

## Accounting and Finance

### **ACFI 844 - Topics in Advanced Accounting**

**Credits:** 3.00

Theory and practice of accounting for corporate acquisitions and mergers and the preparation and presentation of consolidated financial statements. Other topics include multinational consolidations, interim reporting and partnership accounting. Prereq: M.S. in Accounting.

### **ACFI 850 - Accounting Theory and Research**

**Credits:** 3.00

The objective of this course is to study the role of accounting information both in a decision-making and in a performance-evaluation context. This objective will be achieved by studying various accounting theories and the role that research has played in developing and testing those theories. Prereq: M.S. in Accounting.

### **ACFI #890 - Accounting Information Systems**

**Credits:** 3.00

Accounting information systems and the use of computers for decision making with emphasis on sources and types of information and the use of analytical tools in solving accounting management problems. Prereq: M.S. in Accounting.

### **ACFI 895 - Governmental and Non-Profit Accounting**

**Credits:** 3.00

Planning, budgeting, internal and external financial reporting for governmental entities and not for organizations including healthcare and educational institutions. Prereq: M.S. in Accounting.

### **ACFI 897 - Ethics and Professional Practices**

**Credits:** 3.00

The study of ethics as a significant and worthwhile endeavor that infuses all professional activities. Case work forms an integral part of the course. Analysis of situations of potential and actual ethical conflict and discussion of major ethical theories.

### **ACFI 898 - Master's Project**

**Credits:** 3.00

Master's project on a topic approved by the program director. Prereq: M.S. in Accounting.

## Administration

### **ADMN #807 - Multivariate Analysis**

**Credits:** 3.00

Applied multivariate analysis, with examples from business and economics research. Descriptive methods and classical inference methods are covered in the context of models and underlying assumptions. Computer programs are used and their output explained.

### **ADMN #812 - Managing Organizational Change**

**Credits:** 3.00

Conceptual and technical tools to manage the challenge of change, both unpredictable and predictable. Topics include the process of change; change strategies; change agent roles--internal and external; bases of resistance to change; coping with resistance. Prereq: organizational behavior or equivalent desirable.

### **ADMN #813 - Management Skills**

**Credits:** 3.00

Focuses on the role of the manager, particularly the interpersonal competencies required to work effectively with superiors and subordinates. Participants develop and critique their behavior in situations that involve interviewing, listening, delegation, conflict management, performance appraisal, and handling problem employees. May include writing, presentations, field study, and videotaping.

### **ADMN 820 - Tax Planning for Business**

**Credits:** 3.00

Provides coverage of advanced topics from a strategic viewpoint and an understanding of the history and development of taxation, the role taxes play in financial and managerial decisions, and how taxes motivate people and institutions. The major tax issues inherent in business and financial transactions and their consequences are also explored.

### **ADMN 823 - Topics in Finance**

**Credits:** 3.00

Prereq: financial management.

### **ADMN #824 - Resource Management**

**Credits:** 3.00

Analysis and development of resource management planning and control systems. Topics include inventory management, material requirements planning, and capacity management.

### **ADMN #825 - Manufacturing Management**

**Credits:** 3.00

Analysis and development of manufacturing management planning and control systems. Topics include production planning, master scheduling, distribution, and production activity control.

### **ADMN 826 - Decision Support Systems**

**Credits:** 3.00

Exploration of computer usage in support of the problem-solving and decision-making process. Topics include conceptual foundations of decision-support systems, design of decision-support systems, spreadsheets, databases, and expert systems. Use of mainframe and microcomputers, cases, projects; guest speakers.

### **ADMN #827 - Topics in Accounting**

**Credits:** 3.00

Special topics.

### **ADMN 829 - Financial Policy**

**Credits:** 3.00

Analytical tools and practical skills for recognizing and solving complex problems of business finance. Working-capital management; capital budgeting; cost of capital; capital structure; dividend policy.

### **ADMN 830 - Investments Analysis**

**Credits:** 3.00

Security analysis, efficient market hypothesis, portfolio theory, and alternative investments.

### **ADMN 831 - Derivative Securities and Markets**

**Credits:** 3.00

Derivative assets and markets, and their role in business decision-making and portfolio management. Emphasis on practical and theoretical aspects of hedging and speculating using futures and options for both commodities and financial assets, including their market mechanics.

### **ADMN 832 - Exploration in Entrepreneurial Management**

**Credits:** 3.00

Examination of the management of change and innovation with particular attention to the role of the entrepreneur in the management of new ventures. Characteristic behavioral, organizational, financial, and marketing problems of entrepreneurs and new enterprises.

