543. Theory of Probability and Statistics II.(3-0) Cr. 3. S. *Prereq: STAT 542.*

Point estimation including method of moments, maximum likelihood and Bayes. Properties of point estimators, mean squared error, unbiasedness, consistency, loss functions. Large sample properties of maximum likelihood estimators. Exponential families, sufficiency, completeness, ancillarity, Basu's theorem. Hypothesis tests, Neyman-Pearson lemma, uniformly most powerful tests, likelihood ratio tests, Bayes tests. Interval estimation, inverting tests, pivotal quantities. Nonparametric theory, bootstrap.

STAT 544. Bayesian Statistics.(3-0) Cr. 3. S. *Prereq: STAT 543*

Specification of probability models; subjective, conjugate, and noninformative prior distributions; hierarchical models; analytical and computational techniques for obtaining posterior distributions; model checking, model selection, diagnostics; comparison of Bayesian and traditional methods.

STAT 546. Nonparametric Methods in Statistics.(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: STAT 510, STAT 542*

Overview of parametric versus nonparametric methods of inference; introduction to rank-based tests and/or nonparametric smoothing methods for estimating density and regression functions; smoothing parameter selection; applications to semiparametric models and goodness-of-fit tests of a parametric model.

STAT 551. Time Series Analysis.(3-0) Cr. 3. F. *Prereq: STAT 447 or STAT 542*

Concepts of trend and dependence in time series data; stationarity and basic model structures for dealing with temporal dependence; moving average and autoregressive error structures; analysis in the time domain and the frequency domain; parameter estimation, prediction and forecasting; identification of appropriate model structure for actual data and model assessment techniques. Possible extended topics include dynamic models and linear filters.

STAT 554. Introduction to Stochastic Processes.(Cross-listed with MATH). (3-0) Cr. 3. F. *Prereq: STAT 542*

Markov chains on discrete spaces in discrete and continuous time (random walks, Poisson processes, birth and death processes) and their long-term behavior. Optional topics may include branching processes, renewal theory, introduction to Brownian motion.

STAT 557. Statistical Methods for Counts and Proportions.(3-0) Cr. 3. F. *Prereq: STAT 500 or STAT 401; STAT 543 or STAT 447*

Statistical methods for analyzing simple random samples when outcomes are counts or proportions; measures of association and relative risk, chi-squared tests, loglinear models, logistic regression and other generalized linear models, tree-based methods. Extensions to longitudinal studies and complex designs, models with fixed and random effects. Use of statistical software: SAS, S-Plus or R.

STAT 565. Methods in Biostatistics and Epidemiology.(Cross-listed with TOX). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: STAT 500 or STAT 401; STAT 543 or STAT 447*

Statistical methods commonly used in epidemiology and human and animal health studies. Overview of cohort studies, case-control studies and randomized clinical trials. Topics include inference procedures for disease risk factors, analysis of time-to-event and survival data, analysis of longitudinal studies of disease progression and health status, approaches to handling missing data, and meta-analysis. Examples will come from recent studies of physical and mental health, nutrition and disease progression in human and animal populations. Use of statistical software: SAS or R.

STAT 568. Bioinformatics II (Advanced Genome Informatics).(Cross-listed with BCB, COM S, GDCB). (3-0) Cr. 3. S. *Prereq: BCB 567, BBMB 301, BIOL 315, STAT 430, credit or enrollment in GEN 411*

Advanced sequence models. Basic methods in molecular phylogeny. Hidden Markov models. Genome annotation. DNA and protein motifs. Introduction to gene expression analysis.

STAT 570. Bioinformatics IV (Computational Functional Genomics and Systems Biology).(Cross-listed with BCB, COM S, CPR E, GDCB). (3-0) Cr. 3. S. *Prereq: BCB 567, BIOL 315, COM S 311 and either 208 or 228, GEN 411, STAT 430*

Algorithmic and statistical approaches in computational functional genomics and systems biology. Elements of experiment design. Analysis of high throughput gene expression, proteomics, and other datasets obtained using system-wide measurements. Topological analysis, module discovery, and comparative analysis of gene and protein networks. Modeling, analysis, simulation and inference of transcriptional regulatory modules and networks, protein-protein interaction networks, metabolic networks, cells and systems: Dynamic systems, Boolean, and probabilistic models. Multi-scale, multi-granularity models. Ontology-driven, network based, and probabilistic approaches to information integration.

STAT 579. An Introduction to R.(0-2) Cr. 1. F. *Prereq: Enrollment in STAT 500*

An introduction to the logic of programming, numerical algorithms, and graphics. The R statistical programming environment will be used to demonstrate how data can be stored, manipulated, plotted, and analyzed using both built-in functions and user extensions. Concepts of modularization, looping, vectorization, conditional execution, and function construction will be emphasized.

STAT 580. Statistical Computing.(3-0) Cr. 3. S. *Prereq: STAT 579; STAT 447 or STAT 542*

Introduction to scientific computing for statistics using tools and concepts in R: programming tools, modern programming methodologies, modularization, design of statistical algorithms. Introduction to C programming for efficiency; interfacing R with C. Building statistical libraries. Use of algorithms in modern subroutine packages, optimization and integration. Implementation of simulation methods; inversion of probability integral transform, rejection sampling, importance sampling. Monte Carlo integration.

STAT 590. Special Topics.

Cr. arr. Repeatable.

STAT 590A. Special Topics: Theory.

Cr. arr. Repeatable.

STAT 590B. Special Topics: Methods.

Cr. arr. Repeatable.

STAT 590C. Special Topics: Design of Experiments.

Cr. arr. Repeatable.

STAT 590D. Special Topics: Sample Surveys.

Cr. arr. Repeatable.

STAT 590E. Special Topics: Statistics Education.

Cr. arr. Repeatable.

STAT 590F. Special Topics: Statistical Computing and Graphics.

Cr. arr. Repeatable. F.

STAT 598. Cooperative Education.Cr. R. F.S.SS. *Prereq: Permission of the department chair*

Off-campus work periods for graduate students in a field of statistics.

STAT 599. Creative Component.

Cr. arr.

Courses for graduate students:**STAT 601. Advanced Statistical Methods.**(3-0) Cr. 3. S. *Prereq: STAT 520, STAT 543 and MATH 414 or enrollment in STAT 641*

Methods of constructing complex models including adding parameters to existing structures, incorporating stochastic processes and latent variables. Use of modified likelihood functions; quasi-likelihoods; profiles; composite, likelihoods. Asymptotic normality as a basis of inference; Godambe information. Sample reuse; block bootstrap; resampling with dependence. Simulation for model assessment. Issues in Bayesian analysis.

STAT 602. Modern Multivariate Statistical Learning.(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: STAT 520, STAT 543, STAT 579*

Statistical theory and methods for modern data mining and machine learning, inference, and prediction. Variance-bias trade-offs and choice of predictors; linear methods of prediction; basis expansions; smoothing, regularization, and reproducing kernel Hilbert spaces; kernel smoothing methods; neural networks and radial basis function networks; bootstrapping, model averaging, and stacking; linear and quadratic methods of classification; support vector machines; trees and random forests; boosting; prototype methods; unsupervised learning including clustering, principal components, and multi-dimensional scaling; kernel mechanics.

STAT 606. Advanced Spatial Statistics.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* STAT 506, STAT 642
 Consideration of advanced topics in spatial statistics, including areas of current research. Topics may include construction of nonstationary covariance structures including intrinsic random functions, examination of edge effects, general formulation of Markov random field models, spatial subsampling, use of pseudo-likelihood and empirical likelihood concepts in spatial analysis, the applicability of asymptotic frameworks for inference, and a discussion of appropriate measures for point processes.

STAT 611. Theory and Applications of Linear Models.

(3-0) Cr. 3. F. *Prereq:* STAT 510; STAT 542 or STAT 447; a course in matrix algebra

Matrix preliminaries, estimability, theory of least squares and of best linear unbiased estimation, analysis of variance and covariance, distribution of quadratic forms, extension of theory to mixed and random models, inference for variance components.

STAT 612. Advanced Design of Experiments.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* STAT 512

General theory of factorial experiments. Design optimality criteria, approximate design and general equivalence theory, computational approaches to constructing optimal designs for linear models, and extensions to nonlinear models. Advanced topics of current interest in the design of experiments, including one or more of: distance based design criteria and construction of spatial process models, screening design strategies for high-dimensional problems, and design problems associated with computational experiments.

STAT 615. Advanced Bayesian Methods.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* STAT 544 and STAT 601

Complex hierarchical and multilevel models, dynamic linear and generalized linear models, spatial models. Bayesian nonparametric methods. Specialized Markov chain Monte Carlo algorithms and practical approaches to increasing mixing and speed convergence. Summarizing posterior distributions, and issues in inference. Model assessment, model selection, and model averaging.

STAT 621. Advanced Theory of Survey Statistics.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* STAT 521

Advanced topics of current interest in the design of surveys and analysis of survey data, including: asymptotic theory for design and model-based estimators, use of auxiliary information in estimation, variance estimation techniques, small area estimation, non-response modeling and imputation.

STAT 641. Foundations of Probability Theory.

(Cross-listed with MATH). (3-0) Cr. 3. F. *Prereq:* MATH 414 or MATH 501 or equivalent course.

Sequences and set theory; Lebesgue measure, measurable functions. Absolute continuity of functions, integrability and the fundamental theorem of Lebesgue integration. General measure spaces, probability measure, extension theorem and construction of Lebesgue-Stieljes measures on Euclidean spaces. Measurable transformations and random variables, induced measures and probability distributions. General integration and expectation, L_p -spaces and integral inequalities. Uniform integrability and absolute continuity of measures. Probability densities and the Radon-Nikodym theorem. Product spaces and Fubini-Tonelli theorems.

STAT 642. Advanced Probability Theory.

(Cross-listed with MATH). (3-0) Cr. 3. S. *Prereq:* STAT 641, or STAT 543 and MATH 515.

Probability spaces and random variables. Kolmogorov's consistency theorem. Independence, Borel-Cantelli lemmas and Kolmogorov's 0 - 1 Law. Comparing types of convergence for random variables. Sums of independent random variables, empirical distributions, weak and strong laws of large numbers. Convergence in distribution and its characterizations, tightness, characteristic functions, central limit theorems and Lindeberg-Feller conditions. Conditional probability and expectation. Discrete parameter martingales and their properties and applications.

STAT 643. Advanced Theory of Statistical Inference.

(3-0) Cr. 3. F. *Prereq:* STAT 543, STAT 642

Sufficiency and related concepts, completeness, exponential families and statistical information. Elements of decision theory, decision rules, invariance and Bayes rule. Maximum likelihood and asymptotic inference. Generalized estimating equations and estimating functions, M-estimation, U-statistics. Likelihood ratio tests, simple and composite hypotheses, multiple testing. Bayesian inference. Nonparametric inference, bootstrap, empirical likelihood, and tests for nonparametric models.

STAT 645. Advanced Stochastic Processes.

(Cross-listed with MATH). (3-0) Cr. 3. S.

Weak convergence. Random walks and Brownian motion. Martingales. Stochastic integration and Ito's Formula. Stochastic differential equations and applications.

STAT 647. Advanced Multivariate Analysis.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* STAT 543, knowledge of matrix algebra

Multivariate normal distribution, estimation of the mean vector and the covariance matrix, multiple and partial correlation, Hotelling's T^2 statistic, Wishart distribution, multivariate regression, principle components, discriminant analysis, high dimensional data analysis, latent variables.

STAT 648. Seminar on Theory of Statistics and Probability.

Cr. arr. F. *Prereq:* STAT 543.

Seminar topics change with each offering.

STAT 651. Advanced Time Series.

(3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq:* STAT 551, STAT 642

Stationary and nonstationary time series models, including ARMA, ARCH, and GARCH. Covariance and spectral representation of time series. Fourier and periodogram analyses. Predictions. CLT for mixing processes. Estimation and distribution theory. Long range dependence.

STAT 680. Advanced Statistical Computing.

(3-0) Cr. 3. F. *Prereq:* STAT 543 and STAT 580

Normal approximations to likelihoods. The delta-method and propagation of errors. Topics in the use of the E-M algorithm including; its use in the exponential family, computation of standard errors, acceleration. Resampling methods: brief theory and application of the jackknife and the bootstrap. Randomization tests. Stochastic simulation: Markov Chain, Monte Carlo, Gibbs' sampling, Hastings-Metropolis algorithms, critical slowing-down and remedies, auxiliary variables, simulated tempering, reversible-jump MCMC and multi-grid methods.

STAT 690. Advanced Special Topics.

Cr. arr. Repeatable. *Prereq:* Permission of instructor

STAT 690A. Advanced Special Topics: Theory.

Cr. arr. Repeatable. *Prereq:* Permission of instructor

STAT 690B. Advanced Special Topics: Methods.

Cr. arr. Repeatable. *Prereq:* Permission of instructor

STAT 690C. Advanced Special Topics: Design of Experiments.

Cr. arr. Repeatable. *Prereq:* Permission of instructor

STAT 690D. Advanced Special Topics: Sample Surveys.

Cr. arr. Repeatable. *Prereq:* Permission of instructor

STAT 690E. Advanced Special Topics: Statistical Computing.

Cr. arr. Repeatable. *Prereq:* Permission of instructor

STAT 690F. Advanced Special Topics: Graphics.

Cr. arr. Repeatable. *Prereq:* Permission of instructor

STAT 699. Research.

Cr. arr. Repeatable.

Supply Chain Management (SCM)

Courses primarily for undergraduates:

SCM 301. Supply Chain Management.

(3-0) Cr. 3. Prereq: ECON 101 and STAT 226

Various supply chain activities and integration of supply chain management with supply and demand, both within and between firms. Exposure to a wide range of supply chain management terminology, analytical tools, and theories related to four key elements of supply chain management: purchasing, operations, distribution, and integration. Specific topics include strategic sourcing, supply management, demand forecasting, resource planning, inventory management, process management, logistics, location analysis, process integration, and performance measurement.

SCM 340. Project Management.

(Cross-listed with MIS). (3-0) Cr. 3. Prereq: credit or enrollment in MIS 301

Equips students to support team activities in the general project management environment and better manage their careers. Practical experience using project management techniques and tools. Course topics include project initiation and execution, risk assessment, estimating and contracts, planning, human factors, and standard methods.

SCM 422. Manufacturing Planning and Control.

(3-0) Cr. 3. Prereq: SCM 301

Advanced treatment of manufacturing planning and control procedures. Master production scheduling, material requirements planning, enterprise resource planning, capacity planning, shop floor control, just-in-time, and competitive analyses of modern manufacturing systems.

SCM 424. Process Management, Analysis, and Improvement.

(3-0) Cr. 3. Prereq: SCM 301

The design, analysis, and management of production processes to improve performance. Performance measures and their relationships; process design and evaluation; and managerial levers for improving and controlling process performance.

SCM 428. Special Topics in Operations Management.

(3-0) Cr. 3. Prereq: SCM 301

In-depth analysis of current issues, problems, and systems in operations management with emphasis on new theoretical and methodological developments. Topics may include in different semesters, supply chain management, productivity and quality improvement, management of technology and innovation, information technology in operations management, quick response manufacturing, and service operations management.

SCM 440. Supply Chain Information Systems.

(Cross-listed with MIS). (3-0) Cr. 3. Prereq: MIS 301, SCM 301

Internal and inter-organizational information systems necessary for a supply chain to achieve competitive advantage. Topics include: design, development, implementation, and maintenance of supply chain information systems; enterprise resource planning; advanced planning and scheduling, manufacturing execution systems; and the interface between manufacturing planning and control processes, logistics processes, and the information system.

SCM 450. Enterprise Resource Planning Systems in Supply Chain.

(3-0) Cr. 3. Prereq: SCM 301, MIS 301 or IE 148, IE 341

Examination of the role of enterprise resource planning systems (ERP) in the supply chain. Hands-on experience with a major software application in use by many corporations to manage and improve the efficiency of their supply chains and operations. Students will develop a more process-centric perspective about how a supply chain operates and how ERP enables and supports such operations.

SCM 460. Decision Tools for Logistics and Operations Management.

(3-0) Cr. 3. Prereq: SCM 301

Technical tools and skills required for problem solving and decision making in logistics and operations management. Transportation and network planning, inventory decision making, facility location planning, vehicle routing, scheduling, and production planning. Quantitative tools include linear and integer programming, non-linear programming, and simulation. Emphasis on the use of PC-based spreadsheet programs.

SCM 461. Principles of Transportation.

(3-0) Cr. 3. Prereq: SCM 301

Economic, operating, and service characteristics of the various modes of transportation, with a special emphasis on freight transportation. Factors that influence transport demand, costs, market structures, carrier pricing, and carrier operating and service characteristics and their influence on other supply chain costs and supply chain performance.

SCM 462. Transportation Carrier Management.

(3-0) Cr. 3. Prereq: Credit or enrollment in SCM 461

Analysis of transport users' requirements. Carrier management problems involving ownership and mergers, routes, competition, labor, and other decision areas.

SCM 466. International Transportation and Logistics.

(3-0) Cr. 3. Prereq: SCM 301

Logistics systems and legal framework for the international movement of goods. Operational characteristics of providers of exporting and importing services. The effects of government trade policies on global logistics.

SCM 485. Demand Planning and Management.

(3-0) Cr. 3. Prereq: SCM 301

Demand planning process which synchronizes demand with manufacturing and distribution. Addresses linking business plans and demand forecasts both horizontally and vertically within the organization and collaboratively among supply chain partners. Forecasting, customer relationship management, sales and operations planning, customer service, distribution channels, e-fulfillment, and information systems requirements.

SCM 486. Principles of Purchasing and Supply Management.

(3-0) Cr. 3. Prereq: SCM 301

Sourcing strategies, concepts, tools and dynamics in the context of the integrated supply chain. Make or buy decision, supplier evaluation and selection, global sourcing, the total cost of ownership, contracts and legal terms, negotiation, purchasing ethics, and information systems requirements.

SCM 487. Strategic Supply Chain Management.

(3-0) Cr. 3. Prereq: SCM 460 or SCM 422 or SCM 424; SCM 485 or SCM 486

Capstone course in supply chain management. Integrating and applying the theories, concepts, and methods covered in the prerequisite courses through the use of readings, case studies, projects, and industry speakers.

SCM 490. Independent Study.

Cr. 1-3. Repeatable. Prereq: SCM 301, senior classification, permission of instructor

Courses primarily for graduate students, open to qualified undergraduates:

SCM 501. Supply Chain Management.

(3-0) Cr. 3. Prereq: Enrollment in MBA program or departmental permission

Introduction to supply chain management including aspects of operations, logistics and global supply chain strategy development. Topic areas include lean manufacturing and value stream mapping; supplier development and measurement; sustainable supply chain operations; process measurement, management and improvement; supply chain risk and uncertainty; visibility and integration in the supply chain; and inventory control.

SCM 520. Decision Models for Supply Chain Management.

(3-0) Cr. 3. Prereq: SCM 501 or permission of instructor

The application of decision models for supply chain management. Topics include business applications of decision theory, inventory theory, business forecasting, optimization models, transportation and network models, routing problems, and project management.

SCM 522. Supply Chain Planning and Control Systems.

(3-0) Cr. 3. Prereq: SCM 501 or permission of instructor

An integrated analysis of planning and control systems for supply chains. Master production scheduling, material requirements planning, enterprise resource planning, capacity planning, shop floor control, competitive analyses of modern supply chain systems, and implementation of information technologies related to these topics.

SCM 524. Strategic Process Analysis and Improvement.

(3-0) Cr. 3. Prereq: SCM 501 or permission of instructor

Analysis, management, and improvement of the business processes used to produce and deliver products and services that satisfy customer needs. Process attributes that managers can control to influence the key operational performance measures of throughput time, inventory, cost, quality, and flexibility are discussed. Topics such as theory of constraints, lean production, and six sigma are included.

SCM 560. Strategic Logistics Management.

(3-0) Cr. 3. *Prereq: SCM 501 or permission of instructor*

Positions logistics vis-a-vis supply chain management (SCM). Presents different perspectives on SCM vs. logistics. Describes primary logistics functions: transportation, warehousing, facility location, customer service, order processing, inventory management and packaging. Benefits of and obstacles to the integration of these functions.

SCM 561. Transportation Management and Policy.

(3-0) Cr. 3. *Prereq: SCM 501 or permission of instructor*

Analysis of contemporary issues and strategies in transportation management and policy. Emphasis on evaluation of the impacts of transportation policies, new technologies, and strategic carrier and shipper management practices on the freight transportation industry and logistics systems.

SCM 563. Purchasing and Supply Management.

(3-0) Cr. 3. *Prereq: SCM 501 or permission of instructor*

Mechanics, procedures and tools used in purchasing. Recruiting, selecting, developing and managing supply chain partners in order to achieve competitive advantage via superior supply chain management. Factors and information needs for making supply management decisions.

SCM 585. Strategic Demand Planning.

(3-0) Cr. 3. *Prereq: SCM 501 or permission of instructor*

Synchronizes demand with manufacturing and distribution. Emphasis on the strategic advantages of linking business plans and demand forecasts, both vertically within the organization and collaboratively among supply chain partners.

SCM 590. Special Topics.

Cr. 1-3. Repeatable. *Prereq: Graduate classification and permission of instructor*

For students who wish to do individual research in a particular area of supply chain management.

Courses for graduate students:**SCM 601. Theoretical Foundations of Supply Chain Management.**

(3-0) Cr. 3. *Prereq: MGMT 601 or permission of instructor*

An overview of the development of supply chain management (SCM) theory, including review of seminal articles in logistics, operations, and purchasing management and theories from allied disciplines (e.g., economics, marketing, sociology, strategic management). Analysis of trends in SCM research topics and methodologies. Identification of emerging and future areas for research and theory development.

SCM 602. Seminar in Supply Chain Strategy.

(3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment*

Review of research literature on supply chain strategy, including the impact of technology, global economic and social factors, and intra- and inter-organizational integration on supply chain strategy formation. The role of SCM in overall corporate strategy and the impact of SCM on firm performance will also be addressed.

SCM 603. Seminar in Purchasing.

(3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment*

Review of classic purchasing theories. Discussion of contemporary supply management strategy; the role of supply management and its relationship with other functional areas; its impact on logistics and transportation issues; management of supply uncertainties.

SCM 604. Seminar in Logistics Management.

(3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment*

Integration of network, economic, and systems theory in the design, management, and control of logistics systems in the context of integrated supply chain management. Functional areas addressed include transportation, inventory order fulfillment, distribution, and warehousing. Facility location analysis will also be covered.

SCM 605. Seminar in Operations Management.

(3-0) Cr. 3. *Prereq: SCM 601 or concurrent enrollment*

Review of the research literature on methods of organizing, planning, controlling, and improving manufacturing systems to achieve the desired performance objectives related to cost, quality, speed, and flexibility. The relationship between the performance of the manufacturing system and the performance of the supply chain system will also be discussed.

SCM 650. Research Practicum I.

(1-0) Cr. 1. *Prereq: enrollment in the PhD program*

Preparation of a research manuscript to be submitted to a peer-reviewed academic journal. Students will work with a faculty mentor on a research project.

SCM 651. Research Practicum II.

(1-0) Cr. 1. *Prereq: enrollment in the PhD program*

Preparation of a second research manuscript to be submitted to a peer-reviewed academic journal. Although students work under the supervision of a faculty mentor, the students will take independent responsibility for the research project.

SCM 699. Dissertation.

Cr. 12. *Prereq: Graduate classification, permission of dissertation supervisor*
Research.

Sustainable Agriculture (SUSAG)

Courses primarily for graduate students, open to qualified undergraduates:

SUSAG 509. Agroecosystems Analysis.

(Cross-listed with AGRON, SOC). (3-4) Cr. 4. F. *Prereq:* Senior or above classification

Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecological, social, etc), and scales of operation.

SUSAG 515. Integrated Crop and Livestock Production Systems.

(Cross-listed with A B E, AGRON, AN S). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* SUSAG 509

Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

SUSAG 530. Ecologically Based Pest Management Strategies.

(Cross-listed with AGRON, ENT, PL P). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

SUSAG 546. Strategies for Diversified Food and Farming Systems.

(Cross-listed with AGRON, HORT). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* SUSAG 509

Project-focused engagement in food and farming systems using tools and perspectives drawn from multiple disciplines. Includes a field component.

SUSAG 571. Agroforestry Systems.

(Cross-listed with NREM). (2-3) Cr. 3. Alt. S., offered even-numbered years.

Prereq: 6 credits in biological science at 300 level or above

Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry. Meets International Perspectives Requirement.

SUSAG 584. Organic Agricultural Theory and Practice.

(Cross-listed with AGRON, HORT). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* 9 cr. in biological or physical sciences

Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

SUSAG 590. Special Topics.

Cr. 1-3. Repeatable. F.S.SS. *Prereq:* Graduate classification, permission of instructor

For students wishing to conduct in-depth study of a particular topic in sustainable agriculture.

SUSAG 599. Creative Component.

Cr. arr. F.S.SS.

Pre-enrollment contract required. For MS students pursuing the non-thesis degree option. Final product is a creative component.

Courses for graduate students:

SUSAG 600. Sustainable Agriculture Colloquium.

(1-0) Cr. 1. Repeatable. F.S.

Weekly seminar for graduate students in the Sustainable Agriculture program.

SUSAG 610. Foundations of Sustainable Agriculture.

(Cross-listed with A B E, AGRON, ANTHR, SOC). (3-0) Cr. 3. F. *Prereq:* Graduate classification, permission of instructor

Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging agricultural systems in terms of the core concepts of sustainability and their theoretical contexts.

SUSAG 699. Research.

Cr. arr. Repeatable. F.S.SS.

MS and PhD thesis and dissertation research.

Sustainable Environments (SUS E)

Courses primarily for graduate students, open to qualified undergraduates:

SUS E 501. Sustainable Design Studio I.

(0-10) Cr. 5. *Prereq: SUS E 521*

Addressing sustainable design at multiple scales of constructed and natural systems and artifacts, this studio engages multidisciplinary graduate students in a team-oriented, project-based learning environment. Faculty-directed projects will include theoretical investigations and applications of an interdisciplinary design process through brief readings and discussions.

SUS E 502. Sustainable Design Studio II.

(0-10) Cr. 5. *Prereq: SUS E 501, SUS E 512, SUS E 531*

This advanced studio provides a community-based context for an interdisciplinary design team to work on a variety of faculty-directed projects including funded, basic, and applied research. Coursework addresses sustainable design at multiple scales, engaging both systems and artifacts. Field trips.

SUS E 511. Sustainable Design Colloquium I.

(3-0) Cr. 3. *Prereq: Admission to MDSE program*

Study and discuss practices of sustainable design and design research. Investigate responsibilities, roles, technologies and methods for studying and advancing the art and science of designing sustainable environments.

SUS E 512. Sustainable Design Colloquium II.

(1-0) Cr. 1. *Prereq: SUS E 511*

A graduate student-led seminar designed to foster the knowledge and skills to support innovation, entrepreneurship, and leadership in the field of sustainable design. Invitation of outside speakers.

SUS E 521. Foundation of Sustainable Design.

(3-0) Cr. 3. *Prereq: Graduate standing or senior classification with instructor permission.*

Introduction to the broad frameworks and tools for implementing sustainability among a variety of environments, industries, and enterprises. Investigates the role and opportunity for sustainable design strategies.

SUS E 531. Human Dimensions of Sustainability.

(3-0) Cr. 3. *Prereq: Graduate standing or senior classification with instructor permission.*

This seminar provides students from multiple disciplines with a grounding in designers' interactions with clients, consumers, communities, cultures, and biospheres. Through a review of literature and the production of new case studies in sustainable design, students discover and represent conditions in which products of design operate across scales, markets, social conditions, geographic domains, academic disciplines, and zones of professional responsibility.

Technology Systems Management (TSM)

Courses primarily for undergraduates:

TSM 110. Introduction to Technology.

(1-0) Cr. 1. F. *Prereq: AST and I Tec majors only or permission of instructor*
Team-oriented introduction to agricultural systems technology and industrial technology. Internships, careers, competencies, academic success strategies, industry visits, transition to academic life.

TSM 111. Experiencing Technology.

(0-2) Cr. 1. S. *Prereq: AST or I Tec majors only or permission of instructor*
Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of technology. Report writing, internships, competencies, industry visits.

TSM 115. Solving Technology Problems.

(2-2) Cr. 3. F.S. *Prereq: MATH 140 or higher (can be taken concurrently)*
Solving technology problems and presenting solutions through technical reports. Unit conversions, unit factor method, SI units, significant digits, graphing and curve fitting. Use of spreadsheet programs to solve and present technology problems. Solution of technology problems using computer programming languages.

TSM 116. Introduction to Design in Technology.

(2-2) Cr. 3. F.S.
Use of parametric solid modeling software to model, and document, parts and assemblies. Includes national and international standards for documentation, design projects, and teamwork. Free-hand sketching techniques will be covered.

TSM 201. Preparing for Workplace Seminar.

(Cross-listed with A B E). (1-0) Cr. 1. F.S. *Prereq: Prereq: Sophomore classification in AE, AST, BSE, or I TEC*
8 week course. Professionalism in the context of the engineering/technical workplace. Development and demonstration of key workplace competencies: teamwork, initiative, communication, and engineering/technical knowledge. Resumes; Cover Letters; Behavioral Based Interviewing; Industry Speakers; Preparation for internships experiences.

TSM 210. Fundamentals of Technology.

(3-0) Cr. 3. F.S. *Prereq: TSM 115 or equivalent, MATH 140 or higher*
Introduction to problem solving related to fundamental agricultural and/or industrial technology systems and mathematical tools needed for data analysis. Basic laws of energy, force, and mass applied to technology systems such as: mechanical power transmission; heating, ventilation and air conditioning; electrical circuits. Introduction to engineering economics: using the time value of money to make economic decisions.

TSM 216. Advanced Technical Graphics, Interpretation, and CAD.

(2-2) Cr. 3. F.S. *Prereq: TSM 116*
Advanced design systems incorporating 2D and 3D design and productivity tools for use in manufacturing settings. Topics include: Geometric Dimensioning and Tolerancing, ANSI / ASME standard symbols, advanced visualization, design modeling of parts and assemblies, feature based design. Use of AutoCAD and parametric modeling software.

TSM 240. Introduction to Manufacturing Processes.

(1-4) Cr. 3. F.S.
A study of selected materials and related processes used in manufacturing. Lecture and laboratory activities focus on materials, properties, and processes. This includes plastics and metals.

TSM 270. Principles of Injury Prevention.

(3-0) Cr. 3. F.
Basic foundations of injury causation and prevention in home, motor vehicle, public, and work environments.

TSM 310. Total Quality Improvement.

(3-0) Cr. 3. S. *Prereq: STAT 101 or STAT 104, junior classification*
Introduction to the fundamental concepts of TQM - Deming style of management, statistical studies to understand the behavior of products, processes, or services, and how to define and document processes and customer focus. Introduction to continuous improvement tools and methods - emphasis on team work and problem solving skills.

TSM 322. Preservation of Grain Quality.

(2-0) Cr. 2. S. *Prereq: MATH 140 or higher*
Principles and management for grain quality preservation. Quality measurement. Drying and storage. Fans and airflow through grain. Handling methods.

TSM 322L. Preservation of Grain Quality Laboratory.

(0-3) Cr. 1. S. *Prereq: Credit or enrollment for credit in TSM 322*
Hands-on experiences in the principles and management for grain quality preservation. Quality measurement. Drying and storage. Fans and airflow through grain. Handling methods. System planning. Industry tour.

TSM 324. Soil and Water Conservation Management.

(2-2) Cr. 3. S. *Prereq: MATH 140 or MATH 151*
Introduction to engineering and conservation principles applied to the planning of erosion control systems, water control structures, water quality management, and drainage and irrigation systems.

TSM 325. Biorenewable Systems.

(Cross-listed with A B E). (3-0) Cr. 3. F. *Prereq: ECON 101, CHEM 163 or higher, MATH 140 or higher*
Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, and transportation/logistics.

TSM 327. Animal Production Systems.

(3-0) Cr. 3. F. *Prereq: TSM 210*
Confined animal feeding operations. Environmental controls for animal production. Response of animals to the environment. Heat and moisture balance in animal housing. Ventilation, water, feed handling, air pollution, odor and waste management systems.

TSM 330. Agricultural Machinery and Power Management.

(2-3) Cr. 3. S. *Prereq: TSM 210, MATH 145 or MATH 151*
Selection, sizing, and operational principles of tractors and machinery systems. Cost analysis and computer techniques applied to planning and management of agricultural machine systems. Principles, operation, and application of agricultural machinery.

TSM 333. Precision Farming Systems.

(2-2) Cr. 3. F. *Prereq: MATH 140 or higher, junior or senior classification*
Geographic information systems (GIS) and global positioning systems (GPS). Hardware systems for precision farming emphasized. Autosteering and automatic implement control systems. Collection and management of yield data. Sampling strategies for precision farming. Introduction to building fertilizer prescriptions and recommendations. Economic benefits of precision farming systems.

TSM 335. Tractor Power.

(3-3) Cr. 4. F. *Prereq: TSM 210, MATH 145*
Theory and construction of tractor engines, mechanical power trains and hydraulic systems. Introduction to traction, chassis mechanics, and hydraulic power.

TSM 337. Fluid Power Systems Technology.

(2-2) Cr. 3. S. *Prereq: TSM 210*
Fundamental fluid power principles. Fluid properties. Function and performance of components such as pumps, valves, actuators, hydrostatic transmission. Analysis of fluid power circuits and systems. Introduction to electrohydraulics. Course includes lab using fluid power trainers.

TSM 340. Advanced Automated Manufacturing Processes.

(2-2) Cr. 3. F. *Prereq: TSM 216, TSM 240, MATH 151*
NC programming operations for CNC mills and lathes. Transfer of parts descriptions into detailed process plans, tool selection, and NC codes. Computer assisted CAD/CAM NC programming for 2D/3D machining and machining of student programmed NC code in lab.

TSM 363. Electric Power and Electronics for Agriculture and Industry.

(3-3) Cr. 4. F. *Prereq: TSM 210*
Basic electricity. Electrical safety, wiring, 3-phase service, controls, and motors for agricultural and industrial applications. Planning building lighting and electrical systems. Electronics to sense, monitor, and control mechanical processes.

TSM 370. Occupational Safety.

(3-0) Cr. 3. S. *Prereq: TSM 270, junior standing*
Identifies safety and health risks in industrial work environments. Focus on how managers and supervisors meet their responsibilities for providing a safe workplace for their employees. Includes the identification and remediation of workplace hazards.

TSM 371. Occupational Safety Management.

(2-0) Cr. 2. S.
Introduction to occupational safety and health administration and management. Focus on development and management of safety programs and obtaining employee involvement in occupational safety programs.

TSM 372. Legal Aspects of Occupational Safety and Health.

(2-0) Cr. 2. Alt. F., offered odd-numbered years. *Prereq: TSM 371*
A review of the common legal issues facing safety practitioners in the workplace. Includes OSHA, EPA and DOT regulations; workers' compensation, as well as common liability issues.

TSM 376. Fire Protection and Prevention.

(3-0) Cr. 3. Alt. F., offered even-numbered years.
An overview of the current problems and technology in the fields of fire protection and fire prevention, with emphasis on industrial needs, focusing on the individual with industrial safety responsibilities.

TSM 393. Topics in Technology.

Cr. 1-4. F.S.SS.
Offered as demand warrants. Web-based instruction.

TSM 393A. Topics in Technology: Agriculture and Biosystems Management.

Cr. 1-4. F.S.SS.
Offered as demand warrants. Web-based instruction.

TSM 393B. Topics in Technology: Machine Systems.

Cr. 1-4. F.S.SS.
Offered as demand warrants. Web-based instruction.

TSM 393C. Topics in Technology: Manufacturing.

Cr. 1-4. F.S.SS.
Offered as demand warrants. Web-based instruction.

TSM 393D. Topics in Technology: Occupational Safety.

Cr. 1-4. F.S.SS.
Offered as demand warrants. Web-based instruction.

TSM 393E. Topics in Technology: Chemical Application Systems.

Cr. 1-4. F.S.SS.
Offered as demand warrants. Web-based instruction.

TSM 393F. Topics in Technology: Agricultural Safety and Health.

Cr. 1-4. F.S.SS.
Offered as demand warrants. Web-based instruction.

TSM 393G. Topics in Technology: Electronic Integration for Agriculture and Production Systems.

Cr. 1-4. F.S.SS.
Offered as demand warrants. Web-based instruction.

TSM 393I. Topics in Technology: Irrigation Systems Management.

Cr. 1-4. F.S.SS.
Offered as demand warrants. Web-based instruction.

TSM 393J. Topics in Technology: Machinery Management Using Precision Agriculture Technology.

Cr. 1-4. F.S.SS.
Offered as demand warrants. Web-based instruction.

TSM 397. Internship in Technology.

Cr. R. F.S.SS. *Prereq: At least 45 credits of coursework, in AST or I Tec major, and approval of internship coordinator*
A supervised work experience in an approved learning setting with application to technology practices and principles. Reporting during work experience and self and employer evaluation required. Minimum GPA requirement.

TSM 399. Work Experience in Technology.

Cr. 2. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: TSM 397 the preceding semester and approval of internship coordinator*
Written reports and reflection on work experience. A maximum of 4 credits of TSM 399 may be used toward the total credits required for graduation.

TSM 415. Technology Capstone I.

(0-2) Cr. 1. F.S. *Prereq: senior classification with less than 32 credits remaining*
Identification and definition of a current technological problem in agricultural or industrial systems. Formation of project teams, application of technology curriculum content, and use of team communication and management as applied to problem solving in technology.

TSM 416. Technology Capstone II.

(1-8) Cr. 5. F.S. *Prereq: TSM 415 in previous semester*
Continued team and project development, communications, and responsibilities. Development of alternate solutions using tools and knowledge from technology curriculum, creativity, critical analysis, and planning techniques. Selection of promising solutions to technology problem identified in TSM 415 for development and analysis. Presentation of project through oral presentations, written reports, and/or working prototypes.

TSM 440. Cellular Lean Manufacturing Systems.

(2-2) Cr. 3. F. *Prereq: TSM 310*
Introduction to lean tools and techniques that reduce costs and improve business performance: JIT, VSM, SMED, Kaizen, Standard Work, Cycle Time Reduction, Takt Time, A3, etc. Emphasis on lean thinking and competency development through application: simulations, case studies, industry guests and mentors, teamwork and industry-related lean projects.

TSM 443. Statics and Strength of Materials for Technology.

(2-2) Cr. 3. S. *Prereq: PHYS 111, MATH 145 or MATH 151*
Application of standard analytic and computer based techniques of solving problems related to force and moments. The properties of materials and how to select appropriate materials for a particular design is reviewed.

TSM 444. Facility Planning.

(3-0) Cr. 3. F. *Prereq: TSM 216 and TSM 240; STAT 101 or STAT 104*
Principles and practices in designing, evaluating, and organizing existing facilities or creating new facilities. Emphasis on AutoCAD-based new facility design project - product design, production flow analysis, activity relationship analysis, layout deployment, materials handling, office and other service requirement design, and the necessary cost analysis for the new facility.

TSM 465. Automation Systems.

(2-2) Cr. 3. S. *Prereq: TSM 363*
Theory and applications of automation systems. Emphasizes features, capabilities, design and programming skills of Programmable Logic Controller (PLC) based industrial control systems. Introduction to industrial robots and sensors.

TSM 470. Industrial Hygiene: Physical, Chemical, and Biological Hazards.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: MATH 151 or higher*
A qualitative and quantitative introduction to health effects of chemical, biological, and physical hazards in a workplace.

TSM 471. Safety Laboratory.

(0-2) Cr. 1. Alt. F., offered odd-numbered years. *Prereq: TSM 470 (can be taken concurrently)*
Introduction to equipment, methods, and strategies to measure, evaluate, control, and research hazards and risk in the workplaces.

TSM 477. Risk Analysis and Management.

(Dual-listed with TSM 577). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: MATH 151, STAT 101 or STAT 104*
Risk analysis and management focuses on developing a risk oriented pattern of thinking that is appropriate for today's complex world. The tools that will be gained in this course will be helpful in recognizing, understanding, and analyzing hazards and risks in modern complex systems.

TSM 490. Independent Study.

Cr. 1-4. Repeatable. *Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department*
A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 490H. Independent Study: Honors.

Cr. 1-4. Repeatable. *Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department*
A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 490I. Independent Study: Manufacturing.

Cr. 1-4. Repeatable. *Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department*
A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 490J. Independent Study: Agriculture and Biosystems Management.

Cr. 1-4. Repeatable. *Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department*
A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 490M. Independent Study: Machine Systems.

Cr. 1-4. Repeatable. *Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department*
A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 490O. Independent Study: Occupational Safety.

Cr. 1-4. Repeatable. *Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department*

A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 493. Workshop in Technology.

Cr. 1-4. Repeatable.

Offered as demand warrants.

TSM 493A. Workshop in Technology: Agriculture and Biosystems Management.

Cr. 1-4. Repeatable.

Offered as demand warrants.

TSM 493B. Workshop in Technology: Machine Systems.

Cr. 1-4. Repeatable.

Offered as demand warrants.

TSM 493C. Workshop in Technology: Manufacturing.

Cr. 1-4. Repeatable.

Offered as demand warrants.

TSM 493D. Workshop in Technology: Occupational Safety.

Cr. 1-4. Repeatable.

Offered as demand warrants.

TSM 495. Agricultural and Biosystems Engineering Department Study Abroad Preparation or Follow-up.

(Cross-listed with A B E). Cr. 1-2. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Preparation for, or follow-up of, study abroad experience (496). For preparation, course focuses on understanding the tour destination through readings, discussions, and research on topics such as the regional industries, climate, crops, culture, economics, food, geography, government, history, natural resources, and public policies. For follow-up, course focuses on presentations by students, report writing, and reflection. Students enrolled in this course intend to register for 496 the following term or have had taken 496 the previous term. Meets International Perspectives Requirement.

TSM 496. Agricultural and Biosystems Engineering Department Study Abroad.

(Cross-listed with A B E). Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Tour and study at international sites relevant to disciplines of industrial technology, biological systems engineering, agricultural systems technology, and agricultural engineering. Location and duration of tours will vary. Trip expenses paid by students. Pre-trip preparation and/or post-trip reflection and reports arranged through 495.

Meets International Perspectives Requirement.

Courses primarily for graduate students, open to qualified undergraduates:**TSM 540. Advanced Design and Manufacturing.**

(3-0) Cr. 3. S. *Prereq: Permission of instructor*

Application of six sigma philosophy to advance product design and process control. Application of value stream mapping to the existing manufacturing system to develop future continuous improvement plans. Application of Taguchi Parameter design methodologies for optimizing the performance of manufacturing processes. Application of Taguchi Tolerance Design methodologies for product design.

TSM 575. Safety and Public Health Issues in Modern Society.

(2-0) Cr. 2. Repeatable, maximum of 2 times.

Exploration and analysis of current safety and public health issues impacting society. The focus will be on topics that impact individuals in work, public, and home environments.

TSM 577. Risk Analysis and Management.

(Dual-listed with TSM 477). (3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: MATH 151, STAT 101 or STAT 104

Risk analysis and management focuses on developing a risk oriented pattern of thinking that is appropriate for today's complex world. The tools that will be gained in this course will be helpful in recognizing, understanding, and analyzing hazards and risks in modern complex systems.

TSM 590. Special Topics in Technology.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor*

TSM 590A. Special Topics in Technology: Agriculture and Biosystems Management.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor*

TSM 590B. Special Topics in Technology: Machine Systems.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor*

TSM 590C. Special Topics in Technology: Manufacturing.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor*

TSM 590D. Special Topics in Technology: Occupational Safety.

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor*

TSM 593. Workshop in Technology.

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*

TSM 598. Technical Communications for a Master's Degree.

(Cross-listed with A B E). Cr. 1. F.S.SS.

A technical paper draft based on the M.S. thesis or creative component is required of all master's students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on M.S. thesis or creative component is required of all master's students. This presentation must be in a form that satisfies the normal presentation requirements of a professional society. The presentation itself (oral or poster) may be made at a professional society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Offered on a satisfactory-fail basis only.

TSM 599. Creative Component.

Cr. 1-3. Repeatable, maximum of 6 credits.

A discipline-related problem to be identified and completed under the direction of the program adviser. Three credits required for all nonthesis master's degree students.

Courses for graduate students:**TSM 601. Graduate Seminar.**

(Cross-listed with A B E). (1-0) Cr. 1. F.

Keys to writing a good MS thesis or PhD dissertation. How to begin formulating research problems. Discussion of research problems and broader impacts, review of literature, identifying knowledge gaps and needs, long-term goals, research hypotheses, objectives, rationale and significance, methods, procedures, data analysis, and reporting results. Presentation of research proposal in different formats. Using peer review and responding to feedback.

TSM 652. Program and Learner Evaluation.

(3-0) Cr. 3. *Prereq: STAT 401 or equivalent*

Techniques for evaluating learners, facilities, programs, and staff utilizing theories for developing measurement instruments. Outcomes assessment is emphasized.

TSM 655. Academic Leadership in Technology and Engineering.

(3-0) Cr. 3. *Prereq: Permission of instructor*

A definition of the faculty role in technology and engineering disciplines, including strategies for dealing with programs, personnel, and constituencies are presented. Leadership skills involving team formation, team operation, and conflict resolution are addressed.

TSM 657. Curriculum Development in Technology and Engineering.

(3-0) Cr. 3. *Prereq: Permission of instructor*

Basic concepts, trends, practices, and factors influencing curriculum development, techniques, organization and procedures. Emphasis will be given to program and course development.

TSM 694. Teaching Practicum.

(Cross-listed with A B E). Cr. 1-3. Repeatable. F.S.SS. *Prereq: Graduate classification and permission of instructor*

Graduate student experience in the agricultural and biosystems engineering departmental teaching program.

TSM 697. Internship in Technology.

Cr. R. *Prereq: permission of major professor and approval by department chair, graduate classification*

One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

TSM 698. Technical Communications for a Doctoral Degree.

(Cross-listed with A B E). Cr. 1. F.S.SS.

A technical paper draft based on the dissertation is required of all Ph.D. students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on the dissertation is required of all Ph.D. students. This presentation must be in a form that satisfies the normal presentation requirements of a professional society. The presentation itself (oral or poster) may be made at a professional society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Offered on a satisfactory-fail basis only.

TSM 699. Research.

Cr. arr.

Technology and Social Change (T SC)

T SC 590. Special Topics: Technology and Social Change.

Cr. arr. Prereq: T SC 541, permission of instructor and of T SC coordinator
Individual study of topics concerning global and local implications of technological change.

Courses primarily for undergraduates:

T SC 220. Global Sustainability.

(Cross-listed with ANTHR, ENV S, GLOBE, M E, MAT E, SOC). (3-0) Cr. 3. F.S.
An introduction to the key global issues in sustainability. Focuses on interconnected roles of energy, materials, human resources, economics, and technology in building and maintaining sustainable systems. Applications discussed will include challenges in both the developed and developing world and will examine the role of technology in a resource-constrained world. Cannot be used for technical elective credit in any engineering department.
Meets International Perspectives Requirement.

T SC 341. Technology: International, Social, and Human Issues.

(3-0) Cr. 3. F. Prereq: Junior classification
An interdisciplinary study of the international significance of technology and of the societal and human issues attending its development and adoption.

T SC 342. World Food Issues: Past and Present.

(Cross-listed with AGRON, ENV S, FS HN). (3-0) Cr. 3. F.S. Prereq: Junior classification

Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects.

Meets International Perspectives Requirement.

T SC 342H. World Food Issues: Past and Present, Honors.

(Cross-listed with AGRON, ENV S). (3-0) Cr. 3. F.S. Prereq: Junior classification

Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects.

Meets International Perspectives Requirement.

T SC 343. Philosophy of Technology.

(Cross-listed with PHIL). (3-0) Cr. 3. F.S. Prereq: 6 credits of social science or T SC 341 and 3 credits of social science

Moral and other philosophical problems related to developments in technology. Topics may include conditions under which technological innovations contribute to human emancipation, relationship of technology and democracy, utility and limits of technical rationality, and problems of ensuring that benefits of technological advance are communally shared. Topics discussed with reference to such issues as contemporary developments in microelectronics, technology transfer to the Third World, etc.

T SC 474. Communication Technology and Social Change.