### **ADMN 834 - Private Equity/Venture Capital**

**Credits:** 3.00

Covers the financial aspects of new venture creation. Early stage private equity market and mechanisms available for financing the entrepreneurial venture, from seed and startup financing to initial public offering. Includes financing stages from both entrepreneur's and the investor's perspective. Focuses primarily on U.S. market, but also covers Europe and Asia.

### **ADMN 836 - Financial Statement Analysis**

**Credits:** 3.00

The empirical properties of financial statement data and evidence of its ability to predict such events as security returns, corporate restructuring, debt ratings, and financial distress. An empirical research project using computer data banks is required.

### **ADMN 837 - Financial Accounting Theory and Applications I**

**Credits:** 3.00

Theory and practice of income measurement and asset valuation; consolidations, partnerships, leases, pensions, price-level reporting, foreign currencies, and fund accounting. Not available to M.S. in Accounting students.

### **ADMN #839 - Financial Accounting Theory and Applications II**

**Credits:** 3.00

Theory and practice of income measurement and asset valuation; consolidations, partnerships, leases, pensions, price-level reporting, foreign currencies, and fund accounting. Not available to M.S. in Accounting students.

### **ADMN 840 - International Business**

**Credits:** 3.00

Issues and problems confronting managers in the international economy. Emphasis on problems of working across national borders rather than on those encountered within the framework of different national economies, cultures, and institutions. for managers working in a multinational enterprise.

### **ADMN 841 - International Management**

**Credits:** 3.00

Develops an understanding of international business from the point of view of management and leadership, human resource management, and organizational structure and change. Emphasis on cultural impact on management thinking and business practice and on skills for managing effectively in international and multicultural environments.

**ADMN #842 - Time Series Analysis****Credits:** 3.00

The role of time series analysis in operational forecasting is examined. Modern time series models and studied, with particular emphasis on Box-Jenkins methods. Computer programs are used and their output examined. Prereq: introduction to statistics. (Also offered as ECON 828.)

**ADMN #843 - Regressions Analysis****Credits:** 3.00

Regression analysis is studied as an applied statistical methodology, with a blend of underlying theory. Emphasis is on inference, diagnostic checking of assumptions, and remedial measures.

**ADMN #844 - Simulation for Business Decision Making****Credits:** 3.00

Provides the student hands-on experience with simulation model development and use in a decision making context. Both Monte-Carlo simulation and discrete-event simulation will be covered using commercial software packages. Emphasis will be on the foundations of simulation, design and development of the model, verification and validation, use of the model in decision making, and communication of the key insights. A student-defined project is an integral part of the course.

**ADMN 846 - International Financial Management****Credits:** 3.00

Financial management problems facing multinational firms. Focus on effects of currency denominations on financial decisions.

**ADMN 847 - Business Taxation****Credits:** 3.00

Taxation factors relevant to business decisions. Emphasis on federal income taxation from the viewpoint of the firm. Prereq: financial and managerial accounting.

**ADMN 848 - Law: Use and Application in Business****Credits:** 3.00

Use and understanding of law as it applies to business judgment and policy decision making; basic legal rules and their application. Contracts, corporations, agencies, partnerships, administrative agencies, commissions, and other related business matters. Case-method teaching with outside research.

**ADMN 851 - Advertising and Promotion****Credits:** 3.00

Advertising, personal selling, and other promotional tools to help solve marketing problems; advertising as a medium of communication and as a social-cultural force in the Western world.

**ADMN 852 - Marketing Research****Credits:** 3.00

Identification, collection, and analysis of data for the marketing process. Strengths, limitations, environment, and evaluation of research in the marketing process.

**ADMN #854 - Seminar in Accounting and Finance****Credits:** 3.00

Seminar discussions of advanced readings in accounting and finance. For second-year M.B.A. students.

**ADMN 855 - Marketing of Services****Credits:** 3.00

Managerial aspects of the design, development, positioning, and implementation of intangible offerings (services). Theory and application to private, public, nonprofit, and commercial enterprises with local, national, and international perspectives. Discusses service quality attainment and maintenance both internally and competitively. Round-table

discussions, student presentations, and service marketing project. Text, cases, speakers.

### **ADMN #858 - Strategic Management of Operations**

**Credits:** 3.00

Review and application of operations management techniques and methodologies for the development of operations strategies. Team projects with client firms including operations analyses leading to recommendation for developing the firm's strategic operations posture. Prereq: ADMN 940.