(Cross-listed with JL MC). (3-0) Cr. 3. Prereq: Junior classification

Examination of historical and current communication technologies, including how they shape and are shaped by the cultural and social practices into which they are introduced.

Meets International Perspectives Requirement.

T SC 490. Independent Study.

Cr. arr. Repeatable. Prereq: T SC 341, permission of instructor and of T SC coordinator

Courses primarily for graduate students, open to qualified undergraduates:

T SC 543. Technological Innovation, Social Change, and Development.

(3-0) Cr. 3. Alt. F., offered even-numbered years. Prereq: 6 credits in social sciences

Sources, theories and models of technological innovation; social and institutional contexts of technology transfer; appropriate/intermediate technology; issues and methods of impact assessment; planning technology related social change; democratic control of technological innovations and application; local and international case studies.

T SC 574. Communication Technologies and Social Change.

(Cross-listed with JL MC). (3-0) Cr. 3. Prereq: 6 credits in social science

Personal, organizational, and social implications of the use of communication technologies. Includes theories and empirical research across the continuum of perspectives, from techno-utopianism through an anti-technology stance.

Meets International Perspectives Requirement.

Theatre (THTRE)

Courses primarily for undergraduates:

THTRE 106. Introduction to the Performing Arts.

(3-0) Cr. 3. F.S.SS.

An audience oriented, broad-based, team-taught survey of the performing arts which emphasizes theatre and includes segments on television, radio, film, dance, and music.

THTRE 110. Theatre and Society.

(3-0) Cr. 3. F.S.

An introduction to Theatre focusing on its relationship with society throughout history.

THTRE 151. The Actor's Voice.

(3-0) Cr. 3. S.

Study and practice of fundamentals of vocal production: breathing, quality, articulation, projection, and expressiveness for the performing artist.

THTRE 224. Concert and Theatre Dance.

(Cross-listed with DANCE). (0-3) Cr. 0.5-2. Repeatable, maximum of 6 credits.

F.S. *Prereq: By audition only*

Choreography, rehearsal, and performance in campus dance concerts and/or musical theatre productions. Offered on a satisfactory-fail basis only.

THTRE 250. Theatre Practicum.

Cr. 1-2. Repeatable, maximum of 6 credits. F.S. *Prereq: Permission of instructor*

Practice in various aspects of technical theatre production. Offered on a satisfactory-fail basis only.

THTRE 251. Acting I.

(3-0) Cr. 3. F.S.

Theory and practice in fundamentals of acting.

THTRE 255. Introduction to Theatrical Production.

(3-3) Cr. 4. F.S.

Standard structure and procedures, historical overview of performing arts production including the design and creation of scenery, costumes and lighting.

THTRE 263. Script Analysis.

(3-0) Cr. 3. F.S.

Theory, analysis, and interpretation of play scripts for production.

THTRE 290. Special Projects.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: 3 credits in theatre;*

permission of instructor; approval of written proposal

THTRE 316. Creative Writing: Playwriting.

(Cross-listed with ENGL). (3-0) Cr. 3. S. *Prereq: ENGL 250, not open to freshmen*

Progresses from production of scenes to fully developed one-act plays. Emphasis on action, staging, writing, analytical reading, workshop criticism, and individual conferences.

THTRE 351. Acting II.

(3-0) Cr. 3. S. *Prereq: THTRE 251, DANCE 120 recommended*

Theory and practice of techniques of acting with emphasis on character and scene analysis.

THTRE 354. Musical Theatre I.

(2-2) Cr. 3. *Prereq: THTRE 251 or MUSIC 232 or 3 credits in Dance*

Theory, history and practice of musical theatre techniques. Designed to develop the musical theatre performance skills of singers, dancers, and actors.

THTRE 355. Musical Theatre II.

(2-2) Cr. 3. *Prereq: THTRE 354*

Theory, history and practice of musical theatre techniques. Designed to develop the musical theatre performance skills of singers, dancers, and actors.

THTRE 357. Stage Make-up.

(1-2) Cr. 2. F.

Theory and practice of make-up and hair-styling techniques for the performing arts: Theatre, Opera, Dance, Television and Film. Lab required.

THTRE 358. Oral Interpretation.

(3-0) Cr. 3. F.

Principles of oral interpretation: practice in analysis, in reading aloud of literary selections, and in reader's theatre.

THTRE 360. Stagecraft.

(3-2) Cr. 4. S. *Prereq: THTRE 255*

Tools, materials, and techniques of planning, constructing and painting of performing arts scenography. Basic principles of lighting technology. Technical drawing for performing arts production.

THTRE 365. Theatrical Design I.

(2-2) Cr. 3. F. *Prereq: THTRE 255*

An exploration of the elements, principles and art of theatrical design.

THTRE 366. Theatrical Design II.

(2-2) Cr. 3. S. *Prereq: THTRE 365*

Intensive application of the principles introduced in 365. In-depth study and practice of the graphic skills of rendering and drafting.

THTRE 393. Studies in Theatre Design and Production Workshop.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in Theatre*

Studies in Theatre Design and Production.

THTRE 393A. Studies in Theatre Design and Production Workshop: Costume Design.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in theatre*

Special topics related to costume design.

THTRE 393B. Studies in Theatre Design and Production Workshop: Scenic Design.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in theatre*

Special topics related to scenic design.

THTRE 393C. Studies in Theatre Design and Production Workshop: Lighting Design.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in theatre*

Special topics in lighting design.

THTRE 393D. Studies in Theatre Design and Production Workshop: Sound Design.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in theatre*

Special topics in sound design.

THTRE 393E. Studies in Theatre Design and Production Workshop: Stagecraft.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in theatre*

Special topics in stagecraft.

THTRE 393F. Studies in Theatre Design and Production Workshop: Costume Draping and Patterning.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in theatre*

Special topics in costume draping and patterning.

THTRE 393G. Studies in Theatre Design and Production Workshop: Advanced Makeup.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in Theatre*

Special topics related to advanced makeup.

THTRE 393I. Studies in Theatre Design and Production Workshop: Stage Management.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in Theatre*

Special topics related to stage management.

THTRE 393J. Studies in Theatre Design and Production Workshop: Technical Direction.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in Theatre*

Special topics related to technical direction.

THTRE 393K. Studies in Theatre Design and Production Workshop: Arts Management.

Cr. 3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 3 credits in Theatre*

Special topics related to Arts Management.

THTRE 451. Acting III.

(3-0) Cr. 3. F. *Prereq: THTRE 351 and permission of instructor*

Analysis and practice of period scenes.

THTRE 455. Directing I.

(3-0) Cr. 3. F. *Prereq: THTRE 255; THTRE 263; THTRE 251 recommended*

Theory, techniques, and practice of directing.

THTRE 456. Directing II.

(2-2) Cr. 3. S. *Prereq: THTRE 455*

Practical and theoretical experience in directing the stage play.

THTRE 461. Theatrical Design Studio.

(3-2) Cr. 4. Repeatable, maximum of 12 credits. F.S. *Prereq: Permission of instructor*

Focuses on the art and craft of specific areas of theatrical design. Each semester the student will focus on one or two of the following: scenic, costume, or lighting design.

THTRE 465. History of Theatre I.

(3-0) Cr. 3. F. *Prereq: HIST 201 or equivalent*

Theatre history from ancient times to 1800.

THTRE 466. History of Theatre II.

(3-0) Cr. 3. S. *Prereq: THTRE 465*
Theatre history from 1800 to present.

THTRE 469. Advanced Theatre Practicum.

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: 9 credits in theatre courses; junior classification*
Practicum in production with ISU Theatre, with opportunities for specialization within various areas. Required: Approval of written proposal.

THTRE 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 9 credits. F.S.SS. *Prereq: 9 credits in theatre, approved written proposal, junior classification*
Only one independent study enrollment within the department is permitted per semester. No more than 9 credits in Thtre 490 may be counted toward graduation.

THTRE 497. Senior Seminar.

(3-0) Cr. 3. S. *Prereq: 15 credits in theatre courses; senior classification*
Directed study of a theatre issue or problem identified by each student. Students synthesize relevant theory and research culminating in senior project or paper.

THTRE 499. Theatre Internship.

Cr. 1-8. Repeatable, maximum of 8 credits. F.S.SS. *Prereq: 18 credits in THTRE, other courses deemed appropriate by faculty adviser; 2nd semester junior or senior standing; minimum GPA of 2.5 and minimum GPA of 3.0 in THTRE courses*
Supervised application of theatre in professional settings.

Courses primarily for graduate students, open to qualified undergraduates:**THTRE 504. Seminar.**

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 9 credits in theatre*
Topics may include the following:.

THTRE 504A. Seminar: Musical Theatre.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 9 credits in theatre*
Topics may include the following:.

THTRE 504B. Seminar: Acting Techniques.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 9 credits in theatre*
Topics may include the following:.

THTRE 504C. Seminar: Acting Styles.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 9 credits in theatre*
Topics may include the following:.

THTRE 504D. Seminar: Design and Technical Theatre.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 9 credits in theatre*
Topics may include the following:.

THTRE 504E. Seminar: Arts Management.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: 9 credits in theatre*
Topics may include the following:.

THTRE 590. Special Topics.

Cr. 1-4. Repeatable, maximum of 12 credits. *Prereq: Approved written proposal*

Toxicology (TOX)

Courses primarily for undergraduates:

TOX 354. General Pharmacology.

(Dual-listed with TOX 554). (Cross-listed with B M S). (3-0) Cr. 3. S. *Prereq: B M S 549 and B M S 552; BBMB 404, BBMB 405*

General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

TOX 419. Foodborne Hazards.

(Cross-listed with FS HN, MICRO). (3-0) Cr. 3. Alt. S., offered even-numbered years. *Prereq: MICRO 201 or MICRO 302, a course in biochemistry*
Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Only one of FS HN 419 and FS HN 519 may count toward graduation.

TOX 420. Food Microbiology.

(Cross-listed with FS HN, MICRO). (3-0) Cr. 3. F. *Prereq: MICRO 201 or MICRO 302*

Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications.

TOX 426. Veterinary Toxicology.

(Dual-listed with TOX 526). (Cross-listed with VDPAM). (3-0) Cr. 3. S. *Prereq: Third year classification in veterinary medicine*

Study of toxicological diseases of animals emphasizing clinical recognition, circumstances of poisoning, differential diagnosis with clinical and laboratory data, therapeutic procedures, preventive management and public health implications. Supplemented with case-based materials.

Courses primarily for graduate students, open to qualified undergraduates:

TOX 501. Principles of Toxicology.

(3-0) Cr. 3. F. *Prereq: BBMB 404 or equivalent*

Principles of toxicology governing entry, fate, and effects of toxicants on living systems. Includes toxicokinetics and foreign compound metabolism relative to toxification or detoxification. Fundamentals of foreign compound effects on metabolism, physiology, and morphology of different cell types, tissues, and organ systems.

TOX 502. Toxicology Methods.

(0-6) Cr. 3. Alt. S., offered even-numbered years. *Prereq: TOX 501*

Provides demonstrations or laboratory experience in the application of methods used in toxicology, including safety procedures, calculation and data analysis, teratologic and morphologic evaluation, cellular/molecular toxicological techniques, electrophysiologic measures, in vitro enzyme induction/biotransformation, neural and behavioral toxicology testing.

TOX 504. Toxicology Seminar.

(1-0) Cr. 1. Repeatable, maximum of 2 credits. F.S.SS. *Prereq: Permission of instructor required*

Presentation of a seminar about a current topic in toxicology as part of a weekly series of seminars by graduate students, faculty, and guest lecturers from off campus.

TOX 506. Diet and Cancer Prevention.

(Cross-listed with NUTRS). (1-0) Cr. 1. Alt. F., offered even-numbered years. *Prereq: BBMB 404 and BBMB 405 or BBMB 420*

Principles of cancer biology and cancer etiology will be integrated with the impacts of diet on cancer development and prevention. Contributions of research with humans, animals, cultured cells and cell free systems will be included. The importance of dietary contaminants, macronutrients and micronutrients will be examined with an emphasis on the strength of the evidence and mechanisms of action.

TOX 515. Regulatory Toxicology.

(1-0) Cr. 1. Alt. F., offered even-numbered years. *Prereq: BBMB 404 or FSHN 403*

Survey of approaches used by toxicologists in government and industry for generating, enforcing and complying with laws and regulations. Examine policies from multiple regulatory agencies and how risk-based decisions are made. Perform simple risk assessments and suggest ways of dealing with data gaps. Explore new types of data used in risk assessments. Taught online only.

TOX 519. Food Toxicology.

(Cross-listed with FS HN, NUTRS). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: A course in biochemistry*

Basic principles of toxicology. Toxicants in the food supply: modes of action, toxicant defense systems, toxicant and nutrient interactions, risk assessment. Only one of FS HN 419 and FS HN 519 may count toward graduation.

TOX 526. Veterinary Toxicology.

(Dual-listed with TOX 426). (Cross-listed with VDPAM). (3-0) Cr. 3. S. *Prereq: Third year classification in veterinary medicine*

Study of toxicological diseases of animals emphasizing clinical recognition, circumstances of poisoning, differential diagnosis with clinical and laboratory data, therapeutic procedures, preventive management and public health implications. Supplemented with case-based materials.

TOX 529. Foodborne Toxicants.

(Cross-listed with FS HN). (2-0) Cr. 2. F. *Prereq: A course in biochemistry; enrollment in GP-IDEA Food Safety and Defense Graduate Certificate or permission of instructor.*

Mechanisms of action, metabolism, sources, remediation/detoxification, risk assessment of major foodborne toxicants of current interest, design of HACCP plans for use in food industries targeting foodborne toxicants, discussion of toxicants from a food defense perspective. Offered online only.

TOX 546. Clinical and Diagnostic Toxicology.

(Cross-listed with VDPAM). (0-3) Cr. 1-3. Repeatable. F.S.SS. *Prereq: D.V.M. degree or VDPAM 526*

Advanced study of current problems and issues in toxicology. Emphasis on problem solving utilizing clinical, epidemiological, and laboratory resources.

TOX 550. Pesticides in the Environment.

(Cross-listed with ENT). (2-0) Cr. 2. S. *Prereq: 9 credits of biological sciences*
Fate and significance of pesticides in soil, water, plants, animals, and the atmosphere.

TOX 554. General Pharmacology.

(Dual-listed with TOX 354). (Cross-listed with B M S). (3-0) Cr. 3. S. *Prereq: B M S 549 and B M S 552; BBMB 404, BBMB 405*

General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

TOX 565. Methods in Biostatistics and Epidemiology.

(Cross-listed with STAT). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: STAT 500 or STAT 401; STAT 543 or STAT 447*

Statistical methods commonly used in epidemiology and human and animal health studies. Overview of cohort studies, case-control studies and randomized clinical trials. Topics include inference procedures for disease risk factors, analysis of time-to-event and survival data, analysis of longitudinal studies of disease progression and health status, approaches to handling missing data, and meta-analysis. Examples will come from recent studies of physical and mental health, nutrition and disease progression in human and animal populations. Use of statistical software: SAS or R.

TOX 570. Risk Assessment for Food, Agriculture and Veterinary Medicine.

(Cross-listed with AGRON, VDPAM). (3-0) Cr. 3. F. *Prereq: STAT 104 or consent of instructor*

Risk assessment principles as applied to biological systems. Exposure and effects characterization in human and animal health and ecological risk assessment. Risk analysis frameworks and regulatory decision-making. Introduction to quantitative methods for risk assessment using epidemiological and distributional analysis. Uncertainty analysis. This course is available only by distance.

TOX 575. Cell Biology.

(Cross-listed with B M S). (3-0) Cr. 3. F. *Prereq: 10 credits in biological science and permission of instructor*

A multi-instructor course covering major topics in cell structure and function, including: universal features of prokaryotic and eukaryotic cells, types of utilization and conversion of energy, genetic control of cell shape and functionality, internal organization of cells, communication between cells and their environment, development of multicellular systems. Students have to write a term paper.

TOX 590. Special Topics.

Cr. arr. Repeatable.

Contact individual faculty for special projects or topics. Graded.

Courses for graduate students:

TOX 626. Advanced Food Microbiology.

(Cross-listed with FS HN, MICRO). (3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq: FS HN 420 or FS HN 421 or FS HN 504*

Topics of current interest in food microbiology, including new foodborne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials.

TOX 627. Rapid Methods in Food Microbiology.

(Cross-listed with FS HN, MICRO). (2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: FS HN 420 or FS HN 421 or FS HN 504*

Provides an overview of rapid microbial detection methods for use in foods. Topics include historical aspects of rapid microbial detection, basic categories of rapid tests (phenotypic, genotypic, whole cell, etc.), existing commercial test formats and kits, automation in testing, sample preparation and "next generation" testing formats now in development.

TOX 656. Cellular and Molecular Pathology II.

(Cross-listed with V PTH). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: Graduate course in biochemistry, genetics, or cell biology

Cellular and molecular mechanisms of carcinogenesis.

TOX 675. Insecticide Toxicology.

(Cross-listed with ENT). (2-3) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: ENT 555 or TOX 501*

Principles of insecticide toxicology; classification, mode of action, metabolism, and environmental effects of insecticides.

TOX 689. Current Topics in Toxicology.

Cr. R. Repeatable. F.S.

Lecture and discussion participation on current topics in toxicology. An 80% attendance is expected to satisfactorily complete the course. Offered on a satisfactory-fail basis only.

TOX 697. Graduate Research Rotation.

(0-12) Cr. 1-12. Repeatable, maximum of 3 times. F.S.SS. *Prereq: Admission to Toxicology graduate program*

Graduate research projects performed under the supervision of selected faculty members in the graduate Toxicology major.

TOX 699. Research.

Cr. arr. Repeatable. F.S.SS.

Research.

Transportation (TRANS)

Courses primarily for graduate students, open to qualified undergraduates:

TRANS 555. Economic Analysis of Transportation Investments.

(3-0) Cr. 3. *Prereq: C E 350 or C E 355*

Every third semester, offered F 2015. Application of economic analysis methodologies to evaluate transportation projects. Multi-modal approaches to evaluate impacts of transportation investments and maximize economic efficiency while considering equity and other social issues related to investment options.

TRANS 599. Creative Component.

Cr. 1-3. *Prereq: Pre-enrollment contract required*

Advanced topic for creative component report in lieu of thesis.

Courses for graduate students:

TRANS 691. Seminar in Transportation Planning.

Cr. 1. Repeatable. S.

Provides an overview of current transportation issues; speakers provide seminars on a variety of timely transportation topics.

TRANS 699. Research.

Cr. arr. Repeatable.

U.S. Latino/a Studies Program (US LS)

Courses primarily for undergraduates:

US LS 211. Introduction to U.S. Latino/a Studies.

(3-0) Cr. 3. F.S.

History and current lives of the Latino/a peoples in the United States, including Mexican, Cuban, Puerto Rican, Dominican, and South and Central Americans, as well as information specific to Iowa Latino/as, will be covered. Through readings, class discussions, writing assignments, and guest speakers, students will acquire accurate information and a solid understanding of the US Latino/a population and cultural perspectives. Elements of Latino/a culture to be covered include historical, sociological, educational, psychological, economic, and political facets.

Meets U.S. Diversity Requirement

US LS 240. Latina/o History.

(Cross-listed with HIST). (3-0) Cr. 3.

Historical and cultural heritage of Latinas/os in the United States. The histories of Mexican, Puerto Rican, Cuban, and other Latin American peoples in the U.S. emphasizing political and cultural convergence and congruencies.

Meets U.S. Diversity Requirement

US LS 332. The Latino/Latina Experience in U.S. Society.

(Cross-listed with SOC). (3-0) Cr. 3. F. *Prereq: SOC 134*

Examination of the social, historical, economic and political experience of varied Latino ethnic groups in the U.S. - primarily focusing on Mexican, Puerto Ricans, and Cubans.

Meets U.S. Diversity Requirement

US LS 342. Religion and U.S. Latino/a Literature.

(Cross-listed with RELIG). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

A study of the religious behavior and attitudes expressed in the literature of Mexican Americans, Puerto Ricans, Cuban Americans and other groups of people living in the U.S. who trace their ancestry to the Spanish-speaking countries of Latin America.

Meets U.S. Diversity Requirement

US LS 343. Latin American Government and Politics.

(Cross-listed with POL S). (3-0) Cr. 3.

Political institutions, processes, and contemporary issues. Selected countries examined intensively to illustrate generalizations. Role of parties, military, church, human rights, women, environmental issues, interest groups, ideology, and globalization.

US LS 344. U.S. Latino/a Literature.

(Cross-listed with ENGL). (3-0) Cr. 3. S. *Prereq: ENGL 250*

An introduction to the literature of Mexican Americans, Puerto Ricans, Cuban Americans and other Latino/a sub-groups. Special emphasis on themes such as ethnic relations and comparisons with EuroAmerican literary traditions.

Meets U.S. Diversity Requirement

US LS 347. U.S. Latino/a Psychology.

(Cross-listed with PSYCH). (3-0) Cr. 3. S. *Prereq: Two courses in Psychology including PSYCH 101*

Historical, political, and social contexts of psychological and mental health constructs in terms of their validity and utility for use in Latino/a people in the U.S. Unique aspects of psychological functioning particular to Latino/a peoples in the U.S.

Meets U.S. Diversity Requirement

US LS 473. Civil Rights and Ethnic Power.

(Cross-listed with AF AM, HIST). (3-0) Cr. 3. *Prereq: Sophomore classification*

Comparative history of the civil rights and ethnic power movements (African American, Chicano, American Indian, Puerto Rican, among others) in the U.S. from World War II to the present. Topics include institutional foundations, leadership, gender and racial dynamics, and the convergences and divergences of these differing ethnic struggles for rights.

Meets U.S. Diversity Requirement

US LS 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: permission of instructor*

Independent study under supervision of instructor. No more than 3 credits may count towards the U.S. Latino/a Studies certificate.

University Studies (U ST)

Courses primarily for undergraduates:

U ST 101. First Year Seminar I.

(1-0) Cr. 1. F.S. Prereq: *Acceptance/participation in appropriate learning community or special program.*

Orientation to the university focusing on student transition, acclimation to university, exposure to campus resources, and student success strategies. Exploration of topical issues associated with specific learning community or program focus. Offered on a satisfactory-fail basis only.

U ST 101A. First Year Seminar I: Hixson Scholars.

(1-0) Cr. 1. F.S. Prereq: *Acceptance/participation in appropriate learning community or special program.*

Orientation to the university focusing on student transition, acclimation to university, exposure to campus resources, and student success strategies. Exploration of topical issues associated with specific learning community or program focus. Offered on a satisfactory-fail basis only.

U ST 101B. First Year Seminar I: MVP Award.

(1-0) Cr. 1. F.S. Prereq: *Acceptance/participation in appropriate learning community or special program.*

Orientation to the university focusing on student transition, acclimation to university, exposure to campus resources, and student success strategies. Exploration of topical issues associated with specific learning community or program focus. Offered on a satisfactory-fail basis only.

U ST 101C. First Year Seminar I: Science Bound.

(1-0) Cr. 1. F.S. Prereq: *Acceptance/participation in appropriate learning community or special program.*

Orientation to the university focusing on student transition, acclimation to university, exposure to campus resources, and student success strategies. Exploration of topical issues associated with specific learning community or program focus. Offered on a satisfactory-fail basis only.

U ST 101D. First Year Seminar I: Student Athlete Experience.

(1-0) Cr. 1. F.S. Prereq: *Acceptance/participation in appropriate learning community or special program.*

Orientation to the university focusing on student transition, acclimation to university, exposure to campus resources, and student success strategies. Exploration of topical issues associated with specific learning community or program focus. Offered on a satisfactory-fail basis only.

U ST 101E. First Year Seminar I: Student Support Services Program.

(1-0) Cr. 1. F.S. Prereq: *Acceptance/participation in appropriate learning community or special program.*

Orientation to the university focusing on student transition, acclimation to university, exposure to campus resources, and student success strategies. Exploration of topical issues associated with specific learning community or program focus. Offered on a satisfactory-fail basis only.

U ST 102. First Year Seminar II.

(1-0) Cr. 1. S. Prereq: *U St 101 or instructor permission.*

Acceptance/participation in appropriate learning community. Continued exploration of university services, strategies for student success, leadership, and acclimation to university. Exploration of issues associated with learning community focus. Offered on a satisfactory-fail basis only.

U ST 102A. First Year Seminar II: MVP Award.