### **ADMN 859 - Managing Technological Innovations**

**Credits:** 3.00

This course explores the formulation of technological innovation strategy by using case-based examples and technological frameworks to identify industry- and firm-level patterns of innovation and organizational characteristics that promote innovativeness.

### **ADMN 863 - International Marketing**

**Credits:** 3.00

Environmental factors affecting international trade: culture and business customs, political and legal factors and constraints, economic and technological development, and the international monetary system. Integration of these with the marketing management functions of market research and segmentation; product, promotion, distribution, and pricing decisions.

### **ADMN 865 - Total Quality Management**

**Credits:** 3.00

Integration of management aspects of quality improvement with methodologies and tools for problem-solving and implementation. Experiential team projects and hands-on in-class exercises are used to supplement and enhance extensive written and video cases, facility tours, and guest speakers. Prereq: ADMN 940 and 912.

### **ADMN #867 - Art and Science of Decision Making**

**Credits:** 3.00

Explores the way individuals make decisions in organizational environments. Topics include traditional models of decision making, traps into which decision making falls, role of creativity in the generation of alternative choices, and negotiation--decision making with difficult opponents. Emphasis on the way in which the individual can become a better decision maker. The influence of national culture is examined. Course format involves several texts, readings, and the requirement that students maintain a daily decision journal.

### **ADMN #885 - Career Management**

**Credits:** 3.00

Develops individual career management skills. Topics include concepts of career development and issues pertaining to career management in organizations. Helpful for students interested in human resource management.

### **ADMN 898 - Topics**

**Credits:** 2.00 to 3.00

Special topics; may be repeated. Prereq: consent of adviser and instructor.

### **ADMN 900 - Integrative Management Seminar**

**Credits:**

Extends throughout first year of the Executive M.B.A. Program. Material and topics not offered in regular courses are offered here, as are distinguished speakers from business and government, field trips, issues of immediate concern. Cr/F. (Executive M.B.A. program only.) Program fee.

### **ADMN 902 - Integrative Management Seminar**

**Credits:**

Provides an intensive orientation and introduction to the practical and academic aspects of the full-time MBA program during a four week residency period. Analytical problem solving, effective communication skills, team dynamics, and exposure to various aspects of business and MBA education. Cr/F.

### **ADMN 905 - Integrated Team Projects I**

**Credits:** 3.00

Designed to enhance student's field and research experience. Students work with faculty and Corporate Roundtable members on projects that apply and integrate concepts learned in class.

### **ADMN 906 - Integrated Team Projects II**

**Credits:** 3.00

Designed to enhance student's field and research experience. Students work with faculty and Corporate Roundtable members on projects that apply and integrate concepts learned in class.

### **ADMN 907 - Basic Managerial and Statistical Concepts**

**Credits:** 3.00

Provides an orientation to the practical and academic aspects of the part-time MBA program during a four week period. Analytical problem solving, effective communication skills, team dynamics, and exposure to various aspects of business and MBA education.

### **ADMN 908 - Advanced Managerial Concepts**

**Credits:** 3.00

Provides an introduction to the topics of information systems, business ethics, and leadership and crisis management.

### **ADMN 909 - Information Systems Across the Enterprise**

**Credits:** 2.00 to 3.00

Provides an introduction to international management and information systems across the enterprise.

### **ADMN 910 - Business Forum**

**Credits:** 1.00

A forum to discuss current business topics presented by guest lecturers, faculty, and student groups. First and second year MBA students discuss internships, specializations/electives, group projects and employment. Whittemore School faculty members of the Corporate Roundtable are active participants in these monthly events. May be repeated.

### **ADMN 912 - Organizational Behavior**

**Credits:** 3.00

Develops an understanding of individual and work group dynamics in relation to personal and group effectiveness in diverse organizations. Includes: individual and group differences; work groups and teams; interpersonal communications; motivation and rewards; influence and empowerment; conflict resolution; management models; and leadership. Taught experientially. Special fee.

### **ADMN 914 - Integrated Field Project I**

**Credits:** 3.00

In-depth industry field project carried out in the fall semester with a member company of the Corporate Roundtable. The project is of sufficient scope to provide the students the opportunity to demonstrate a mastery of the competencies required in the program.

### **ADMN 915 - Integrated Field Project II**

**Credits:** 3.00

In-depth industry field project carried out in the winter semester with a member company of the Corporate Roundtable. The project will be of sufficient scope to provide students with the opportunity to demonstrate a mastery of the competencies required in the program.