(1-0) Cr. 1. S. Prereq: *U St 101 or instructor permission.*

Acceptance/participation in appropriate learning community. Continued exploration of university services, strategies for student success, leadership, and acclimation to university. Exploration of issues associated with learning community focus. Offered on a satisfactory-fail basis only.

U ST 102B. First Year Seminar II: Science Bound.

(1-0) Cr. 1. S. Prereq: *U St 101 or instructor permission.*

Acceptance/participation in appropriate learning community. Continued exploration of university services, strategies for student success, leadership, and acclimation to university. Exploration of issues associated with learning community focus. Offered on a satisfactory-fail basis only.

U ST 104. Personal Career Development.

(2-0) Cr. 2. F.S.

Comprehensive approach to personal career development providing students with the skills and structure to make informed choices about their major and career path. Self-exploration of interests, skills, values, and personality as related to the world of work using a variety of techniques; exploration of majors and occupations; model for major and career decision-making and career goal implementation; exposure to effective job search and interviewing skills and resources.

U ST 105. Carver Academy Seminar: Freshmen.

(1-0) Cr. 1. F. Prereq: *Acceptance in Carver Academy Program, George Washington Carver scholarship recipient*

Orientation to the university for Carver Academy students focusing primarily on transition and acclimation to the university environment. Individual and group identity development. Life and legacy of George Washington Carver. Offered on a satisfactory-fail basis only.

Meets U.S. Diversity Requirement

U ST 106. Carver Academy Seminar: Freshmen.

(1-0) Cr. 1. S. Prereq: *Acceptance in Carver Academy Program, George Washington Carver scholarship recipient*

Introduction for Carver Academy students to resources at ISU to supplement classroom learning. Exploration of multicultural communities and leadership opportunities at ISU. Offered on a satisfactory-fail basis only.

Meets U.S. Diversity Requirement

U ST 201. WiSE Success Seminar.

(1-0) Cr. 1. F.S. Prereq: *Participation in Women in Science and Engineering Sophomore or Transfer Learning Community.*

Exploration of individual leadership styles, career opportunities, personal values as they relate to career possibilities, and issues facing women in the workplace. Offered on a satisfactory-fail basis only.

U ST 205. Carver Academy Seminar: Peer Mentors.

(1-0) Cr. 1. F. Prereq: *U ST 106, intended primarily for sophomores*

Leadership and peer mentor training for Carver Academy students who will be serving as peer mentors in Carver Academy. Definitions and analysis of diversity in academia. Academic portfolio preparation and career exploration. Offered on a satisfactory-fail basis only.

Meets U.S. Diversity Requirement

U ST 206. Carver Academy Seminar: Peer Mentors.

(1-0) Cr. 1. S. Prereq: *U ST 106, Intended primarily for sophomores*

Development of leadership and mentoring skills. Survey of leadership in diverse communities in the U.S. Offered on a satisfactory-fail basis only.

Meets U.S. Diversity Requirement

U ST 290. Independent Study.

Cr. arr. Prereq: *Permission of the associate provost for academic programs*

Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores.

U ST 301. McNair Scholars Seminar: Orientation to the McNair Program and to Academic Research.

(0-2) Cr. 1. F. Prereq: *Acceptance to the Iowa State University McNair Program*

Covers program guidelines and requirements, the basics of preparing for the graduate admissions process, and the formulation of a research topic to begin the required research project. Offered on a satisfactory-fail basis only.

U ST 302. McNairs Scholars Seminar: The Review of Literature and the Methodology.

(0-2) Cr. 1. S. Prereq: *U ST 301*

Covers the review of literature and the methodology components of the required research project. Offered on a satisfactory-fail basis only.

U ST 305. Carver Academy Seminar: Community Leaders.

(1-0) Cr. 1. F. Prereq: *Intended primarily for juniors*

Leadership development for Carver Academy students; frameworks for multicultural leadership. Students will research and assess needs for community enhancement projects under faculty supervision. Offered on a satisfactory-fail basis only.

U ST 306. Carver Academy Seminar: Community Leaders.

(1-0) Cr. 1. S. Prereq: *Intended primarily for juniors*

Leadership development for Carver Academy students; self-directed development of leadership abilities. Implement student-directed community enhancement projects under faculty supervision. Begin preparation for graduate and professional schools and career placement. Offered on a satisfactory-fail basis only.

U ST 311. Leaders Seminar I.

(1-0) Cr. 1. Repeatable.

For students serving as peer mentor first-year seminar leaders under faculty supervision. Development of course facilitation and peer leadership skills. Offered on a satisfactory-fail basis only.

U ST 311A. Leaders Seminar I: Leaders in Hixson Seminar.

(1-0) Cr. 1. Repeatable.

For students serving as peer mentor first-year seminar leaders under faculty supervision. Development of course facilitation and peer leadership skills. Offered on a satisfactory-fail basis only.

U ST 311B. Leaders Seminar I: Leaders in MVP Seminar.

(1-0) Cr. 1. Repeatable.

For students serving as peer mentor first-year seminar leaders under faculty supervision. Development of course facilitation and peer leadership skills. Offered on a satisfactory-fail basis only.

U ST 311C. Leaders Seminar I: Leaders in Strengths Seminar.

(1-0) Cr. 1. Repeatable. F.

For students serving as peer mentor learning community leaders under faculty supervision. Development of peer mentor abilities through an understanding of personal strengths and how strengths interact with leadership style. Exploration of connections between strengths and mentor role will be coupled with learning community peer mentor training to interweave identified strengths with those of the students they serve. Offered on a satisfactory-fail basis only.

U ST 312. Leaders Seminar II.(1-0) Cr. 1. Repeatable. *Prereq: U ST 311*

For students serving as leaders in Hixson Seminar or MVP Seminar under faculty supervision. Development of course facilitation and peer leadership skills. Offered on a satisfactory-fail basis only.

U ST 312A. Leaders Seminar II: Leaders in Hixson Seminar.(1-0) Cr. 1. Repeatable. *Prereq: U ST 311*

For students serving as leaders in Hixson Seminar or MVP Seminar under faculty supervision. Development of course facilitation and peer leadership skills. Offered on a satisfactory-fail basis only.

U ST 312B. Leaders Seminar II: Leaders in MVP Seminar.(1-0) Cr. 1. Repeatable. *Prereq: U ST 311*

For students serving as leaders in Hixson Seminar or MVP Seminar under faculty supervision. Development of course facilitation and peer leadership skills. Offered on a satisfactory-fail basis only.

U ST 315. Cyclone Aide Leaders Seminar.(3-0) Cr. 2. S. *Prereq: Selection as Cyclone Aide Student Leader*

Development of public speaking, group facilitation, and peer leadership skills. Exploration of issues associated with student transition to college, university organizational structures, and processes associated with student matriculation. Offered on a satisfactory-fail basis only.

U ST 321. NCORE Scholars: Race and Ethnicity in the U.S.(2-2) Cr. 3. F. *Prereq: Selection as an NCORE Student Scholar and attendance at NCORE.*

Exploration of issues of race and ethnicity in the United States. Meets U.S. Diversity Requirement

U ST 401. McNair Scholars Seminar: Data Collection and Data Analysis.(0-2) Cr. 1. F. *Prereq: Intended for second year McNair participants*

Covers the data collection and data analysis sections of the required research project. Offered on a satisfactory-fail basis only.

U ST 402. McNair Scholars Seminar: Findings, Conclusions, and the Writing of the Final Report.(0-2) Cr. 1. S. *Prereq: U ST 401*

Final course for second year scholars. Covers data analysis, data clean up, and the writing of the final project. Offered on a satisfactory-fail basis only.

U ST 405. Carver Academy Seminar: Fellows.(1-0) Cr. 1. F. *Prereq: Intended primarily for seniors*

Continued preparation for graduate school, professional school and/or chosen profession. Research project experience with faculty mentor is required. Offered on a satisfactory-fail basis only.

U ST 406. Carver Academy Seminar: Fellows.(1-0) Cr. 1. S. *Prereq: Intended primarily for seniors*

Oral and written presentation of research under faculty supervision. Offered on a satisfactory-fail basis only.

U ST 490. Independent Study.Cr. arr. Repeatable. *Prereq: Permission of the associate provost for academic programs*

Independent study on topics of an interdisciplinary nature. Intended primarily for juniors and seniors.

Courses primarily for graduate students, open to qualified undergraduates:

U ST 590. Special Topics.Cr. arr. Repeatable. *Prereq: Permission of graduate college*

Independent study on topics of an interdisciplinary nature. Intended primarily for graduate students.

Urban Design (URB D)

Courses primarily for graduate students, open to qualified undergraduates:

URB D 501. Urban Design Local Studio.

(3-6) Cr. 6. *Prereq: Graduate standing or senior classification with instructor permission*

Analysis and observation of urban morphology and culture with urban design projects set in local cities of the United States. Students will learn skills to observe and interpret urbanism as they develop processes for designing cities concerned for both physical form, ecological principles and human activity.

URB D 502. Urban Design Global Studio.

(1-10) Cr. 6. *Prereq: Graduate standing or senior classification with instructor permission.*

Students develop proposals for urban design interventions in an international context at multiple scales using investigation, analysis, observation, and interaction. Field trips.

URB D 511. History of Urban Design.

(3-0) Cr. 3. *Prereq: Graduate standing or senior classification with instructor permission*

Exploration of key episodes, movements and pioneering figures in the history of urban design from antiquity to the present. Focus on continual transformation of spatial organization, built form, and public space in relation to changing political power, social structure, and technology. Course sessions develop chronologically and thematically with readings, discussions, student presentations, and research projects.

URB D 521. Foundations of Urban Design.

(3-0) Cr. 3. *Prereq: Graduate standing, senior classification with instructor permission.*

Introduction to the ways that urban designers think about the city with a focus on how history, theory, and a wide range of contextual factors inform urban design practice. Field trip.

URB D 522. Theory of Urban Design.

(3-0) Cr. 3. *Prereq: Graduate standing or senior classification with instructor permission.*

Study of contemporary theoretical texts that address the process of urbanization and the challenges of urban design in a global context. Course will be conducted in a combination of lecture and seminar formats and requires graduate level readings, discussions and research.

URB D 531. Methods of Urban Design Workshop.

(3-0) Cr. 3. *Prereq: Graduate standing or senior classification with instructor permission.*

An exploration of contemporary urban design methods derived from significant urban projects and (re)development initiatives. Selected case studies to articulate and evaluate methods for implementing urban design goals and objectives in a variety of urbanized contexts. Case studies will build on a combination of analytical research, lectures, student presentations, and field trips.

URB D 532. Urban Design Media Workshop.

(3-0) Cr. 3. *Prereq: Graduate standing or senior classification with instructor permission.*

An introduction to visual representation tools and techniques for generating and communicating urban design concepts and analytical research. Projects and exercises will utilize traditional and contemporary approaches to drawing, modeling, and mapping, as well as desktop publishing tools for print, web, and presentation graphics. Field trip.

URB D 533. Urban Design Methods.

(3-0) Cr. 3. *Prereq: Graduate standing or senior classification with instructor permission.*

Alternative and competing urban design methods employed by the allied disciplines of planning, architecture, and landscape architecture. Introduction to the techniques for developing conceptual models and representational skills through all phases of the urban design process. Readings, lectures, group discussions, applied exercises, student presentations, and field trips.

Veterinary Clinical Sciences (V C S)

Courses primarily for professional curriculum students:

V C S 305. Shelter Medicine.

Cr. 1. S. Prereq: First year classification in Veterinary Medicine or with permission of instructor

An elective course designed to educate the veterinary student about issues of relevance to companion animal population and shelter medicine and welfare.

V C S 311. Veterinarian in Society I.

Cr. R. F. Prereq: First-year classification in veterinary medicine

Introduction to the veterinary profession and the various career opportunities available.

V C S 313. Veterinarian in Society III.

(1-1) Cr. 1. F. Prereq: Second-year classification in veterinary medicine

A continuation of the Veterinarian in Society series. The course covers selected topics on moral and ethical issues affecting the practice of veterinary medicine.

V C S 314. Veterinarian in Society IV.

(1-0) Cr. 1. F. Prereq: Third-year classification in veterinary medicine

A continuation of the Veterinarian in Society series. This course will focus on helping students develop their communication, leadership, team building and conflict resolution skills.

V C S 315. Veterinarian in Society V.

(1-0) Cr. 1. S. Prereq: Third-year classification in veterinary medicine

A continuation of the Veterinarian in Society series. This course will emphasize veterinary law.

V C S 339. Clinical Foundations I.

(Cross-listed with B M S). (0-2) Cr. 1. F. Prereq: First-year classification in veterinary medicine

Canine physical examination; basic behavior, animal handling and restraint; medical record keeping.

V C S 385. Grand Rounds.

Cr. R. Repeatable. F.S. Prereq: Classification in veterinary medicine

Seminars and case presentations on selected clinical subjects by fourth-year students of the College of Veterinary Medicine. Attendance is required for a passing grade. Offered on a satisfactory-fail basis only.

V C S 391. Clinical Imaging.

(1-0) Cr. 1. F. Prereq: First-year classification in veterinary medicine

Evaluation of morphologic anatomy of the dog and cat utilizing clinical imaging methods - radiography, ultrasonography, computed tomography, magnetic resonance imaging and nuclear imaging. Emphasis will be placed on normal radiographic anatomy.

V C S 393. Principles of Surgery.

(3-0) Cr. 3. F. Prereq: Second year classification in veterinary medicine

General principles of surgery of companion animals.

V C S 394. Principles of Surgery Laboratory.

(0-3) Cr. 1. S. Prereq: Second year classification in veterinary medicine

General principles of surgery of companion animals.

V C S 395. Small Animal Surgery.

(2-0) Cr. 2. S. Prereq: V C S 394

Small animal surgery.

V C S 396. Equine Surgery.

(2-0) Cr. 2. S. Prereq: V C S 394

Elective course in equine surgery.

V C S 398. Anesthesiology.

(1-0) Cr. 1. S. Prereq: Second-year classification in veterinary medicine

Anesthetic equipment, agents, and procedures for domestic animals.

V C S 399. Ophthalmology.

(1-0) Cr. 1. S. Prereq: Third year classification in veterinary medicine

Principles and techniques of medical and surgical ophthalmology.

V C S 402. Clinical Cardiology.

(1-0) Cr. 1. F. Prereq: Third or fourth-year classification in veterinary medicine; V CS 444 or concurrent enrollment in V C S 444

Elective course in diagnosis and management of cardiac diseases. Emphasis on interpretation of electrocardiography.

V C S 405. Pet Bird and Exotic Species Medicine.

(1-3) Cr. 2. S. Prereq: third classification in veterinary medicine

Elective course in management and diseases of pet birds and exotic species.

V C S 407. Feline Internal Medicine.

(1-0) Cr. 1. F. Prereq: Third-year classification in veterinary medicine

Elective course in feline internal medicine.

V C S 409. Oncology.

Cr. 2-4. Repeatable, maximum of 4 credits. Prereq: Fourth-year classification in veterinary medicine

Elective clinical assignment in oncology.

V C S 414. Companion Animal Nutrition.

(1-0) Cr. 1. S. Prereq: Third or fourth -year classification in veterinary medicine

Elective course in small animal and equine nutrition.

V C S 415. Advanced Small Animal Dermatology.

(1-2) Cr. 2. F. Prereq: Third or Fourth-year classification in veterinary medicine

Elective course in dermatology.

V C S 419. Preceptorship in Companion Animal/Equine Veterinary Medical Practice.

Cr. 2-6. Repeatable, maximum of 6 credits. Prereq: Fourth-year classification in veterinary medicine, permission of department curriculum committee

Elective course in veterinary practice under the guidance of veterinarians in approved practice settings. Maximum of 6 credits in 2 credit increments.

V C S 420. Practicum.

Cr. R. Repeatable. Prereq: VM4 classification, permission of instructor

External practical experiences in the fourth year curriculum for additional professional development of the veterinary student. Offered on a satisfactory-fail basis only.

V C S 422. Rotation at Blank Park Zoo.

Cr. 4. F.S.SS. Prereq: Fourth-year classification in veterinary medicine and completion of V C S 405. Enrollment by permission of instructor.

Clinical experience in husbandry, nutrition and training of exotic animals in a zoo environment. Students will get instruction and learn the application of the clinical skills required when dealing with exotic animals, including the hands-off visual examination obtaining historical and clinical information from zookeepers, and the use of immobilization drugs for patient exams. Students will learn the common medical disorders of exotic species and treatment techniques.

V C S 436. Small Animal Internal Medicine.

(3-0) Cr. 3. F. Prereq: Third year classification in veterinary medicine

Clinical diagnosis and treatment of diseases of small animals.

V C S 437. Small Animal Shelter Medicine.

(2-0) Cr. 2. Repeatable. Prereq: Fourth year classification in Veterinary Medicine

A 2-week elective rotation at an animal shelter/humane society that works with the public to place pets in homes. This rotation will encompass population medicine (medicine, surgery, intake, adoption, behavior and temperament, neglect and cruelty) that animal shelters deal with on a daily basis. The selected animal shelter/humane society must have a veterinarian(s) on staff and be approved by the course coordinator. More than one VCS 437 may be taken upon approval of the course coordinator.

V C S 440. Introduction to Clinics.

Cr. R. S. Prereq: Third-year classification in veterinary medicine

Rotating assignments through multiple sections within the Veterinary Medical Center.

V C S 441. Canine Rehabilitation.

Cr. 2. Prereq: Fourth-year classification in veterinary medicine.

Elective clinical assignment in rehabilitation.

V C S 443. Equine Lameness.

(1-2) Cr. 2. S. Prereq: Second or third-year classification in veterinary medicine

Orthopedic diseases of the equine.

V C S 444. Small Animal Medicine.

(4-0) Cr. 4. F.S. Prereq: Third-year classification in veterinary medicine

Clinical diagnosis and treatment of diseases of small animals.

V C S 445. Equine Medicine.

(2-0) Cr. 2. F. Prereq: Third-year classification in veterinary medicine

Clinical diagnosis and treatment of diseases of equine.

V C S 446. Clinical Neurology.

Cr. 2. Repeatable. Prereq: Fourth-year classification in veterinary medicine

Clinical rotation in neurology with an emphasis on neurolocalization, disease processes, use of diagnostics in medical and surgical neurology and treatment options. Exposure to neurosurgical techniques.

V C S 447. Equine Veterinary Diagnostic Skills.

(3-0) Cr. 2. S. *Prereq: Fourth-year classification in veterinary medicine - preference to equine track student. Limited to 16 students.*

Hands on experience with equine veterinary diagnostic skills related to theriogenology, medicine, surgery, radiology, and ophthalmology.

V C S 448. Diagnostic Imaging and Radiobiology.

(2-2) Cr. 3. F.S. *Prereq: Third-year classification in veterinary medicine*
Essentials of diagnostic image interpretation. Essentials of radiobiology, radiation therapy and protection from radiation.

V C S 449. Junior Surgery Laboratory.

(1-6) Cr. 3. F. *Prereq: Third-year classification in veterinary medicine*
Pre-laboratory presentations and laboratories introduce the student to anesthetic and surgical principles and techniques that can be applied to all animal species.

V C S 449A. Junior Surgery Laboratory: Alternative Curriculum.

(1-6) Cr. 3. F. *Prereq: Third-year classification in veterinary medicine*
This laboratory introduces the student to anesthetic and surgical principles - and techniques that can be applied to all animal species. Consists of only neutering humane society animals throughout the laboratory.

V C S 449B. Junior Surgery Laboratory: Traditional Curriculum.

(1-6) Cr. 3. F. *Prereq: Third-year classification in veterinary medicine*
This laboratory introduces the student to anesthetic and surgical principles and techniques that can be applied to all animal species. Provides a broader range of surgical experiences throughout the laboratory.

V C S 451. Advanced Junior Surgery Laboratory.

(1-6) Cr. 2. S. *Prereq: V C S 449*
8 weeks. Continuation of surgical laboratory experience. Techniques and advanced principles learned are applicable to all animal species.

V C S 451A. Advanced Junior Surgery Laboratory: Alternative Curriculum.

(1-6) Cr. 2. S. *Prereq: V C S 449*
8 weeks. Continuation of surgical laboratory experience. Techniques and advanced principles learned are applicable to all animal species. Consists of only neutering humane society animals throughout the laboratory.

V C S 451B. Advanced Junior Surgery Laboratory: Traditional Curriculum.

(1-6) Cr. 2. S. *Prereq: V C S 449*
8 weeks. Continuation of surgical laboratory experience. Techniques and advanced principles learned are applicable to all animal species. Exposure to more advanced surgical techniques with most surgical principles.

V C S 451C. Advanced Junior Surgery Laboratory: Traditional Curriculum.

(1-6) Cr. 2. S. *Prereq: V C S 449*
8 weeks. Continuation of surgical laboratory experience. Techniques and advanced principles learned are applicable to all animal species. A second repeat for students with a special interest in small animal surgery.

V C S 452. Clinical Dermatology.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine. Must have instructor permission to repeat this course.*

Study of clinical dermatological problems via computer-aided instruction, case simulations, and/or lectures. Clinical management of cases presented to Veterinary Medical Center.

V C S 453. Small Animal Medicine I.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment in small animal medicine.

V C S 454. Small Animal Medicine II.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment in small animal medicine.

V C S 455. Small Animal Soft Tissue Surgery.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment in soft tissue surgery.

V C S 456. Small Animal Orthopedic Surgery.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment in orthopedic surgery.

V C S 457. Equine Medicine.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment in equine medicine.

V C S 458. Equine Surgery.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment in equine surgery.

V C S 459. Small Animal Overpopulation Medicine and Surgery.

Cr. 2. *Prereq: Fourth year classification in Veterinary Medicine*
A 2-week surgical emphasis, elective rotation at a humane society that addresses the issues facing veterinarians and non-veterinary humane society personnel who deal with small animal overpopulation issues. Each section can be taken for credit once.

V C S 459A. Small Animal Overpopulation Medicine and Surgery :Nebraska Humane Society, Omaha NE.

Cr. 2. *Prereq: Fourth year classification in Veterinary Medicine*
A 2-week surgical emphasis, elective rotation at a humane society that addresses the issues facing veterinarians and non-veterinary humane society personnel who deal with small animal overpopulation issues. Each section can be taken for credit once.

V C S 459B. Small Animal Overpopulation Medicine and Surgery: Animal Rescue League of Iowa, Des Moines IA.

Cr. 2. *Prereq: Fourth year classification in Veterinary Medicine*
A 2-week surgical emphasis, elective rotation at a humane society that addresses the issues facing veterinarians and non-veterinary humane society personnel who deal with small animal overpopulation issues. Each section can be taken for credit once.

V C S 459C. Small Animal Overpopulation Medicine and Surgery: WaySide Waifs, Kansas City MO.

Cr. 2. *Prereq: Fourth year classification in Veterinary Medicine*
A 2-week surgical emphasis, elective rotation at a humane society that addresses the issues facing veterinarians and non-veterinary humane society personnel who deal with small animal overpopulation issues. Each section can be taken for credit once.

V C S 460. Radiology.

Cr. 2. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment in veterinary radiology.

V C S 461. Advanced Small Animal Internal Medicine.

Cr. 1. S. *Prereq: V C S 444 and V C S 436*
A discussion of advanced topics in small animal internal medicine.

V C S 463. Primary Care.

Cr. 2. Repeatable, maximum of 4 credits. *Prereq: Fourth-year classification in veterinary medicine*
Clinical experience in hospital based general practice.

V C S 464. Equine Field Services.

Cr. 2. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment in equine ambulatory practice.

V C S 465. Farrier.

Cr. 2. *Prereq: Fourth-year classification in veterinary medicine; V C S 457 and V C S 458*
Elective clinical assignment on the principles and practices of normal and therapeutic horseshoeing and equine foot care.

V C S 466. Anesthesiology.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment in small animal and large animal anesthesiology.

V C S 467. Pain Management.

Cr. 1-2. Repeatable, maximum of 2 credits. *Prereq: Fourth year classification in veterinary medicine*
Elective clinical assignment with emphasis on pain management.

V C S 468. Intensive Care.

Cr. 4. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment to provide supervision of hospital cases requiring intensive care and including emergency cases.

V C S 469. Ophthalmology.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Clinical assignment in ophthalmology.

V C S 470. Radiology.