### **ADMN 920 - Financial Accounting**

**Credits:** 3.00

Introduces students to the accounting discipline and develops financial statement literacy grounded in contemporary business issues. Develops an understanding of how and why economic events are recorded, communicated and evaluated. Consideration is also given to the roles of tax and compensation strategies in the business environment.

**ADMN 921 - Managerial Accounting****Credits:** 3.00

Builds on material covered in Financial Accounting. Enhances students' ability to acquire, analyze, and interpret decision, control, and financial performance information within a managerial, strategic, and systems framework in the context of rapid global change.

**ADMN #925 - Advanced Organizational Theory****Credits:** 3.00

Examines organizations as complex social systems, focusing on organizational structures as they relate to various functions, including rewards, controls, and decision making. Emphasis placed on the design of organizations for the future with special attention to rapid changes in technology and environmental factors.

**ADMN 926 - Management Information Systems****Credits:** 3.00

Provides students with the background to understand, develop, and use computer-based information systems in organizations. Five major topics are covered including: the information system framework; information technology; application software for managers; applications development; and management of information systems resources. The application software component covers the use of spreadsheets and relational database systems. Students participate in groups and are required to make several presentations during the semester. Prereq: M.B.A. student.

**ADMN 927 - Introduction to Information Systems****Credits:** 1.00 to 3.00

Introduces students to the role of information systems in management. Topics include: information technology and competitive advantage; information systems and organization; information economics; database management systems; and data communications and network management.

**ADMN 930 - Financial Management****Credits:** 3.00

Focuses on financial decision making to maximize shareholder value. Course concepts are integrated into the standard theories of risk and return, valuation of assets and market efficiency.

**ADMN 940 - Technology and Operations Management****Credits:** 3.00

Provides a foundation for dealing with managerial decisions about technology and operations issues. Based on the premise that technology and operations can be a significant source of competitive advantage for a firm. Prepares students to identify and implement operating improvements that directly affect firm performance.

**ADMN 950 - Managerial Statistics****Credits:** 2.00 or 3.00

Examines the role of statistics in the decision-making environment. Application of statistical procedures to practical problems, increasing ability to make and implement better managerial and business decisions. Probability; discrete, continuous distributions; sampling distributions; interval estimation; linear regression; quality control; hypothesis testing.

**ADMN 955 - Quantitative Business Analysis****Credits:** 3.00

Examines the role of quantitative models in the decision-making environment. Topics include general modeling and analysis principles; correlation and regression; forecasting, simulation, optimization. Emphasis on "art and science" of model building and analysis and application to business decision-making. Role of decision tools in information systems architecture.

**ADMN 960 - Marketing Management****Credits:** 3.00

Identification, development, and retention of markets for the goods and services offered by the firm. Attention is given

to the dynamics of demand and to the blending of the marketing mix.

**ADMN 970 - Economics**

**Credits:** 3.00

A study of economic principles useful to business managers. Microeconomic topics include market behavior, economic costs, and economic decision-making. Macroeconomic topics include macroeconomic performance, financial markets, international trade and finance, and monetary and fiscal policy.

**ADMN 981 - Business, Government, and Society**

**Credits:** 3.00

Analysis of contemporary forms in relation to changing external environments.

**ADMN 982 - Strategic Management: Decision Making**

**Credits:** 3.00

A "capstone" course, focused on industries, companies, and other organizations in operation, and studied through the role of the strategic manager and case examples, with emphasis on integration of materials covered in prior courses.

**ADMN 985 - Organizational Structure and Environments**

**Credits:** 3.00

Examines organizations as open systems whose effectiveness depends on the design of internal structures and culture to fit external demands, opportunities, and threats. Develops students' analytic and diagnostic skills as designers of ethical and socially responsible organizations. Topics include organizational environments; organizational structure-authority, control, specialization, coordination; creating and changing organizational culture; business-government influences, corporate governance, and ethics; managing organizational technology, and innovation; managing organizational life cycles and transformation.

**ADMN 992 - Special Projects and Independent Study**

**Credits:** 1.00 to 6.00

Projects, research, and reading programs in areas required for concentration. Sixty days advance approval of the student's plan of study by adviser and by proposed instructor required. Maximum of 6 credit, except by special permission. Variable credit.

## Animal Sciences

### **ANSC 801 - Physiology of Reproduction**

**Credits:** 4.00

Comparative aspects of embryology, anatomy, endocrinology, and physiology of reproduction. Special fee. Lab.