Cr. 2. Repeatable, maximum of 4 credits. *Prereq: Fourth-year classification in veterinary medicine. Completion of V C S 460 is recommended.*
Elective clinical assignment in veterinary radiology.

V C S 471. Animal Reproduction.

Cr. 2. *Prereq: Fourth-year classification in veterinary medicine*
Elective clinical assignment in animal reproduction. Equine, Small Animal, Comparative, and Food Animal reproduction only.

V C S 471C. Animal Reproduction: Comparative.

Cr. 2. SS. *Prereq: Fourth-year classification in veterinary medicine.*
Elective comparative clinical assignment in animal reproduction.

V C S 471E. Animal Reproduction: Equine Reproduction.

Cr. 2. *Prereq: Fourth-year classification in veterinary medicine*
Elective clinical assignment in animal reproduction. Equine and small animal reproduction only.

V C S 471S. Animal Reproduction: Small Animal Reproduction.

Cr. 2. *Prereq: Fourth-year classification in veterinary medicine*
Elective clinical assignment in animal reproduction. Equine and small animal reproduction only.

V C S 473. Small Animal Surgery.

Cr. 1. *Prereq: fourth-year classification in veterinary medicine*
Clinical assignment in small animal surgery split between soft tissue surgery (one week) and orthopedic surgery (one week).

V C S 473O. Small Animal Surgery: Orthopedic.

Cr. 1. *Prereq: fourth-year classification in veterinary medicine*
Clinical assignment in small animal surgery split between soft tissue surgery (one week) and orthopedic surgery (one week).

V C S 473S. Small Animal Surgery: Soft Tissue.

Cr. 1. *Prereq: fourth-year classification in veterinary medicine*
Clinical assignment in small animal surgery split between soft tissue surgery (one week) and orthopedic surgery (one week).

V C S 475. Cardiology Rotation.

Cr. 1-2. Repeatable, maximum of 2 credits. *Prereq: Fourth year classification in veterinary medicine*
Elective clinical assignment in cardiology.

V C S 476. Veterinary Anesthesiology.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Assignments in equine, small animal, and large animal anesthesiology. Experience includes case work-up, management and recovery. Understanding of the unique physiology and potential complications of anesthetized patients. Pharmacology of commonly used drugs. Specific protocols and management for both field and general anesthesia.

V C S 476E. Equine Anesthesiology.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Assignments in equine, small animal, and large animal anesthesiology. Experience includes case work-up, management and recovery. Understanding of the unique physiology and potential complications of anesthetized patients. Pharmacology of commonly used drugs. Specific protocols and management for both field and general anesthesia.

V C S 476S. Small Animal Anesthesiology.

Cr. 2. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Assignments in equine, small animal, and large animal anesthesiology. Experience includes case work-up, management and recovery. Understanding of the unique physiology and potential complications of anesthetized patients. Pharmacology of commonly used drugs. Specific protocols and management for both field and general anesthesia.

V C S 478. Intensive Care.

Cr. arr. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Elective clinical assignment in intensive care.

V C S 480. Veterinary Dentistry.

Cr. 1. F. *Prereq: Third or Fourth-year classification in veterinary medicine*
All aspects of veterinary dentistry, prophylaxis, endodontics, and orthodontics. This course is an on-line course.

V C S 481. Advanced Equine Dentistry.

Cr. 2. S. *Prereq: Fourth year classification in veterinary medicine*
Clinical rotation in equine dentistry with an emphasis on routine equine dental examinations, specialized equipment, and corrective procedures. Offered only offered for one 2-week rotation. Enrollment is limited.

V C S 490. Independent Study.

Cr. arr. Repeatable. *Prereq: Permission of instructor and the VCS Associate Chair for Academic Affairs.*
Independent Study in veterinary medicine focusing on basic / translational research or learning issues. Enrollment in this course is not appropriate for clinical experiences in the Veterinary Medical Center or extramural experiences in clinical veterinary practice (i.e., preceptorships).

V C S 492. Orientation for International Experience.

(2-0) Cr. 1. Repeatable. S. *Prereq: Classification in veterinary medicine*
8 weeks. Predeparture orientation for group study abroad. Cultural considerations for the study abroad experience and a conversational language introduction. Out of class work may be assigned.

V C S 495. Grand Rounds Presentations.

Cr. R. S. *Prereq: Fourth-year classification in veterinary medicine*
Seminars and case presentations on selected subjects by fourth year students of the College of Veterinary Medicine. Completion of a seminar presentation is required for graduation. Offered on a satisfactory-fail basis only.

V C S 496. International Preceptorship.

Cr. 1-12. Repeatable. *Prereq: Second-year classification in veterinary medicine.*
International Preceptorships and Study Abroad Group programs. Provides opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

V C S 590. Special Topics.

Cr. 1-3. Repeatable.

V C S 590A. Special Topics: Medicine.

Cr. 1-3. Repeatable.

V C S 590B. Special Topics: Surgery.

Cr. 1-3. Repeatable.

V C S 590C. Special Topics: Theriogenology.

Cr. 1-3. Repeatable.

V C S 590D. Special Topics: Radiology.

Cr. 1-3. Repeatable.

V C S 590E. Special Topics: Anesthesiology.

Cr. 1-3. Repeatable.

V C S 590F. Special Topics - Ophthalmology.

Cr. 1-3. Repeatable, maximum of 3 credits. F.S.
Special topics in Ophthalmology.

V C S 596. International Preceptorship.

(0-40) Cr. 1-12. Repeatable. F.S.SS. *Prereq: Admission to graduate college*
International Preceptorships and Study Abroad Group programs. Provides opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

V C S 599. Creative Component.

Cr. arr. *Prereq: Enrollment in nonthesis master's degree program*

Courses for graduate students:

V C S 604. Seminar.

Cr. 1. Repeatable. F.S.

V C S 640. Advanced Radiology.

(2-0) Cr. 2. *Prereq: V C S 448*
Detailed principles of clinical radiology with particular reference to radiographic interpretation.

V C S 671. Advanced General Surgery.

(1-3) Cr. 2. *Prereq: Permission of instructor*
Course designed to discuss and perform advanced surgical procedures in soft tissue, orthopedic and neurological surgery. Minimally invasive surgical procedures and organ transplantation will be included.

V C S 672. Advanced Special Surgery.

(1-3) Cr. 2. *Prereq: Permission of instructor*
Innovative techniques in microvascular, thoracic, gastrointestinal, neurological and reconstructive surgery will be investigated.

V C S 676. Advanced Medicine.

(2-0) Cr. 2. *Prereq: V C S 445*
Principles of general medicine. A study in depth of factors that contribute to the development of clinical signs as related to the pathogenesis of disease.

V C S 677. Advanced Medicine.

(2-0) Cr. 2. *Prereq: V C S 445*
An advanced study of metabolic diseases.

V C S 699. Research.

Cr. arr. Repeatable.

V C S 699A. Research: Medicine.

Cr. arr. Repeatable.

V C S 699B. Research: Surgery.

Cr. arr. Repeatable.

V C S 699C. Research: Theriogenology.

Cr. arr. Repeatable.

V C S 699E. Research: Anesthesiology.

Cr. arr. Repeatable.

V C S 699F. Research: Ophthalmology.

Cr. arr. Repeatable.

Graduate Level Research.

Veterinary Diagnostic and Production Animal Medicine (VDPAM)

Courses primarily for professional curriculum students:

VDPAM 308. Spanish for Veterinarians.

(2-0) Cr. 2. S. *Prereq: Classification in veterinary medicine and basic knowledge of Spanish*

This course is designed to meet the needs of veterinary students who will practice in an environment in which the use of Spanish for accurate client communication is essential which includes much of our food animal industry in the state of Iowa. This is not a traditional Spanish language course. To be successful, students taking the course should have a basic knowledge of Spanish pronunciation, grammar and syntax.

VDPAM 309. Introduction to Production Animal Informatics.

(1-0) Cr. 1. S.

The fundamentals of how clinical, diagnostic, production and financial information is obtained and used by production animal operations will be presented. Students will acquire skills to create and use spreadsheets for manipulating and summarizing data. They will also acquire knowledge of where to find inexpensive and readily available resources with information on how to use spreadsheets and other software. Students will also have the opportunity to work with different record keeping programs used by swine, beef and dairy operations.

VDPAM 310. Introduction to Production Medicine.

Cr. 2. S. *Prereq: Classification as second or third year veterinary student or permission of instructor*

The role of the veterinarian in the management of animal health and production in populations including evaluation tools in dairy and beef cattle herds, beef feedlots and swine herds will be described. Provides veterinary students with a starting point to understand the principles and techniques that are the basis of food-animal population health diagnosis management programs. Course available on-line, attendance is not required.

VDPAM 312. Introduction to Animal Welfare.

(1-0) Cr. 1. S. *Prereq: First-year classification in veterinary medicine*

A continuation of the Veterinarian in Society series. An introduction to the topics of animal behavior, animal welfare, and the human animal bond.

VDPAM 340. Clinical Foundations.

(0-30) Cr. 1. F.S. *Prereq: Classification in veterinary medicine*

One week course at Iowa State University. An introduction to Food Supply Veterinary Medicine covering overviews of major animal agriculture species (beef, dairy, pork, sheep and camelid), production systems, behavior, welfare, handling and restraint, examination techniques, biosecurity, epidemiology and food safety. Visits to production units are utilized to introduce the application of clinical skills. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 351. Bovine Embryo Transfer and Related Technology.

(2-0) Cr. 2. S. *Prereq: Second or third year classification in veterinary medicine*

This course will meet for two hours once each week of the Spring Semester. The first hour will be traditional lecture and the second hour will be a combination of student projects, labs and demonstrations of applied clinical procedures. Bovine embryo transfer and closely related topics such as: female reproductive physiology, estrus synchronization, semen sexing and reproductive disease will be emphasized. In addition, several class periods will be devoted to the use of ultrasound for diagnosis of reproductive and non-reproductive conditions.

VDPAM 365. Animal Welfare Judging and Assessment.

Cr. 2. Repeatable. F.SS.

Preparation for competition in the Intercollegiate Animal Welfare Judging Contest. Development of critical appraisal and oral communication skills in regard to animal welfare. Animal behavior, physiology, health and performance parameters, basic husbandry, housing and preventive care will be explored for select farmed, companion and exotic species. Optional field trips.

VDPAM 402. Advanced Dairy Production Informatics.

(1-1) Cr. 2. Repeatable. F.S. *Prereq: VDPAM 309 or permission of instructor*

Advanced coverage of concepts related to collection, manipulation, analysis and reporting of information used by dairy farms and their consultants. Hands on experience with Dairy Comp 305 and PC Dart as well as other dairy management and information software.

VDPAM 402A. Advanced Dairy Production Informatics: Lecture Series.

(1-1) Cr. 2. S. *Prereq: Classification in veterinary medicine*

Advanced coverage of concepts related to collection, manipulation, analysis and reporting of information used by dairy farms and their consultants. Hands on experience with Dairy Comp 305 and PC Dart as well as other dairy management and information software.

VDPAM 402B. Advanced Dairy Production Informatics: Experience I.

(1-1) Cr. 2. F.S. *Prereq: VDPAM 402A*

Independent records analysis and reporting of information used by dairy farms and their consultants. Hands on experience with Dairy Comp 305 and PC Dart.

VDPAM 402C. Advanced Dairy Production Informatics: Experience II.

(1-1) Cr. 2. F.S. *Prereq: VDPAM 402A, VDPAM 402B*

Independent records analysis and reporting of information used by dairy farms and their consultants. Hands on experience with Dairy Comp 305 and PC Dart.

VDPAM 402D. Advanced Dairy Production Informatics: Experience III.

(1-1) Cr. 2. F.S. *Prereq: VDPAM 402A, VDPAM 402B, VDPAM 402C*

Independent records analysis and reporting of information used by dairy farms and their consultants. Hands on experience with Dairy Comp 305 and PC Dart.

VDPAM 407. Evidence Based Clinical Decision Making.

(Dual-listed with VDPAM 507). (1-0) Cr. 1. S. *Prereq: Permission of instructor*

Discussion, lectures and laboratories to assess the quality and significance of medical evidence in making informed decisions about the treatment of individual animals and animal populations.

VDPAM 408. Poultry Diseases.

(Dual-listed with VDPAM 508). Cr. 2. Alt. S., offered even-numbered years.

Prereq: Classification in veterinary medicine or permission of instructor

Bacterial, viral, parasitic, and nutritional diseases of domestic poultry and gamebirds; biosecurity, immunization, and management procedures to prevent poultry diseases.

VDPAM 409. Veterinary Practice Management and Organization.

(2-0) Cr. 2. F.S.

An A to Z introduction to proven veterinary practice management methods and strategies. The student will follow a detailed hands-on workbook describing most of the processes and procedures of day to day veterinary practice. The class content will be composed of class room discussions, didactic presentations, a practical workbook, ancillary handouts, and both in and out of class assignments.

VDPAM 410. Llama Medicine.

(1-0) Cr. 1. F. *Prereq: Classification as second or third year student in veterinary medicine*

Introduction to basic camelid medicine, including anatomy, behavior, restraint, handling, husbandry, herd health, common diseases, surgical conditions, and anesthesia protocols.

VDPAM 414. Veterinary Practice Entrepreneurship.

(Dual-listed with VDPAM 514). Cr. 2-3. S.

Formal exposure to the entrepreneurial and business skills necessary to own and operate a successful veterinary practice or other small business opportunity. Personal finance, marketing, human resource management, general accounting, site assessment, location demographics, practice valuation, and a host of other issues which must be considered when purchasing or starting a new business are covered. Class instruction will be delivered by successful practice and business owners with examples from real world experience.

VDPAM 416. Bovine Reproduction Evaluation Laboratory.

(0-4) Cr. 1. F.S. *Prereq: Third year classification in veterinary medicine. 10 students per section.*

Bovine rectal palpation techniques will be repetitively taught in 7 four-hour sessions. Students will also learn techniques of epidural anesthesia, artificial insemination, and ultrasonic imaging. University-owned cattle will be used. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.,No Wednesday section in Spring semester.

VDPAM 419. Advanced Swine Production Informatics.

(1-0) Cr. 1. F. *Prereq: VDPAM 309 or permission of instructor*

Advanced coverage of concepts related to collection, manipulation, analysis and reporting of information used by swine production companies. Production, financial, diagnostic and clinical data will be covered in the course. Hands-on experience with computer software and information systems used in swine production will be provided. Students will learn to objectively evaluate the validity of information that is presented to them and also be able to make practical and useful recommendations regarding the types of information tools that can/should be used. The students will learn what software and information systems are available and be able to critically evaluate them.

VDPAM 420. Applied Production Animal Medicine Preceptorship.

(0-30) Cr. 1-6. Repeatable. F.S.SS. *Prereq: Fourth year classification in veterinary medicine*

Advanced course in production animal medicine with emphasis on government, industry or veterinary practice settings. Forty hours clinical experience per week. Assignments will be preceptorships with a practicing veterinarian, governmental agency and/or production unit. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 420A. Applied Production Animal Medicine Preceptorship: Mixed Animal Practice with Food Animal Emphasis.

(0-30) Cr. 1-6. Repeatable. F.S.SS. *Prereq: Fourth year classification in veterinary medicine*

Advanced course in production animal medicine with emphasis on mixed animal practice with food animal emphasis in a veterinary practice settings. Forty hours clinical experience per week. Assignments will be preceptorships with a practicing veterinarian, governmental agency and/or production unit. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 420B. Applied Production Animal Medicine Preceptorship: General Mixed Animal Practice.

(0-30) Cr. 1-6. Repeatable. F.S.SS. *Prereq: Fourth year classification in veterinary medicine*

Advanced course in production animal medicine with emphasis on general mixed animal veterinary practice settings. Forty hours clinical experience per week. Assignments will be preceptorships with a practicing veterinarian, governmental agency and/or production unit. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 420C. Applied Production Animal Medicine Preceptorship: Government Agency or Food Processing Company.

(0-30) Cr. 1-6. Repeatable. F.S.SS. *Prereq: Fourth year classification in veterinary medicine*

Advanced course in production animal medicine with emphasis on government agency or food processing company in veterinary practice settings. Forty hours clinical experience per week. Assignments will be preceptorships with a practicing veterinarian, governmental agency and/or production unit. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 421. Great Plains Veterinary Educational Center.

Cr. 1. F.S.SS. *Prereq: Fourth year classification in veterinary medicine; ability to provide own transportation to each site.*

The Great Plains Veterinary Education Center (GPVEC), located on the US Meat Animal Research Center (USMARAC) near Clay Center, Nebraska offers one week clinical training in production animal medicine species. All sections will be held at GPVEC. Students need to provide their own transportation to the site and overnight stays at or near GPVEC are required.

VDPAM 421A. Great Plains Veterinary Educational Center: Calving.

Cr. 1. F.S.SS. *Prereq: Fourth year classification in veterinary medicine; ability to provide own transportation to each site.*

The Calving Elective provides an opportunity to expand knowledge and experience in all phases of calving management. The program is structured around normal calving operations at USMARC. The GPVEC and USMARC veterinary staff will make an effort to include students in veterinary activities that take place during the Calving Elective. The opportunity exists for assistance in diagnosis, treatment, and management of many commonly encountered situations in the dam and calf. Students are encouraged to make every effort to become involved in USMARC calving activities. Direct involvement includes routine husbandry activities beyond those involving traditional veterinary roles which are expected of the student.

VDPAM 421B. Great Plains Veterinary Educational Center: Bull Breeding Soundness.

Cr. 1. S. *Prereq: Fourth year classification in veterinary medicine; ability to provide own transportation to each site.*

The Bull Breeding Soundness Examination Elective involves training in all phases of the examination, collection, and semen evaluation for up to 200 herd bulls and/or sale bulls as recommended by the Society for Theriogenology. Chuteside training and hand-on experience are the primary training techniques for this elective with informal discussions held during the performance of the breeding soundness examinations.

VDPAM 421C. Great Plains Veterinary Educational Center: Clinical Calving.

Cr. 1. S. *Prereq: Fourth year classification in veterinary medicine; ability to provide own transportation to each site.*

This clinical rotation involves participation in veterinary field services at the U.S. MARC during calving season. Activities include examination, diagnosis, treatment, and intensive care of individual animals as well as occasional herd problems. Additional activities include clinical and/or microbiological diagnostic techniques, clinical pharmacology, record keeping, and health surveillance. Students will accompany the "on duty" veterinarian on all cases, including emergency, after-hours calls. The majority of clinical activities during calving season are related to peri-parturient, perinatal and neonatal problems. Students will assist in handling difficult calf deliveries and cesarean sections and will be involved with the necropsy examination of all animals lost during the previous 24 hours.

VDPAM 421D. Great Plains Veterinary Educational Center: Feedlot Management.

Cr. 1. F.S. *Prereq: Fourth year classification in veterinary medicine; ability to provide own transportation to each site.*

Evaluation of production techniques and production efficiency including ration and feeding management, health management program development and evaluation, environmental management, quality assurance, feedlot necropsy and microbiology techniques, and break even analysis. Approaches to solve seasonal health problems within the management objectives for different feed yards are the strong emphasis of this elective. Students may have the opportunity to follow cattle to a packing plant to learn the methods for tracking animals into the food chain, identifying production problems that are not diagnosable at the feedlot level, and monitoring beef quality assurance. Biosecurity activities will be emphasized and practiced.

VDPAM 421E. Great Plains Veterinary Educational Center: Weaning Management.

Cr. 1. F. *Prereq: Fourth year classification in veterinary medicine; ability to provide own transportation to each site.*

This is a hands-on elective in which students participate in the weaning management at the U.S. Meat Animal Research Center. Students will be involved with processing, feeding, finding, and treating sick calves. Additionally, students will be introduced to developing weaning rations and managing feed delivery. Students will also learn how to develop vaccination and treatment protocols and each student will have as an objective the development of their own vaccination and treatment protocol template. As time allows, students will visit commercial feed yards and cover production management topics.

VDPAM 421F. Great Plains Veterinary Educational Center: Pregnancy Examination.

Cr. 1. F. *Prereq: Fourth year classification in veterinary medicine; ability to provide own transportation to each site.*

The Pregnancy Examination Elective involves students, the GPVEC faculty, and USMARC personnel during pregnancy examination. Activities involve rectal examinations for pregnancy, collecting data and entry into the CowCalf5 computer software program to evaluate the reproductive performance of the herd. This elective is designed for students who have some palpation experience and are interested in honing their skills. Ultrasonography may be utilized by students based on adequate time and interest. Pregnancy Examination occurs during yearly fall herd work at the USMARC, therefore, speed and accuracy will be stressed, rather than basic technique. Introduction into rectal examination for reproductive use is stressed during the Bovine Reproduction Elective.

VDPAM 421G. Great Plains Veterinary Educational Center: Bovine Reproduction.

Cr. 1. F. *Prereq: Fourth year classification in veterinary medicine; ability to provide own transportation to each site.*

This elective involves some of the clinical techniques utilized in beef cattle reproductive management. The majority of time will be spent in the examination of cows for pregnancy and the collection of ovarian data from non-pregnant cows. Additional opportunities will involve hands on activities such as data collection and analysis, breeding herd nutrition, artificial insemination, and the use of ultrasonography for pregnancy detection and staging of ovarian evaluation.

VDPAM 421J. Great Plains Veterinary Educational Center: Lambing.

Cr. 1. S. *Prereq: Fourth year classification in veterinary medicine; ability to provide own transportation to each site.*

The Lambing Elective involves students with the USMARC lambing crew and GPVEC faculty in observations, assistance with delivery when necessary, and routine lambing duties. Students will work with veterinary personnel in sheep necropsy and health surveillance. Activities and objectives closely parallel to those listed in the Calving Elective. Self study material will be provided covering topics such as pre-breeding and breeding, pregnancy diagnosis, pregnant ewe management, pre-lambing ewe/lambing management, feeder lamb health and nutrition management, and replacement ewe and ram management.

VDPAM 421K. Great Plains Veterinary Educational Center: Equine Dentistry. (20-20) Cr. 1. S. *Prereq:* Fourth year classification in veterinary medicine; ability to provide own transportation to each site

The Equine Dentistry Elective provides the opportunity for students to expand their knowledge and experience related to equine dentistry. The rotation consists of lectures on topics relevant to equine dental care and hands-on laboratories during which students practice routine dental care procedures on USMARC horses. Equine Dentistry will involve both lecture and lab time at about equal shares.

VDPAM 421M. Great Plains Veterinary Educational Center: Preconditioning. Cr. 1. F.S.S. *Prereq:* Fourth year classification in veterinary medicine; ability to provide own transportation to each site.

The Preconditioning Elective provides the opportunity for students to expand their knowledge and experience in the development and implementation of calf preweaning programs. Students will assist GPVEC and USMARC personnel during routine processing of USMARC spring-born calves prior to weaning. GPVEC faculty will also lead discussions related to vaccine and dewormer protocols, preweaning nutrition, and other topics related to preparing beef calves for weaning.

VDPAM 421P. Great Plains Veterinary Educational Center: Gomer Bull Surgery.

Cr. 1. F. *Prereq:* Fourth year classification in veterinary medicine; ability to provide own transportation to each site.

The Gomer Bull Surgery Elective is designed to give students interested in food animal surgery an opportunity to practice their surgical skills by performing penile translocations and epididymectomies on USMARC teaser bull candidates. Lectures specific to gomer bull surgery as well as other topics related to food animal surgery will be presented during this elective.

VDPAM 422. Beef Cattle Calving.

Cr. 2. Repeatable. F.S.S.S. *Prereq:* VDPAM 310; fourth year classification in veterinary medicine

This elective provides students opportunity to assist cow-calf operations with calving in Nebraska, South Dakota or other locations. These operations typically calve 300-1,000 head each spring. Calving experience is not required, but a good understanding of working around cattle is necessary. Students will be actively participating in the day to day, normal calving routine including detecting and sorting off "springers", calf "watch", detecting when intervention is needed and assisting delivery, caring for and monitoring newborns and dams for good health and early disease detection, tagging/processing new calves, treating calves needing intervention and performing other routine calving chores. Students need to provide their own transportation to the site and overnight stays at or near the production sites are required. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 426. Veterinary Toxicology.

(Dual-listed with VDPAM 526). (Cross-listed with TOX). (3-0) Cr. 3. S. *Prereq:* Third year classification in veterinary medicine

Study of toxicological diseases of animals emphasizing clinical recognition, circumstances of poisoning, differential diagnosis with clinical and laboratory data, therapeutic procedures, preventive management and public health implications. Supplemented with case-based materials.

VDPAM 428. Principles of Epidemiology and Population Health.

(Dual-listed with VDPAM 528). (Cross-listed with V MPM). (3-0) Cr. 3. S.

Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigations. Issues in disease prevention, control, and eradication. This course is available on campus and by distance.

VDPAM 436. Beef Records Analysis.

(0-30) Cr. 1. F.S. *Prereq:* First, second or third year classification in veterinary medicine, or permission of instructor

Lectures will emphasize current production and evaluation techniques for beef cow/calf operations and students will learn to conduct and critically assess production and financial data using a standardized approach. Lab activities will allow students an opportunity to work with individual beef cattle producers to identify areas for improving profitability, health, and sustainability. Each semester's content builds on the material from the previous semester. Enrolling in the class for multiple semesters will be encouraged.

VDPAM 436A. Beef Records Analysis: Introduction.

(0-30) Cr. 1. F. *Prereq:* First, second or third year classification in veterinary medicine, or special permission of instructor

Lectures will emphasize current production and evaluation techniques for beef cow/calf operations and students will learn to conduct and critically assess production and financial data using a standardized approach. Lab activities will allow students an opportunity to work with individual beef cattle producers to identify areas for improving profitability, health, and sustainability.

VDPAM 436B. Beef Records Analysis: Herd Management.

(0-30) Cr. 1. S. *Prereq:* First, second or third year classification in veterinary medicine, or special permission of instructor, VDPAM 436A

Lectures will emphasize current production and evaluation techniques for beef cow/calf operations and students will learn to conduct and critically assess production and financial data using a standardized approach. Lab activities will allow students an opportunity to work with individual beef cattle producers to identify areas for improving profitability, health, and sustainability.

VDPAM 436C. Beef Records Analysis: Cow/Calf Preventive Medicine.

(0-30) Cr. 1. F. *Prereq:* Second or third year classification in veterinary medicine, or special permission of instructor, VDPAM 436A, VDPAM 436B

Lectures will emphasize current production and evaluation techniques for beef cow/calf operations and students will learn to conduct and critically assess production and financial data using a standardized approach. Lab activities will allow students an opportunity to work with individual beef cattle producers to identify areas for improving profitability, health, and sustainability.

VDPAM 436D. Beef Records Analysis: Feedlot Production Medicine.

(0-30) Cr. 1. S. *Prereq:* Second or third year classification in veterinary medicine, or special permission of instructor, VDPAM 436A, VDPAM 436B, VDPAM 436C

Lectures will emphasize current production and evaluation techniques for beef cow/calf operations and students will learn to conduct and critically assess production and financial data using a standardized approach. Lab activities will allow students an opportunity to work with individual beef cattle producers to identify areas for improving profitability, health, and sustainability.

VDPAM 445. Production Animal Clinical Medicine.

(3-0) Cr. 3. S. *Prereq:* Third year classification in veterinary medicine

Clinical diagnosis and treatment of diseases of swine, beef and dairy cattle, and small ruminants.

VDPAM 450. Disturbances of Reproduction.

(4-0) Cr. 4. F. *Prereq:* Third year classification in veterinary medicine

General principles of normal reproductive functions in addition to environment, management and diseases causing disturbances in reproduction.

VDPAM 451. Clinical Embryo Transfer.

Cr. 2. F.S.S.S. *Prereq:* Fourth year classification in veterinary medicine

Elective clinical assignment in techniques of embryo transfer. Primary species studied will be bovine but equine and small ruminant embryo transfer will be covered during appropriate seasons. Enrollment is limited to four students per two week session. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 455. Diagnostic Laboratory Practicum.

Cr. 1. Repeatable. F.S. *Prereq:* Classification as a fourth year student in veterinary medicine

Practical experience and training in necropsy, recognition of gross lesions, diagnostic sample collection and test selection for the diagnosis of infectious, toxic, nutritional and metabolic diseases of small animal and production livestock species through exposure to diagnostic cases submitted to the ISU Veterinary Diagnostic Laboratory.

VDPAM 456. Veterinary Diagnostic Lab Methods & Applications.

(16-0) Cr. 1. F. *Prereq:* Second, third or fourth year classification in veterinary medicine

Case materials are used to develop diagnostic questions and to better understand the value of diagnostic tests. Testing methods and interpretation of diagnostic tests are coupled with sampling strategy and objective assessment of available evidence to provide accurate diagnosis.

VDPAM 471. Theriogenology: Food Animal.

Cr. 2. *Prereq:* Fourth year classification in veterinary medicine.

Elective clinical assignment in Food Animal and Small Ruminant Theriogenology involving male and female breeding soundness exams, dystocia management, advanced diagnostic procedures, surgical and nonsurgical insemination programs in small ruminants, and semen cryopreservation. Medical and surgical correction of reproductive disorders in cattle and small ruminants.

VDPAM 476. Food Animal and Camelid Field Service.

(0-40) Cr. 2. Repeatable. F.S.S.S. *Prereq:* VDPAM 310; Fourth year classification in Veterinary Medicine

Elective course in food animal and camelid field services. Students will assist university veterinarians in delivering health care and production management services to the ISU livestock farms and other livestock farms in the local area. Focus will be on delivery of individual animal care and establishment of best practices for herd management of production systems at the university and in the region. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 477. Food Animal and Camelid Medicine and Surgery.

Cr. 1-2. Repeatable. F.S.SS. *Prereq: Fourth-year classification in veterinary medicine*

Clinical assignment focused on the management of food animal and camelid medicine and surgery cases. Specific instruction in clinical evaluation of cases coupled with appropriate diagnostic testing and therapeutic intervention will be emphasized. Additional instruction will be provided in disease prevention, intensive care and management of food animal and camelid species. Particular emphasis will be placed on appropriate on-label and extra-label drug usage in food animal species. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 479. Applied Swine Production Medicine Preceptorship.

(0-30) Cr. 1-6. Repeatable. F.S.SS. *Prereq: VDPAM 310; Fourth year classification in Veterinary Medicine*

Preceptorship course in swine production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week. Assignments will be preceptorships with a practicing veterinarian and/or a production unit. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 480. Swine Production Medicine.

(15-25) Cr. 2. Repeatable. F.S.SS. *Prereq: VDPAM 310; Fourth year classification in Veterinary Medicine or permission of instructor*

Two week clinical rotation in swine production medicine. Students will be assigned to take the lead in investigating field based client cases with supervision of the instructors. Development of critical thinking skills that will allow students to apply concepts of herd management, production analysis, economic analysis, and disease prevention in addressing client cases. Variable amounts of travel to farm sites will be required with the potential for rare overnight stays. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 481. Advanced Cow/Calf Production Medicine.

(Dual-listed with VDPAM 581). (20-20) Cr. 2. S. *Prereq: Completion of two semesters of VDPAM 436 or UNL equivalent (V MED 596 Cattle Production), fourth year classification in veterinary medicine*

Two-week senior elective that will focus on the economics of animal disease in cow/calf operations. Evidence based medicine and epidemiological principles will be used in investigation of disease outbreaks. Extensive partial budgeting used. Students will complete at least two disease investigations involving outbreaks in commercial cow/calf operations and communicate their findings to the class, the herd owner, and local practitioner. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 482. Applied Beef Production Medicine Preceptorship.

Cr. 1-6. Repeatable. F.S.SS. *Prereq: VDPAM 310; Fourth year classification in veterinary medicine*

Advanced course in beef production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week. Assignments will include preceptorships with a practicing veterinarian and/or a production unit. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 483. Beef Production Medicine.

(15-20) Cr. 2. F. *Prereq: VDPAM 310; fourth year classification in veterinary medicine*

Two week advanced clinical rotation in beef production medicine. Fifteen hours recitation/discussion and 20 hours clinical experience per week. This course is designed to expose students to cow-calf and feedlot production concepts. The activities scheduled for the rotation depend greatly on the time of year. Whenever possible, the class incorporates field trips. Students should anticipate that travel, including overnight stays, may be required. These field trips can vary in length from several hours to several days and may include weekends. Typically, 3-4 days of the rotation are spent at the Great Plains Veterinary Education Center, Clay Center, NE. Students should, therefore, plan accordingly and contact the instructor, immediately, if they anticipate a conflict. Students should not schedule Grand Rounds during this rotation. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 484. Dairy Production Medicine.

(15-20) Cr. 2. F.S.SS. *Prereq: VDPAM 310; fourth year classification in veterinary medicine*

Two week course in dairy production medicine combining class time with multiple on-farm visits to learn various management aspects (DHIA, DC305 & PC Dart record analysis, calf rearing through lactating cows, reproduction programs, udder health and milk quality, biosecurity, welfare, nutrition and cow comfort) for a wide variety of dairy operations. Students will learn the latest in dairy management by reviewing current topic articles and gain experience in farm evaluation through a group project. Fifteen hours recitation/discussion and 20 hours clinical experience per week. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 485. Applied Dairy Production Medicine Preceptorship.

(0-30) Cr. 1-6. Repeatable. F.S.SS. *Prereq: VDPAM 310; fourth year classification in veterinary medicine*

Advanced course in dairy production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week. Assignments will include preceptorships with a practicing veterinarian and/or a production unit. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 486. Introduction to Small Ruminant Production Medicine.

(15-0) Cr. 1. S. *Prereq: Third year classification in veterinary medicine or permission of instructor.*

Survey of small ruminant production systems, common management practices, and disease processes of small ruminants. This course is intended to give the student a background in small ruminant medicine. Herd health, disease monitoring and prevention, and typical management systems will be emphasized in lecture.

VDPAM 487. Livestock Disease Prevention.

(3-0) Cr. 3. F.

The course is designed for both the pre-veterinary and animal science majors who have an interest in production animal health, disease prevention methods, epidemiology of economically important agents, and the ecology of currently important pathogens found in North American livestock industries. It will focus on disease prevention principles for individuals and large production population systems.

VDPAM 488. Laboratory in Clinical Microbiology.

Cr. 1. Repeatable. F.S. *Prereq: Fourth year classification in veterinary medicine*
Application of microbiological procedures to the diagnosis of infectious diseases.

VDPAM 489. Issues in Food Safety.

(Cross-listed with AN S, FS HN, HSP M). (1-0) Cr. 1. S. *Prereq: Credit or enrollment in FS HN 101 or FS HN 272 or HSP M 233; FS HN 419 or FS HN 420; FS HN 403*

Capstone seminar for the food safety minor. Case discussions and independent projects about safety issues in the food system from a multidisciplinary perspective.

VDPAM 490. Independent Study.

Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of department chair*

VDPAM 491. Advanced Ruminant Nutrition.

(30-10) Cr. 3. F.

Focus on dairy nutrition and balancing rations from the calf to the adult, lactating cow. Introduction to different feedstuffs and forage varieties to determine those that are best suited to bovine diets. This course is held the week immediately prior to the start of the fall semester. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 492. Orientation for International Experience.

(2-0) Cr. 1. S. *Prereq: Classification in veterinary medicine*

Predeparture orientation for group study abroad. Cultural considerations for the study abroad experience and a conversational language introduction. Out of class work will be assigned. Offered on a satisfactory-fail basis only.

VDPAM 494. Advanced Dairy Production Medicine.

(20-20) Cr. 2. S. *Prereq: VDPAM 484 or permission of instructor*

Advanced course in investigating dairy herd problems relating to milk quality or nutrition. Milk quality and nutrition troubleshooting will be taught through the combination of lecture and on-farm investigations. Students will combine lecture knowledge, data acquired from on-farm investigations and record analysis to generate management plans. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 495. Advanced Small Ruminant Production Medicine.

(15-20) Cr. 2. F.S. *Prereq:* VDPAM 486, fourth year classification in veterinary medicine, or permission of instructor

Two week clinical rotation in small ruminant production medicine. Field trips (including overnight stays) will be incorporated when possible. Topics to be covered include small ruminant industries (milk, meat, and fiber), milk quality, nutrition, reproduction, and disease management of small ruminants. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 496. International Preceptorship.

(Dual-listed with VDPAM 596). Cr. 1-12. Repeatable. F.S.SS. *Prereq:* Second, third or fourth year classification in veterinary medicine

International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:**VDPAM 507. Evidence Based Clinical Decision Making.**

(Dual-listed with VDPAM 407). (1-0) Cr. 1. S. *Prereq:* Permission of instructor

Discussion, lectures and laboratories to assess the quality and significance of medical evidence in making informed decisions about the treatment of individual animals and animal populations.

VDPAM 508. Poultry Diseases.

(Dual-listed with VDPAM 408). Cr. 2. Alt. S., offered even-numbered years.

Prereq: Classification in veterinary medicine or permission of instructor
Bacterial, viral, parasitic, and nutritional diseases of domestic poultry and gamebirds; biosecurity, immunization, and management procedures to prevent poultry diseases.

VDPAM 514. Veterinary Practice Entrepreneurship.

(Dual-listed with VDPAM 414). Cr. 2-3. S.

Formal exposure to the entrepreneurial and business skills necessary to own and operate a successful veterinary practice or other small business opportunity. Personal finance, marketing, human resource management, general accounting, site assessment, location demographics, practice valuation, and a host of other issues which must be considered when purchasing or starting a new business are covered. Class instruction will be delivered by successful practice and business owners with examples from real world experience.

VDPAM 526. Veterinary Toxicology.

(Dual-listed with VDPAM 426). (Cross-listed with TOX). (3-0) Cr. 3. S. *Prereq:*

Third year classification in veterinary medicine

Study of toxicological diseases of animals emphasizing clinical recognition, circumstances of poisoning, differential diagnosis with clinical and laboratory data, therapeutic procedures, preventive management and public health implications. Supplemented with case-based materials.

VDPAM 527. Applied Statistical Methods in Population Studies.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq:* STAT 401

ANOVA, Linear Regression, Model Selection, Mixed Models, ANCOVA, Repeated Measurement Analysis, MANOVA, Nonparametric Methods, Diagnostic Test Evaluation, ROC Curve Analysis, Generalized Linear Models, Logistic Regression, Survival Analysis, Cox Proportional Hazards Regression. This course is available on campus and by distance.

VDPAM 528. Principles of Epidemiology and Population Health.

(Dual-listed with VDPAM 428). (Cross-listed with V MPM). (3-0) Cr. 3. S.

Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigations. Issues in disease prevention, control, and eradication. This course is available on campus and by distance.

VDPAM 529. Epidemiological Methods in Population Research.

(3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* STAT 401

Designing, conducting, and analyzing outcomes from field-based studies, including cross-sectional, case-control, cohort, and clinical trials with categorical outcomes. This course is available on campus and by distance.

VDPAM 542. Introduction to Molecular Biology Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM). Cr. 1. Repeatable. F.S.SS.

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

VDPAM 542A. Introduction to Molecular Biology Techniques: DNA Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM). Cr. 1. Repeatable. F.S.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

VDPAM 542B. Introduction to Molecular Biology Techniques: Protein.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS).

Cr. 1. Repeatable. S.SS. *Prereq:* Graduate classification

Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

VDPAM 542C. Introduction to Molecular Biology Techniques: Cell Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM). Cr. 1. Repeatable. F.S.

Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

VDPAM 542D. Introduction to Molecular Biology Techniques: Plant Transformation.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM).

Cr. 1. Repeatable. S.

Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

VDPAM 542E. Introduction to Molecular Biology Techniques: Proteomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM). Cr. 1. Repeatable. F.

Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

VDPAM 542F. Introduction to Molecular Biology Techniques: Metabolomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM). Cr. 1. Repeatable. F.

Includes metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

VDPAM 542G. Introduction to Molecular Biology Techniques: Genomic.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

VDPAM 546. Clinical and Diagnostic Toxicology.

(Cross-listed with TOX). (0-3) Cr. 1-3. Repeatable. F.S.SS. *Prereq:* D.V.M. degree or VDPAM 526

Advanced study of current problems and issues in toxicology. Emphasis on problem solving utilizing clinical, epidemiological, and laboratory resources.

VDPAM 551. Advanced Veterinary Diagnostic Medicine.

(0-3) Cr. 1-3. Repeatable. F.S.SS. *Prereq:* VDPAM 455

Necropsy techniques of animals with emphasis on gross and microscopic lesion description and microbiological diagnosis of disease in food animals.

VDPAM 570. Risk Assessment for Food, Agriculture and Veterinary Medicine.

(Cross-listed with AGRON, TOX). (3-0) Cr. 3. F. *Prereq:* STAT 104 or consent of instructor

Risk assessment principles as applied to biological systems. Exposure and effects characterization in human and animal health and ecological risk assessment. Risk analysis frameworks and regulatory decision-making. Introduction to quantitative methods for risk assessment using epidemiological and distributional analysis. Uncertainty analysis. This course is available only by distance.

VDPAM 581. Advanced Cow/Calf Production Medicine.

(Dual-listed with VDPAM 481). (20-20) Cr. 2. S. *Prereq:* Completion of two semesters of VDPAM 436 or UNL equivalent (V MED 596 Cattle Production), fourth year classification in veterinary medicine

Two-week senior elective that will focus on the economics of animal disease in cow/calf operations. Evidence based medicine and epidemiological principles will be used in investigation of disease outbreaks. Extensive partial budgeting used. Students will complete at least two disease investigations involving outbreaks in commercial cow/calf operations and communicate their findings to the class, the herd owner, and local practitioner. Biosecurity policies require documentation of your presence in the USA 5 days immediately prior to the start of class if international travel has occurred.

VDPAM 590. Special Topics.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*
Topics in medicine, surgery, theriogenology; beef, swine, dairy, or sheep production medicine.

VDPAM 596. International Preceptorship.

(Dual-listed with VDPAM 496). Cr. 1-12. Repeatable. F.S.SS. *Prereq: Second, third or fourth year classification in veterinary medicine*
International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities. Offered on a satisfactory-fail basis only.

VDPAM 599. Creative Component.

Cr. arr. Repeatable. F.S.SS. *Prereq: Enrollment in nonthesis master's degree program*

Courses for graduate students:

VDPAM 650. Swine Diagnostic Medicine.

Cr. 4. Alt. S., offered even-numbered years. *Prereq: Permission of instructor*
A detailed study of swine diseases emphasizing the pathogenesis and diagnosis of swine respiratory, enteric, reproduction, metabolic, and septicemic diseases. Course activities include interpretation of diagnostic case reports and development of diagnostic plans for specific disease objectives.

VDPAM 654. Comparative Antimicrobial Clinical Pharmacology.

Cr. 2. S. *Prereq: Graduate student, resident, or intern in College of Veterinary Medicine*
Initial antimicrobial selection for infectious diseases of domestic animals. The antimicrobial drug groups will be examined, stressing pharmacokinetics, minimal inhibitory concentrations, and the use of these parameters to select appropriate compounds and dosages for maximum efficacy.

VDPAM 655. Advanced Swine Production Medicine.

Cr. 4. Alt. S., offered odd-numbered years. *Prereq: Permission of instructor*
Detailed overview of applied techniques used in swine production medicine; production modeling and record analysis, facility design and management, analysis of competing intervention options, design and evaluation of therapeutic and vaccination strategies, quality control procedures and food safety. Course activities include interpretation of diagnostic case reports and development of diagnostic plans for specific disease objectives.

VDPAM 699. Research.

Cr. arr. Repeatable.

Veterinary Microbiology and Preventive Medicine (V MPM)

Courses primarily for professional curriculum students:

V MPM 378. Case Study IV.

(2-0) Cr. 2. S. *Prereq:* Second-year classification in veterinary medicine
Case-based applied learning that relates to the basic science courses. Emphasis on early integration of basic and clinical science concepts.

V MPM 380. Veterinary Immunology.

(2-0) Cr. 2. S. *Prereq:* First-year classification in veterinary medicine
Structure and function of the immune system in animals.

V MPM 386. Veterinary Microbiology.

(3-5) Cr. 5. F. *Prereq:* Second-year classification in veterinary medicine
Bacteria and fungi of veterinary importance with emphasis on mechanisms of disease production and laboratory diagnostic procedures.

V MPM 387. Veterinary Virology.

(3-0) Cr. 3. S. *Prereq:* Second-year classification in veterinary medicine
Basic principles of animal virology. Pathogenesis of viral infections. The nature and ecology of viruses of veterinary and zoonotic importance.

V MPM 388. Public Health and the Role of the Veterinary Profession.

(3-0) Cr. 3. S. *Prereq:* Second-year classification in veterinary medicine
Fundamental epidemiology, zoonotic diseases, occupational health, food safety, other public health topics.

V MPM 390. Topics in Veterinary History.

(1-0) Cr. 1. F.

An overview of the history of veterinary medicine focused primarily on disease-specific events. A review of the historical aspects of the veterinary profession's accomplishments in the discovery of the etiological origins of disease and their subsequent control will provide students with insights that are applicable to understanding and solving today's animal and human health challenges.

V MPM 409. Infectious Diseases of Wild Animals.

(0-2) Cr. 1. F.S. *Prereq:* Second year classification in veterinary medicine
Infectious diseases (bacterial, viral, and mycotic) of non-human primates, birds, ruminants, cold-blooded animals, marine mammals, and carnivores.*Spring only offered to UNL students.

V MPM 428. Principles of Epidemiology and Population Health.

(Dual-listed with V MPM 528). (Cross-listed with VDPAM). (3-0) Cr. 3. S.
Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigations. Issues in disease prevention, control, and eradication. This course is available on campus and by distance.

V MPM 437. Infectious Diseases and Preventive Medicine.

(3-0) Cr. 3. S. *Prereq:* Third-year classification in veterinary medicine
Etiology, epidemiology, laboratory diagnosis, regulatory control and preventive medicine aspects of the infectious diseases of swine, sheep, goats, cattle and horses.

V MPM 486. Laboratory in Public Health.

Cr. 2. Repeatable. F.S.SS. *Prereq:* Fourth-year classification in veterinary medicine
Discussions, lectures, exercises and field trips related to veterinary public health.

V MPM 490. Independent Study.

Cr. arr. Repeatable. F.S.SS. *Prereq:* Permission of instructor and department chair

V MPM 491. CDC Epidemiology Elective Preceptorship.

Cr. 6. F.S.SS. *Prereq:* Written permission of instructor
Introduction to preventive medicine, public health and the principles of applied epidemiology within the working atmosphere of the Centers for Disease Control and Prevention.

V MPM 494. Zoo Preceptorship.

Cr. 1-8. Repeatable. F.S.SS. *Prereq:* Fourth year classification in veterinary medicine
Elective course in zoo veterinary practice under guidance of approved veterinarians.

V MPM 496. International Preceptorship.

(0-40) Cr. 1-12. Repeatable. F.S.SS. *Prereq:* Second-year classification in veterinary medicine

International Preceptorships and Study Abroad group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

V MPM 501. Basic Principles of Microbiology.

Cr. 3. F.

The general principles of bacteriology, immunology and virology will be discussed. The structure and function of bacteria and viruses, the mechanisms of pathogenesis, and the host response to infectious agents will be reviewed. Vaccines, their failures, and new developments in vaccine development will be explored.

V MPM 502. Microbial Genetics and Genomics.

(Cross-listed with MICRO). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq:* MICRO 302, BIOL 313

The fundamental concepts of bacterial and bacteriophage genetics including mutagenesis, mechanisms of both vertical and horizontal genetic information transfer, gene regulation, and genetic approaches to study complex cellular processes. Review and discussion of research literature to examine experimental design, methodology, and interpretation of both historical and contemporary relevance to microbial genetics.

V MPM 520. Medical Immunology I.

(4-0) Cr. 4. F. *Prereq:* MICRO 310 or V MPM 386, 3 credits in biochemistry
Nature of the immune system and its role in health and disease. Credit for either V MPM 520 or 575, but not both may be applied toward graduation.

V MPM 522. Principles of Epidemiology and Population Health.

(3-0) Cr. 3. S.

Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigations. Issues in disease prevention, control, and eradication. This course is available on campus and by distance.

V MPM 525. Intestinal Microbiology.

(Cross-listed with MICRO). Cr. 3. Alt. S., offered even-numbered years. *Prereq:* Micro 302, BIOL 313

Overview of commensal microbiota in the health and well-being of vertebrates. Topics include diversity of intestinal structure, microbial diversity/function, innate immune development, community interactions and metabolic diseases associated with alterations of the intestinal microbiome.

V MPM 528. Principles of Epidemiology and Population Health.

(Dual-listed with V MPM 428). (Cross-listed with VDPAM). (3-0) Cr. 3. S.
Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigations. Issues in disease prevention, control, and eradication. This course is available on campus and by distance.

V MPM 536. Zoonoses and Environmental Health.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. *Prereq:* V MPM 386, V MPM 387 and V MPM 388 or equivalent or permission of instructor
Pathogenesis and control of zoonotic diseases. Factors influencing transmission and survival of pathogenic microorganisms in the environment.

V MPM 540. Livestock Immunogenetics.

(Cross-listed with AN S, MICRO). (2-0) Cr. 2. Alt. S., offered odd-numbered years. *Prereq:* AN S 561 or MICRO 575 or V MPM 520
Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

V MPM 542. Introduction to Molecular Biology Techniques.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. F.S.SS.
Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

V MPM 542A. Introduction to Molecular Biology Techniques: DNA Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. F.S.
Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

V MPM 542C. Introduction to Molecular Biology Techniques: Cell Techniques.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. F.S.

Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

V MPM 542D. Introduction to Molecular Biology Techniques: Plant Transformation.

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.

Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

V MPM 542E. Introduction to Molecular Biology Techniques: Proteomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. F.

Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

V MPM 542F. Introduction to Molecular Biology Techniques: Metabolomics.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. F.

Includes metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

V MPM 542G. Introduction to Molecular Biology Techniques: Genomic.

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

V MPM 575. Immunology.

(Cross-listed with MICRO). (3-0) Cr. 3. S. *Prereq: MICRO 310*

An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Micro 475L optional. Credit for either Micro 575 or V MPM 520, but not both, may be applied toward graduation.

V MPM 586. Medical Bacteriology.

(Cross-listed with MICRO). (4-0) Cr. 4. F. *Prereq: Permission of instructor*

Bacteria associated with diseases of vertebrates, including virulence factors and interaction of host responses.

V MPM 586L. Medical Bacteriology Laboratory.

(0-6) Cr. 2. F. *Prereq: credit or enrollment in V MPM 586 or V MPM 625*

Procedures used in isolation and identification of pathogenic bacteria, including molecular and genetic techniques used in research.

V MPM 587. Animal Virology.

(4-0) Cr. 4. *Prereq: Permission of instructor*

Principles of animal virology. Biology of viruses associated with diseases of veterinary importance, including mechanisms of pathogenesis.

V MPM 590. Special Topics.

Cr. 1-5. Repeatable. F.S.SS. *Prereq: Permission of instructor*

V MPM 596. International Preceptorship.

(0-40) Cr. 1-12. Repeatable. F.S.SS. *Prereq: Admission to graduate college*

International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities. Offered on a satisfactory-fail basis only.

V MPM 599. Creative Component.

Cr. arr. *Prereq: Nonthesis M.S. Option only*

A written report based on laboratory research, library reading, or topics related to the student's area of specialization and approved by the student's advisory committee.

Courses for graduate students:**V MPM 604. Seminar.**

(1-0) Cr. 1. Repeatable. F.

Offered on a satisfactory-fail basis only.

V MPM 608. Molecular Virology.

(Cross-listed with MICRO, PL P). (3-0) Cr. 3. Alt. F., offered even-numbered years. *Prereq: BBMB 405 or GDCB 511*

Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

V MPM 615. Molecular Immunology.

(Cross-listed with BBMB, MICRO). (3-0) Cr. 3. Alt. F., offered odd-numbered years. *Prereq: BBMB 405 or BBMB 502*

Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signaling pathways leading to expression of genes that control and activate immune function.

V MPM 625. Mechanisms of Bacterial Pathogenesis.

(Cross-listed with MICRO). (4-0) Cr. 4. Alt. S., offered odd-numbered years.

Prereq: Credit in Biochemistry and Microbiology

Review of current concepts in specific areas of microbial pathogenesis including the genetic basis for bacterial disease, genetic regulation and control of virulence factors and their mechanisms of action, and host-pathogen interactions at the cellular and molecular levels. The application of microbial genetics to understanding pathogenesis will be included.

V MPM 629. Advanced Topics in Cellular Immunology.

(2-0) Cr. 2. Alt. S., offered even-numbered years. *Prereq: V MPM 520 or V MPM 575*

Current topics and literature in cellular immunology. Topics include thymocyte development and selection, T cell interactions with antigen presenting cells, and lymphocyte effector functions.

V MPM 660. Pathogenesis of Persistent Infections.

(Cross-listed with V PTH). (2-0) Cr. 2. Alt. S., offered odd-numbered years.

Prereq: Permission of instructor

Study of current knowledge related to host pathogen interactions during persistent and chronic infections by bacteria, viruses and parasites.

V MPM 690. Current Topics.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Colloquia or advanced study of specific topics in a specialized field.

V MPM 690A. Current Topics: Immunology.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Colloquia or advanced study of specific topics in a specialized field.

V MPM 690B. Current Topics: Infectious Diseases.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Colloquia or advanced study of specific topics in a specialized field.

V MPM 698. Seminar in Molecular, Cellular, and Developmental Biology.

(Cross-listed with BBMB, GDCB, MCDB, MICRO). (2-0) Cr. 1-2. Repeatable. F.S. Student and faculty presentations.

V MPM 699. Research.

Cr. arr. Repeatable.

Veterinary Pathology (V PTH)

Courses primarily for professional curriculum students:

V PTH 342. Anatomic Pathology I.

(Dual-listed with V PTH 542). (2-2) Cr. 3. S. *Prereq: for V PTH 342, prereq: First-year classification in veterinary medicine. For V PTH 542, prereq: Graduate classification and BIOL 352 or equivalent for graduate credit, permission of instructor.*

Basic pathology with emphasis on disease in animals and introduction to diseases by system.

V PTH 349. The Genome Perspective in Biology.

(Cross-listed with BIOL, GEN, MICRO). (2-0) Cr. 2. S. *Prereq: GEN 313 or GEN 320*

Analysis of genome, RNA, and protein data using computer technology to answer biological questions on topics ranging from microbial diversity to human health. An introduction for students in the life sciences to the fields of genomics, bioinformatics and systems.

V PTH 353. Introductory Parasitology.

(Cross-listed with BIOL, MICRO). (3-0) Cr. 3. S. *Prereq: BIOL 212*

Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites.

V PTH 372. Anatomic Pathology II.

(Dual-listed with V PTH 572). (3-3) Cr. 4. F. *Prereq: for V PTH 372, prereq: V PTH 342. For V PTH 572, prereq: Graduate classification and V PTH 542.*

Response to injury by each body system.

V PTH 376. Veterinary Parasitology.

(Dual-listed with V PTH 576). (3-3) Cr. 4. F. *Prereq: For V PTH 376, prereq: Second-year classification in veterinary medicine. For V PTH 576, prereq: Graduate classification and V PTH 542.*

Parasitic diseases of domestic animals and their control.

V PTH 377. Case Study III.

(0-4) Cr. 2. F. *Prereq: Second-year classification in veterinary medicine*

Clinical applications of the basic sciences taught concurrently in the fall semester of the second year curriculum in veterinary medicine.

V PTH 401. Basics of Medical Terminology.

(1-0) Cr. 1. F.

8 weeks, offered first half semester only. Discussion of prefixes, suffixes, and roots (mostly from Latin and Greek) that comprise medical terms.

V PTH 402. Introduction to Pathology.

(Cross-listed with BIOL). (3-0) Cr. 3. S. *Prereq: BIOL 211 and BIOL 212 with labs*

Introductory exploration of pathology as a medical discipline. This includes study of disease mechanisms via an introduction to general pathology topics (cell degeneration, necrosis, disturbances of growth, disturbances of blood flow, inflammation, neoplasia) and organ system-specific response to injury.

V PTH 409. Introduction to Veterinary Cytology and Laboratory Techniques.

(0-2) Cr. 1. S. *Prereq: Third-year classification in veterinary medicine*

Description, interpretation, and techniques for cellular preparations from tissues and body fluids.

V PTH 425. Clinical Pathology.

(2-4) Cr. 4. S. *Prereq: V PTH 372*

Principles of clinical hematology, clinical chemistry, and urinalysis in domestic animals.

V PTH 456. Necropsy Laboratory Practicum.

Cr. 1. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Practicum in postmortem examination and diagnosis.

V PTH 457. Clinical Pathology Laboratory Practicum.

Cr. 1. Repeatable. *Prereq: Fourth-year classification in veterinary medicine*
Methodology in clinical chemistry, hematology and cytology; practice in interpretation of laboratory data.

V PTH 490. Independent Study.

Cr. arr. Repeatable. *Prereq: Permission of instructor and department chair*

V PTH 492. Orientation for International Experience.

(2-0) Cr. 1. Repeatable. S. *Prereq: Classification in veterinary medicine*
8 weeks. Predeparture orientation for group study abroad. Cultural considerations for the study abroad experience and a conversational language introduction. Out of class work will be assigned. Offered on a satisfactory-fail basis only.

V PTH 496. International Preceptorship.

(0-40) Cr. 1-12. Repeatable. F.S.SS. *Prereq: Second-year classification in veterinary medicine*

International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experience in international locations. The course consists of 40 hour per week experiential learning opportunities. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

V PTH 503. Principles of Pathology.

(3-0) Cr. 3. S.

Introductory exploration of pathology as a medical discipline. This includes study of disease mechanisms via an introduction to general pathology topics (cell degeneration, necrosis, disturbances of growth, disturbances of blood flow, inflammation, neoplasia) and organ system-specific response to injury.

V PTH 530. Teaching and Learning in Veterinary Medical Education.

(3-0) Cr. 3. Alt. F., offered even-numbered years.

Study of principles of teaching and learning as they relate to veterinary medical education. These include: theories of learning, analyzing content/learners/context, identifying goals, identifying appropriate instructional strategies (specific to medical education), matching assessment processes to goals and strategies, common curricular approaches and decision-making processes in medical education, and the scholarship of teaching and learning for veterinary medical educators.

V PTH 542. Anatomic Pathology I.

(Dual-listed with V PTH 342). (2-2) Cr. 3. S. *Prereq: for V PTH 342, prereq: First-year classification in veterinary medicine. For V PTH 542, prereq: Graduate classification and BIOL 352 or equivalent for graduate credit, permission of instructor.*

Basic pathology with emphasis on disease in animals and introduction to diseases by system.

V PTH 548. Diagnostic Parasitology Laboratory.

Cr. 1-3. F.S.SS. *Prereq: V PTH 376 or V PTH 576*

Contact hours are (0-3 to 0-9). A laboratory experience in the technical and applied aspects of veterinary parasitology.

V PTH 549. Clinical Pathology Laboratory.

(0-3) Cr. 1. Repeatable. F.S.SS. *Prereq: V PTH 457; permission of instructor*

Laboratory procedures and clinical interpretations with emphasis on hematology, cytology, and clinical chemistry. Offered on a satisfactory-fail basis only.

V PTH 550. Surgical Pathology Laboratory.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: V PTH 570 or V PTH 571; permission of instructor*

Contact hours are (0-3 to 0-9). Diagnosis of lesions in biopsy specimens; classification of neoplasms. Course includes rotation through departmental biopsy service and review of selected cases from departmental archives. Offered on a satisfactory-fail basis only.

V PTH 551. Postmortem Pathology Laboratory.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: V PTH 542; permission of instructor*

Contact hours are (0-3 to 0-9). Necropsy techniques of animals with emphasis on gross and microscopic lesions and diagnosis. Offered on a satisfactory-fail basis only.

V PTH 554. Ethics in Scientific Research and Writing.

(1-0) Cr. 1. Alt. S., offered even-numbered years. *Prereq: Graduate classification*

Ethical conduct in biomedical research, criticism, writing, and adherence to regulations. Offered on a satisfactory-fail basis only.

V PTH 570. Systemic Pathology I.

(4-0) Cr. 4. Alt. F., offered even-numbered years. *Prereq: V PTH 342 or V PTH 542; permission of instructor*

Pathology of the respiratory, reproductive, endocrine, musculoskeletal, and cardiovascular systems. Emphasis on pathogenesis and anatomic pathology correlated with interpretive clinical pathology where appropriate.

V PTH 571. Systemic Pathology II.

(4-0) Cr. 4. Alt. F., offered odd-numbered years. *Prereq: V PTH 342 or V PTH 542; permission of instructor*

Pathology of the integumentary, urinary, digestive, lymphoid, and nervous systems and special senses. Emphasis on pathogenesis and anatomic pathology correlated with interpretive clinical pathology where appropriate.

V PTH 572. Anatomic Pathology II.

(Dual-listed with V PTH 372). (3-3) Cr. 4. F. *Prereq: for V PTH 372, prereq: V PTH 342. For V PTH 572, prereq: Graduate classification and V PTH 542.*

Response to injury by each body system.

V PTH 576. Veterinary Parasitology.

(Dual-listed with V PTH 376). (3-3) Cr. 4. F. Prereq: For V PTH 376, prereq: Second-year classification in veterinary medicine. For V PTH 576, prereq: Graduate classification and V PTH 542.
Parasitic diseases of domestic animals and their control.

V PTH 590. Special Topics.

Cr. 1-4. Repeatable. F.S.SS. Prereq: Permission of instructor

V PTH 590A. Special Topics: Veterinary Pathology.

Cr. 1-4. Repeatable. F.S.SS. Prereq: Permission of instructor

V PTH 590B. Special Topics: Veterinary Parasitology.

Cr. 1-4. Repeatable. F.S.SS. Prereq: Permission of instructor

V PTH 590C. Special Topics: Veterinary Toxicology.

Cr. 1-4. Repeatable. F.S.SS. Prereq: Permission of instructor

V PTH 590D. Special Topics: Veterinary Clinical Pathology.

Cr. 1-4. Repeatable. F.S.SS. Prereq: Permission of instructor

V PTH 590E. Special Topics: Other.

Cr. 1-4. Repeatable. F.S.SS. Prereq: Permission of instructor

V PTH 596. International Preceptorship.

(0-40) Cr. 1-12. Repeatable. F.S.SS. Prereq: Admission to graduate college
International Preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities. Offered on a satisfactory-fail basis only.

V PTH 599. Creative Component Research.

Cr. arr. Repeatable.
Course for departmental graduate research.

V PTH 599A. Creative Component Research: Veterinary Pathology.

Cr. arr. Repeatable.
Course for departmental graduate research.

V PTH 599B. Creative Component Research: Veterinary Parasitology.

Cr. arr. Repeatable.
Course for departmental graduate research.

V PTH 599C. Creative Component Research: Veterinary Toxicology.

Cr. arr. Repeatable.
Course for departmental graduate research.

V PTH 599D. Creative Component Research: Veterinary Clinical Pathology.

Cr. arr. Repeatable.
Course for departmental graduate research.

Courses for graduate students:**V PTH 604. Pathology Case Seminar.**

Cr. 1-2. Repeatable. F.S. Prereq: permission of instructor
Description and interpretation of microscopic lesions and clinical pathology data collected from cases of natural and experimental disease. Offered on a satisfactory-fail basis only.

V PTH 605. Current Topics Seminar.

Cr. 1. Repeatable. F.S.SS.
A seminar of graduate research at the time of thesis or dissertation defense.

V PTH 606. Diagnostic Interpretation.

Cr. R. F.S.SS. Prereq: permission of instructor
A comprehensive examination in the diagnostic description and interpretation of case materials relevant to veterinary pathology and areas of specialization for the graduate degree preliminary examination.

V PTH 606A. Diagnostic Interpretation: Veterinary Pathology.

Cr. R. F.S.SS. Prereq: permission of instructor
A comprehensive examination in the diagnostic description and interpretation of case materials relevant to veterinary pathology and areas of specialization for the graduate degree preliminary examination.

V PTH 606B. Diagnostic Interpretation: Veterinary Parasitology.

Cr. R. F.S.SS. Prereq: permission of instructor
A comprehensive examination in the diagnostic description and interpretation of case materials relevant to veterinary pathology and areas of specialization for the graduate degree preliminary examination.

V PTH 606C. Diagnostic Interpretation: Veterinary Toxicology.

Cr. R. F.S.SS. Prereq: permission of instructor
A comprehensive examination in the diagnostic description and interpretation of case materials relevant to veterinary pathology and areas of specialization for the graduate degree preliminary examination.

V PTH 606D. Diagnostic Interpretation: Veterinary Clinical Pathology.

Cr. R. F.S.SS. Prereq: permission of instructor
A comprehensive examination in the diagnostic description and interpretation of case materials relevant to veterinary pathology and areas of specialization for the graduate degree preliminary examination.

V PTH 652. Pathologic Hematology.

(2-2) Cr. 3. Prereq: V PTH 425; permission of instructor
Pathologic changes in blood constituents of domestic animals.

V PTH 655. Cellular and Molecular Pathology I.

(3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: Graduate course in biochemistry, genetics, or cell biology
Cellular and molecular mechanisms of cell injury, cellular responses to injury, and inflammation.

V PTH 656. Cellular and Molecular Pathology II.

(Cross-listed with TOX). (3-0) Cr. 3. Alt. S., offered even-numbered years. Prereq: Graduate course in biochemistry, genetics, or cell biology
Cellular and molecular mechanisms of carcinogenesis.

V PTH 660. Pathogenesis of Persistent Infections.

(Cross-listed with V MPM). (2-0) Cr. 2. Alt. S., offered odd-numbered years. Prereq: Permission of instructor
Study of current knowledge related to host pathogen interactions during persistent and chronic infections by bacteria, viruses and parasites.

V PTH 661. Comparative Immunology and Infectious Disease.

(Cross-listed with IMBIO). (2-0) Cr. 2. Alt. S., offered odd-numbered years. Prereq: Graduate level Immunology or permission of instructor.
Discuss and define similarities and differences of varied host responses to infectious challenge. Learning will focus on comparative aspects of the host response and the unique aspects of immunity from different organisms, while highlighting molecular and mechanistic similarities of pathogen recognition, response and resolution.

V PTH 663. Clinical Chemistry.

(2-2) Cr. 3. Prereq: V PTH 425; permission of instructor
The pathophysiology, methodology, and clinical application of laboratory medicine.

V PTH 679. Histopathology of Laboratory Animals.

(1-2) Cr. 2. Alt. SS., offered even-numbered years. Prereq: V PTH 570 or V PTH 571; permission of instructor
Study of microscopic lesions in laboratory animals with emphasis on description, etiology, pathogenesis, and diagnosis.

V PTH 699. Research.

Cr. arr. Repeatable.
Course restricted to graduate program within the department.

V PTH 699A. Research: Veterinary Pathology.

Cr. arr. Repeatable.
Course restricted to graduate program within the department.

V PTH 699B. Research: Veterinary Parasitology.

Cr. arr. Repeatable.
Course restricted to graduate program within the department.

V PTH 699C. Research: Veterinary Toxicology.

Cr. arr. Repeatable.
Course restricted to graduate program within the department.

V PTH 699D. Research: Veterinary Clinical Pathology.

Cr. arr. Repeatable.
Course restricted to graduate program within the department.

Wind Energy Science, Engineering and Policy (WESEP)

Courses primarily for graduate students, open to qualified undergraduates:

WESEP 501. Wind Energy Resources.

(3-0) Cr. 3. *Prereq: Graduate standing*

Forecasting, wind measurement and analysis, site placement, aerodynamic principles associated with blade design, power generation technologies, power electronic topologies used in wind energy conversion, collection circuits, and grid operation with high wind penetration.

WESEP 502. Wind Energy Systems.

(3-0) Cr. 3. *Prereq: Graduate standing*

Systems approach to wind turbine design, manufacturing, installation, integrated with wind economics and policy issues. Topics include manufacturing practices used to produce wind turbines, construction practices, sensing and inspection technologies used in monitoring wind farm health, and the impact of policy making on the wind energy industry.

WESEP 511. Wind Energy System Design.

(3-0) Cr. 3. *Prereq: WESEP 501 and WESEP 502*

Advanced design, control, and operation of wind plants. Topics include electromechanical energy conversion systems, aerodynamic and aeroelastic loads, optimal control of wind farms, life cycle management strategies, tall tower design, and prediction of component residual life.

WESEP 590. Special Topics.

Cr. 1-3. Repeatable.

Advanced study of a research topic in the field of wind energy, science, engineering, and policy.

WESEP 594. Wind Energy Real-Time Research Collaborative.

(1-0) Cr. 1. F.S. *Prereq: Graduate standing*

Identifying current wind energy research issues and conducting components of the research cycle in real-time, including proposal development, investigation/analysis/discovery, publication and presentation, ethical behavior, and leadership.

Women's Studies (W S)

Courses primarily for undergraduates:

W S 160. Gender Justice.

(2-0) Cr. 1. F.S.

Half semester course. Examines the socialization process in the United States and how our perspectives are formed. An introduction to patriarchy, sexism, and ally development are explored. Skills to enhance communication and understanding among women and men will be developed. Offered on a satisfactory-fail basis only.

Meets U.S. Diversity Requirement

W S 201. Introduction to Women's Studies.

(3-0) Cr. 3.

Introduction to the interdisciplinary field of Women's Studies. Contemporary status of women in the U.S. and worldwide from social, economic, historical, political, philosophical and literary perspectives. Analysis of intersection of gender, race, class, and sexuality. Subject matter includes work, health, sexuality, and violence. Foundation for the other courses in the program.

Meets U.S. Diversity Requirement

W S 203. Introduction to Lesbian Studies.

(3-0) Cr. 3. S.

Study of contemporary and historic lesbian cultures and communities from a US and international perspective. Addresses issues of race, class, gender and sexuality as they intersect with the formation of lesbian identities. Explores who identifies as lesbian and how that dis/enables political resistance and formation of community.

Meets U.S. Diversity Requirement

W S 205. Introduction to Queer Studies.

(3-0) Cr. 3. F. Prereq: ENGL 150

Interdisciplinary study of issues relating to lesbian, gay, bisexual, transgender, and queer identities in the U.S. Attention will be given to race and socioeconomic class.

Meets U.S. Diversity Requirement

W S 258. Human Reproduction.

(Cross-listed with BIOL). (3-0) Cr. 3. F. Prereq: BIOL 101, or BIOL 155, or BIOL 211

Anatomy and physiology of human reproductive systems, including fertility, pregnancy, and delivery. Does not satisfy biology major requirements.

W S 301. International Perspectives on Women and Gender.

(3-0) Cr. 3. F.S. Prereq: W S 201 or 3 credits in Women's Studies at the 300 level or above

Study of women in a range of cultures, depending on faculty specialization. Special emphasis on women in development seen in postcolonial context.

Meets International Perspectives Requirement.

W S 302. Issues in Women's Health and Reproduction.

(3-0) Cr. 3. Prereq: W S 201 or 3 credits in Women's Studies at 300 level or above

Current feminist scholarship in the social sciences and humanities on women's health, health care, and reproduction. Intersections among race, gender, class, ability, and sexuality are emphasized.

Meets U.S. Diversity Requirement

W S 304. Creative Writing--Fiction.

(Cross-listed with ENGL). (3-0) Cr. 3. F.S. Prereq: ENGL 250, not open to freshmen

Progresses from practice in basic techniques of fiction writing to fully developed short stories. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

W S 307. Women in Science and Engineering.

(Cross-listed with BIOL). (3-0) Cr. 3. F. Prereq: a 200 level course in science, engineering or women's studies; ENGL 250

The interrelationships of women and science and engineering examined from historical, sociological, philosophical, and biological perspectives. Factors contributing to under-representation; feminist critiques of science; examination of successful strategies. Does not satisfy biology major advanced credit requirements.

Meets U.S. Diversity Requirement

W S 308. Write Like a Woman.

(3-0) Cr. 3. F. Prereq: ENGL 250

Writing and reading interpretive fiction written by women. Emphasis on stories that embody a female literary life, gender-specific ways of creating characters and conflicts, analytical reading and writing, workshop criticism and shared commentaries. Includes multi-modal projects.

W S 320. Ecofeminism.

(Cross-listed with ENV S). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: W S 201 or 3 credits in Women's Studies at the 300 level or above

Women's relationships with the earth, non-human nature, and other humans.

The course explores the connections between society's treatment of women and nature; origins of ecofeminism and how it relates to the science of ecology, conventional and sustainable agriculture as well as how ecofeminism relates to other branches of feminist philosophy. Evaluation and critique of modern science, technology, political systems and SOLUTIONS will be included.

W S 321. Economics of Discrimination.

(Cross-listed with ECON). (3-0) Cr. 3. Prereq: ECON 101

Economic theories of discrimination. Analysis of the economic problems of women and minorities in such areas as earnings, occupations, and unemployment. Public policy concerning discrimination. Poverty measurement and antipoverty programs in the U.S.

Meets U.S. Diversity Requirement

W S 323. Gender and Communication.

(Cross-listed with SP CM). (3-0) Cr. 3.

Examines how understanding and enactment of gender identity is shaped by communication. Verbal and nonverbal communication across various contexts including personal relationships and the media. Explores discourse of social movements aiming to transform cultural definitions of gender.

Meets U.S. Diversity Requirement

W S 325. Portrayals of Gender and Sexualities in the Media.

(3-0) Cr. 3. Prereq: Sophomore classification

Survey of how the media and popular culture portray gender and sexualities and the impact on individuals and society. Images of women, men, transgender as well as heterosexual, non-heterosexual and others. Studies both historical and emerging images in the media in terms of stereotypes and positive images.

W S 327. Sex and Gender in Society.

(Cross-listed with SOC). (3-0) Cr. 3. F.S.SS. Prereq: SOC 134

How the biological fact of sex is transformed into a system of gender stratification. The demographics and social positions of women and men in the family, education, media, politics, and the economy. Theories of the social-psychological and sociological bases for behavior and attitudes of women and men. The relationship between gender, class, and race.

Meets U.S. Diversity Requirement

W S 328. Sociology of Masculinities and Manhood.

(Cross-listed with SOC). (3-0) Cr. 3. S. Prereq: SOC 134 or W S 201

Examination of socially constructed and idealized images of manhood, the nature of social hierarchies and relations constructed on the basis of imagery, ideologies, and norms of masculinity. Theories on gender (sociological, psychological, and biological). Particular attention given to theory and research on gender variations among men by race, class, ethnicity, sexual orientation, physical ability and age.

Meets U.S. Diversity Requirement

W S 333. Women and Leadership.

(Cross-listed with CL PS). (3-0) Cr. 3. Prereq: Sophomore classification

This course will examine historical and contemporary barriers to and opportunities for women's leadership in a variety of contexts, including professions and public service. It will examine theories of women's leadership, gender differences in leadership styles, and the perceptions and expectations about women's leadership. Multiple perspectives of women's leadership will be highlighted through lectures, readings, videos, guest speakers and group work.

Meets U.S. Diversity Requirement

W S 336. Women and Religion.

(Cross-listed with RELIG). (3-0) Cr. 3. F. Prereq: RELIG 205, RELIG 210 or W S 201 recommended

Examines the status of women in various religions, feminist critiques of religious structures and belief systems, and contemporary women's spirituality movements.

Meets U.S. Diversity Requirement

W S 338. Feminist Philosophy.

(Cross-listed with PHIL). (3-0) Cr. 3. F. Prereq: 3 credits in philosophy or women's studies recommended

A critical, theoretical examination of the oppression of women, especially as it relates to issues of race, class, and sexual orientation. How concepts such as sex and gender, self and other, nature and nurture, complicate our understanding of what it means to be a woman. Historical and contemporary feminist philosophers addressing topics such as violence, sexuality, pornography, political power, family structure and women's paid and unpaid labor.

Meets U.S. Diversity Requirement

W S 340. Women's Literature.

(Cross-listed with ENGL). (3-0) Cr. 3. *Prereq: ENGL 250*
Historical and thematic survey of literature by and about women. May include autobiographies, journals, letters, poetry, fiction, and drama.
Meets U.S. Diversity Requirement

W S 342. American Indian Women Writers.

(Cross-listed with AM IN, ENGL). (3-0) Cr. 3. *Prereq: ENGL 250*
Literature of American Indian women writers which examines their social, political, and cultural roles in the United States. Exploration of American Indian women's literary, philosophical, and artistic works aimed at recovering elements of identity, redefining stereotypes, resisting colonization, and constructing femininity.
Meets U.S. Diversity Requirement

W S 345. Women and Literature: Selected Topics.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: ENGL 250*

Literature by women and/or dealing with the images of women, e.g., study of individual authors or related schools of authors; exploration of specific themes or genres in women's literature; analysis of recurrent images of women in literature.
Meets U.S. Diversity Requirement

W S 346. Psychology of Women.

(Cross-listed with PSYCH). (3-0) Cr. 3. S. *Prereq: 2 courses in psychology including PSYCH 101*

Survey of theory and research related to major biological, interpersonal, and cultural issues affecting girls' and women's psychological development and behavior.

Meets U.S. Diversity Requirement

W S 350. Women of Color in the U.S.

(Cross-listed with AF AM). (3-0) Cr. 3. S. *Prereq: 3 credits in Women's Studies or African American Studies*

Economic, social, political and cultural roles of Women of Color in the U.S. Includes literary, philosophical, and artistic expressions. Myths and realities explored.

Meets U.S. Diversity Requirement

W S 352. Gay and Lesbian Literature.

(Cross-listed with ENGL). (3-0) Cr. 3. *Prereq: ENGL 250*

Literary portrayals of gay and lesbian lives and relationships from many different genres. Attention to changing definitions and representations of sexual orientation and gender identity over time.

Meets U.S. Diversity Requirement

W S 370. Studies in English Translation.

(3-0) Cr. 3.

Readings, discussions, and papers in English.
Meets International Perspectives Requirement.

W S 370F. French studies in English: French Topics on Women and Gender Studies.

(Cross-listed with FRNCH). (3-0) Cr. 3. Repeatable.

Topics vary according to faculty interest. Readings, discussions, and papers in English.

Meets International Perspectives Requirement.

W S 370G. German Studies in English: German topics on women or feminism.

(3-0) Cr. 3-4. Repeatable, maximum of 6 credits. *Prereq: Sophomore classification. For fourth credit, 6 credits in German at the 300 level*

Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Three credits: English, open to all students. Four credits: Required for German concentration credit, supplementary readings and compositions in German.

Meets International Perspectives Requirement.

W S 370R. Russian Studies in English Translation: Russian topics on women or feminism.

(Cross-listed with RUS). (3-0) Cr. 3. Repeatable.

Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English.

Meets International Perspectives Requirement.

W S 370S. Hispanic Topics in English Translation: Hispanic Topics on Women or Feminism.

(Cross-listed with SPAN). (3-0) Cr. 3. Repeatable, maximum of 6 credits.

Topics vary according to faculty interest. Author, genre or period study, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English. May not be counted as a prerequisite.

Meets International Perspectives Requirement.

W S 374. Sex, Gender, and Culture in the Ancient Mediterranean World.

(Cross-listed with CL ST, HIST). (3-0) Cr. 3. S. *Prereq: Any one course in Cl St, W S, Latin, or Greek*

Chronological and topical survey of the status of women and men, focusing on sex and gender issues in the Ancient Mediterranean world; study of constructs of the female and the feminine. Readings from ancient and modern sources. Emphasis on ancient Greece, Rome, and Egypt.

Meets International Perspectives Requirement.

W S 380. History of Women in Science, Technology, and Medicine.

(Cross-listed with HIST). (3-0) Cr. 3. *Prereq: Sophomore classification*

History of women's relationship to the fields of science, technology, and medicine, as students and professionals, consumers, subjects and patients, family members, workers and citizens. Concentrates especially on 19th and 20th century United States, concluding with an examination of current issues of special interest to women in science, technology, and medicine.

Meets U.S. Diversity Requirement

W S 385. Women in Politics.

(Cross-listed with POL S). (3-0) Cr. 3. S.

Examination of the entry and participation of women in politics in the United States and other countries including a focus on contemporary issues and strategies for change through the political process.

Meets U.S. Diversity Requirement

W S 386. History of Women in America.

(Cross-listed with HIST). (3-0) Cr. 3. *Prereq: Sophomore classification*

A survey of social, economic, and political aspects of women's role from colonial era to present; emphasis on employment, education, concepts of sexuality, and changing nature of the home.

Meets U.S. Diversity Requirement

W S 401. Feminist Theories.

(3-0) Cr. 3. *Prereq: W S 201 or 3 credits in Women's Studies at the 300 level or above*

Current theories of feminism, the feminine and sexual difference. Topics in race, class, sexuality, and ethnicity as they are addressed in diverse feminisms. May include readings in lesbian, Black, postcolonial, psychoanalytic and postmodern thought.

W S 402. Feminist Research in Action.

(3-0) Cr. 3. S. *Prereq: W S 201 and W S 301*

Feminist research methods and scholarship. Class collaborates on a community research and action project to improve women's lives.

W S 422. Women, Men, and the English Language.

(Cross-listed with ENGL, LING). (3-0) Cr. 3. S. *Prereq: ENGL 219 or LING 219*

The ways men and women differ in using language in varied settings and the ways in which language both creates and reflects gender divisions.

Meets U.S. Diversity Requirement

W S 425. Intersections of Race, Class and Gender.

(Dual-listed with W S 525). (3-0) Cr. 3. *Prereq: W S 201 and one additional W S course*

Race, ethnicity, class and gender distinctions and intersections lead to inequitable distributions of power, social well-being, and resources. Explores how inequities are institutionalized and how multiple identities are experienced by women in daily life.

W S 435. Women and Development.

(Dual-listed with W S 535). (3-0) Cr. 3. *Prereq: W S 301*

Cross-cultural study of development utilizing both case studies and theoretical works. Explores the nature of women's roles in developing countries and the ways women and their needs have been excluded/included in development approaches, policies, and projects. Includes discussion of actual development projects as well as women's organizing.

W S 439. Goddess Religions.

(Cross-listed with RELIG). (3-0) Cr. 3. *Prereq: RELIG 205 recommended*

Exploration of the foundational myths of Goddess spirituality, including historical and cross-cultural female images of the divine and their modern usage by American women.

W S 444. Sex and Gender in Cross-cultural Perspective.

(Dual-listed with W S 544). (Cross-listed with ANTHR). (3-0) Cr. 3. S. *Prereq: ANTHR 201; ANTHR 306 recommended*

Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

W S 450. Topics in Women's Studies.

(Dual-listed with W S 550). (3-0) Cr. 3. Repeatable, maximum of 6 credits. S. *Prereq: W S 201 or 3 credits in Women's Studies at the 300 level or above* Special and/or experimental topics in a specific discipline, e.g., women and education, women and religion, women and the law, women and science.

W S 460. Seminar in Gender and Ethnicity.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: Completion of 9 credits of surveys; completion of or concurrent enrollment in ENGL 339; junior classification* Selected readings of various authors, movements, eras, or genres. Readings in criticism; required research paper.

W S 488. Research on Women and Leadership.

(Cross-listed with CL PS). (3-0) Cr. 3. Research on women and leadership in selected content areas (e.g., business, education, politics and public service, and popular culture). Following an overview of quantitative and qualitative methods and critical analyses of journal articles on women and leadership, students will work in groups in selected content areas to research, write and present paper.

W S 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 6 credits. *Prereq: Any two courses in Women's Studies* Independent study on a topic in Women's Studies.

W S 491. Senior Internship.

(3-0) Cr. 3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq: Senior classification* Internship designed to provide an application of Women's Studies principles and methods in a workplace. To be arranged with an internal or external employer and conducted under the supervision of a member of the Women's Studies faculty.

W S 494. Women/Gender in Art.

(Cross-listed with ART H). (3-0) Cr. 3. Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture. Meets U.S. Diversity Requirement

W S 499. Senior Thesis.

(3-0) Cr. 3. F.S.SS. *Prereq: Senior classification* Senior thesis to be independently researched and written under the supervision of a member of the Women's Studies faculty.

Courses primarily for graduate students, open to qualified undergraduates:**W S 501. Contemporary Feminist Theories.**

(3-0) Cr. 3. F. Advanced study of current theoretical developments in Women's Studies in the U.S. and around the world. Examination of the epistemological bases of feminist scholarship.

W S 502. Advanced Seminar in Feminist Research Methods.

(3-0) Cr. 3. S. Focus on feminist interdisciplinary research methods. Analysis of contemporary issues facing feminist scholars. Students conduct original research.

W S 525. Intersections of Race, Class and Gender.

(Dual-listed with W S 425). (3-0) Cr. 3. *Prereq: W S 201 and one additional W S course* Race, ethnicity, class and gender distinctions and intersections lead to inequitable distributions of power, social well-being, and resources. Explores how inequities are institutionalized and how multiple identities are experienced by women in daily life.

W S 535. Women and Development.

(Dual-listed with W S 435). (3-0) Cr. 3. *Prereq: W S 301* Cross-cultural study of development utilizing both case studies and theoretical works. Explores the nature of women's roles in developing countries and the ways women and their needs have been excluded/included in development approaches, policies, and projects. Includes discussion of actual development projects as well as women's organizing.

W S 544. Sex and Gender in Cross-cultural Perspective.

(Dual-listed with W S 444). (Cross-listed with ANTHR). (3-0) Cr. 3. S. *Prereq: ANTHR 201; ANTHR 306 recommended* Cross-cultural examination of the social construction of genders out of the biological fact of sex. Emphasis on non-western societies. Topics, presented through examination of ethnographic data, will include the range of gender variation, status and roles, the institution of marriage, and symbols of gender valuation.

W S 545. Women's Literature.

(Cross-listed with ENGL). (3-0) Cr. 3. Repeatable, maximum of 6 credits. *Prereq: Graduate classification or 6 credits in literature at 300 level or above* Primary texts by women writers; historical, thematic, formal, or theoretical approaches; secondary readings; e.g., Nineteenth-Century Women Writers; American Women's Personal Narratives; Southern Women Writers of the U.S.

W S 550. Topics in Women's Studies.

(Dual-listed with W S 450). (3-0) Cr. 3. Repeatable, maximum of 6 credits. S. *Prereq: W S 201 or 3 credits in Women's Studies at the 300 level or above* Special and/or experimental topics in a specific discipline, e.g., women and education, women and religion, women and the law, women and science.

W S 586. Proseminar in Women's History and Feminist Theory.

(Cross-listed with HIST). (3-0) Cr. 3. *Prereq: Permission of instructor* Feminism as a movement and feminist theory from the early modern period to the present as it relates to the writing of women's history. Analysis of interpretations of European and U.S. women's history from patriarchal and postmodernist perspectives.

W S 590. Special Topics.

Cr. arr. *Prereq: Permission of Women's Studies Program Director* Independent study on a topic in Women's Studies.

W S 594. Women/Gender in Art.

(Cross-listed with ART H). (3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor* Issues of gender related to cultural environments from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically gender issues in art that are becoming widespread in the artistic culture.

Courses for graduate students:**W S 621. Pedagogies of Dissent: Radical Theories of Education, Social Justice, and Economic Democracy.**

(Cross-listed with EL PS). (3-0) Cr. 3. S. *Prereq: EL PS 620* Critical examination of the philosophical foundations of education that seek to challenge the status quo and advance radical educational change. Exploration of macro-level (and some micro-level) issues relevant to educational change, in relation to how they inform practices of dissent and every day social relations.

World Languages and Cultures (WLC)

Courses primarily for undergraduates:

WLC 119. Introduction to World Languages.

(Cross-listed with LING). (3-0) Cr. 3.

Study of language diversity and the personal, social and political effects of diversity. Language families, attitudes toward language and language use, language and culture, multilingualism, foreign language learning, written codes, official languages, and language policy.

Meets International Perspectives Requirement.

WLC 270. Cultures in Transition.

(3-0) Cr. 3.

An interdisciplinary introduction to a world region in a state of rapid social and cultural transition. Discussion of the history, social and political institutions, arts, economy, agriculture, and environment of the new nations.

Meets International Perspectives Requirement.

WLC 278. Introduction to Global Film.

(3-0) Cr. 3. F.

Introduction to the cinema of non-English speaking regions and cultures of the world through representative subtitled films, lectures, and readings. Topics vary according to faculty interest. Emphasis on selected national cinemas and film as a mode of cultural expression as well as on diverse cultural contexts of cinema.

Meets International Perspectives Requirement.

WLC 370. Topics in World Languages and Cultures in English Translation.

(3-0) Cr. 3. Repeatable, maximum of 9 credits.

Topics vary according to faculty interest. Author, genre or period study, women's writing, cinema, or cultural studies of a non-English speaking world culture or cultures. Readings, discussion, and written work in English.

WLC 370A. Topics on Global Sustainability.

(3-0) Cr. 3. Repeatable, maximum of 9 credits.

Topics vary according to faculty interest. Author, genre or period study, women's writing, cinema, or cultural studies of a non-English speaking world culture or cultures. Readings, discussion, and written work in English.

Meets International Perspectives Requirement.

WLC 370B. Topics on the Middle East.

(3-0) Cr. 3. Repeatable, maximum of 9 credits.

Topics vary according to faculty interest. Author, genre or period study, women's writing, cinema, or cultural studies of a non-English speaking world culture or cultures. Readings, discussion, and written work in English.

Meets International Perspectives Requirement.

WLC 370C. Topics on Global Urban Cultures.

(3-0) Cr. 3. Repeatable, maximum of 9 credits.

Topics vary according to faculty interest. Author, genre or period study, women's writing, cinema, or cultural studies of a non-English speaking world culture or cultures. Readings, discussion, and written work in English.

Meets International Perspectives Requirement.

WLC 417. Student Teaching.

Cr. 8-12. F.S. *Prereq: minimum GPA of 2.5; Admission to teacher education, approval of coordinator during semester before student teaching*

Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

WLC 417G. Student Teaching: World Language.

(Dual-listed with WLC 517G). (Cross-listed with C I). Cr. arr. F.S. *Prereq: Admission to teacher education or licensed teacher, approval of coordinator during semester before student teaching.*

Evaluation of instruction, lesson planning, and teaching in world languages grades K-8.

WLC 484. Technology, Globalization and Culture.

(Dual-listed with WLC 584). (Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: senior classification for M E 484; graduate classification for M E 584*

Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

Meets International Perspectives Requirement.

WLC 486. Methods in Elementary School World Language Instruction.

(Cross-listed with C I, LING). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language Planning, implementation, and assessment of standards-based, student-centered, and thematic instruction in the elementary (K-8) classroom. Special emphasis on K-8 students' communicative skills, cultural knowledge, and content learning.*

WLC 487. Methods in Secondary School World Language Instruction.

(Cross-listed with C I). (3-0) Cr. 3. F. *Prereq: 25 credits in a world language, admission to the teacher education program, OPI*

Theories and principles of contemporary world language learning and teaching. Special emphasis on designing instruction and assessments for active learning.

WLC 491. Experiences Abroad: Learning to Think Globally.

(Cross-listed with INTST). (1-0) Cr. 1. Repeatable, maximum of 2 credits. *Prereq: Minimum of 3 cr. study abroad and/or internship abroad*

Students returning from study abroad gain perspective on the personal, academic, and professional impact of their time spent abroad through readings and discussions. Students will be expected to make one presentation about the culture they experienced to an audience outside ISU. Offered on a satisfactory-fail basis only.

Courses primarily for graduate students, open to qualified undergraduates:

WLC 517G. Student Teaching: World Language.

(Dual-listed with WLC 417G). (Cross-listed with C I). Cr. arr. F.S. *Prereq: Admission to teacher education or licensed teacher, approval of coordinator during semester before student teaching.*

Evaluation of instruction, lesson planning, and teaching in world languages grades K-8.

WLC 584. Technology, Globalization and Culture.

(Dual-listed with WLC 484). (Cross-listed with M E). (3-0) Cr. 3. F. *Prereq: senior classification for M E 484; graduate classification for M E 584*

Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.

Meets International Perspectives Requirement.

Youth (YTH)

Courses primarily for graduate students, open to qualified undergraduates:

YTH 501. Foundations of Youth Development.

(1-0) Cr. 1. F.S.SS.

Fundamentals of youth development and the youth development profession. Through this introduction to the field, students will explore the ethical, professional, and historical elements of youth development as it has evolved toward professionalization. (on-line course offering via Distance Education).

YTH 508. Grant Development and Management.

(3-0) Cr. 3. F.S.

Basic Grant Development and Management will introduce students to the grant-getting process and provide an overview of what happens after a project is funded. The following topics will be covered: researching funding sources, generating cutting edge ideas, assessing needs, planning a project, establishing credibility, formulating a sustainable budget, designing an evaluation plan, managing the funded project, and disseminating project results. (on-line course offering via Distance Education).

YTH 510. Adolescents and Their Families.

(3-0) Cr. 3. F.S.

Adolescent development as it is related to and intertwined with family development; reciprocal influences between adolescents and their families are examined. Working with youth vis à vis the family system will be highlighted. (on-line course offering via Distance Education).

YTH 520. Community Youth Development.

(3-0) Cr. 3. F.S.

Focus on the national emphasis of a strength-based or asset approach to community youth development, encompassing individual development (i.e., positive youth development) and adolescent interrelationships with environments. Emphasis is placed upon research, theory, and practice applied in communities throughout the U.S. Students will explore existing models, read theoretical and applied literature, and examine current community efforts as a basis for understanding community youth development. (on-line course offering via Distance Education).

YTH 530. Youth in Cultural Contexts.

(3-0) Cr. 3. F.S.

Examination of the cultural context factors that affect youth from a holistic perspective within and outside the family unit. The course will provide an understanding of the cultural heritage of differing family structures and types. Students will explore the social and educational processes experienced by youth through in-depth reading, writing, discussion, critical listening, viewing of contemporary videos, and informal interviews with youth. Students will be encouraged to think critically about society and culture, gain further knowledge of how ethnic groups fit historically into society, and examine the results of how history has shaped the current cultural climate of the U.S. (on-line course offering via Distance Education).

YTH 540. Youth Professionals as Consumers of Research.

(3-0) Cr. 3. F.S.

This course will help youth development professionals understand and evaluate research reports to reduce anxiety about applying research results and theories to practice. Specific emphasis will be on research and theory reports related to youth development. (on-line course offering via Distance Education).

YTH 550. Youth Policy.

(3-0) Cr. 3. F.S.

Various federal and state policies designed specifically for youth. Students will examine how and why policies for youth are constructed. A guiding question that will be used to evaluate existing state and national policies is whether they contribute to, or act as, barriers to desired developmental outcomes. (on-line course offering via Distance Education).

YTH 570. Contemporary Youth Issues.

(3-0) Cr. 3. Repeatable. F.S.SS.

Issues faced by youth today and associated risk and resiliency factors. A different topic will be presented each year, with the course rotating among participating universities. Past topics have included Youth Violence, Youth and Appearance, Adolescent Health, Global Perspectives and Volunteerism. The course may be taken more than once, as long as the content is different each time. (on-line course offering via Distance Education).

YTH 580. Administration and Program Management.

(3-0) Cr. 3. F.S.

This course will introduce students to the development, administration and management of youth-serving organizations. (on-line course offering via Distance Education).

YTH 585. Program Design, Evaluation and Implementation.

(3-0) Cr. 3. F.S.

Theoretical, methodological, and pragmatic issues involved in conducting programs and scholarship. Overview of the program development process and outcome evaluation of children and family programs. Modes of outcome scholarship and their implications for community-based programs are discussed. Students will develop knowledge through participating in a community-based project involving the practical application of program design and evaluation methods. (on-line course offering via Distance Education).

YTH 599. Creative Component.

Cr. arr. Repeatable. F.S.SS.

Nonthesis students creative component (e.g., a special report, capstone course, integrated field experience, annotated bibliography, research project, design, or other creative endeavor). A minimum of five credits of independent work is required on the programs of study (POS). Creative component format determined cooperation with the POS committee. (on-line course offering via Distance Education). Offered on a satisfactory-fail basis only.

Courses for graduate students:

YTH 634. Youth Development.

(3-0) Cr. 3. F.S.

Introduction to the developmental period of adolescence. The theory and research of positive youth development will be the lens through which this developmental period is examined. The course will emphasize how the developmental tasks of this life stage are influenced by (and influence) family and home, school, peers, and other contextual forces. The course will help students recognize and become familiar with the major issues and transitions adolescents face as they successfully navigate this developmental stage by critically examining the theoretical and research literature. (on-line course offering via Distance Education).

YTH 690. Advanced Topics.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*

Advanced topics. (on-line course offering via Distance Education).

YTH 691. Internship.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of instructor.*

Supervised practice and experience in college teaching, research, professional experience. On-line course offering via Distance Education. Offered on a satisfactory-fail basis only.