### **ANSC 802 - Endocrinology**

**Credits:** 4.00

Biochemical and molecular structure and function of vertebrate endocrine systems. Influence of endocrine systems physiology of vertebrates, with special reference to mammals. Current investigations of the endocrine system as a regulator and integrator of body functions including such systems as growth, reproduction, metabolism, differentiation, and behavior. Prereq: general biochemistry; principles of biochemistry;/ or permission. (Also offered as BCHM 802.) Special fee.

### **ANSC 804 - Principles of Pathobiology**

**Credits:** 4.00

Principles and mechanisms of disease at the cellular and tissue levels, including responses to cell injury, death and adaptation, inflammation, circulatory disturbances, disorders of the immune system, and neoplasia. Prereq: anatomy and physiology or permission.

### **ANSC 805 - Veterinary Microbiology and Zoonotic Disease**

**Credits:** 2.00

Clinical microbiological techniques using veterinary medical specimens. Along with the isolation and identification of bacterial, fungal and parasitic pathogens, the zoonotic potential of a variety of organisms is discussed. Prereq: permission of instructor.

### **ANSC 806 - Human Genetics**

**Credits:** 3.00

The genetic basis of human traits and diseases. New understanding added by molecular genetic approaches. Human genome project, gene therapy. Discussion of genetic components of quantitative and behavioral traits in human evolution. Also offered as GEN 806. (Not offered every year.)

### **ANSC 807 - Veterinary Histologic Techniques**

**Credits:** 2.00

Routine histologic techniques including tissue trimming, processing, sectioning, routine and specialized staining, lab safety, and troubleshooting skills are taught through small group discussions, demonstrations, and hands-on training. Prereq: permission of instructor.

### **ANSC 808 - Ruminology**

**Credits:** 2.00

Anatomy of the ruminant gastrointestinal tract, physiological factors related to rumen function, and microbial metabolism of carbohydrates, protein, and lipids. Prereq: general microbiology or equivalent.

### **ANSC 810 - Dairy Nutrition**

**Credits:** 4.00

Feeding and related management of dairy cows, nutrients and their use, digestive anatomy, physiology, energy systems, forage quality and conservation methods, metabolic disorders, ration balancing. Prereq: principles of nutrition; nutritional biochemistry or equivalent, permission.

**Co-requisites:**

### **ANSC 814 - Research Methods in Endocrinology**

**Credits: 5.00**

Principles of biochemical, cellular and molecular techniques and their applications to research in the endocrine system. Techniques include protein and nucleic acid assays, thin layer chromatography, radioimmunoassay, enzyme-linked immunosorbent assay, agarose and polyacrylamide gel electrophoresis, transfection, restriction analysis, plasmid amplification, RNA extraction, and dot-dot hybridization. Eight lab reports required with the option of doing a ninth. Prereq: physiology of reproduction or general biochemistry or endocrinology; permission. Special fee. Lab.

**ANSC 815 - Physiology of Lactation****Credits: 4.00**

Examines the biological and biochemical influences of the lactation process. Emphasis on the physiological effects of environments, hormones, and nutrition on milk synthesis and secretion, mammary physiology, and maternal response. Prereq: physiology of reproduction, permission.

**ANSC 818 - Mammalian Physiology****Credits: 4.00**

Advanced study of the systems that control mammalian functions with emphasis on cellular and molecular mechanisms. Includes the nervous, muscular, cardiovascular, renal, gastrointestinal, and endocrine systems. Prereq: human anatomy and physiology, principles of animal physiology, one semester of biochemistry, or permission.

**ANSC 824 - Reproductive Management and Artificial Insemination****Credits: 4.00**

Focus on goals and fundamentals of reproductive management of horses, dairy and livestock animals, and, through experience, development of competency in performing modern breeding techniques for equine or bovine reproduction. Prereq: physiology of reproduction and permission. Special fee. Lab.

**ANSC 827 - Advanced Dairy Management I****Credits: 4.00**

Advanced management evaluation of milking procedures, reproduction, nutrition, mastitis, and calf and heifer management. Prereq: principles of nutrition, permission.

**ANSC 828 - Advanced Dairy Management II****Credits: 4.00**

Advanced management evaluation of dairy cattle, housing milking equipment, milk quality, record keeping, herd health, financial, personnel management, environmental issues. Visits to farms in the area to provide critical assessments of dairy farm businesses. Prereq: advanced dairy management I, permission.

**ANSC 850 - Nutritional Biochemistry****Credits: 4.00**

Study of the digestion, absorption, transport, and utilization of food nutrients from a biochemical perspective. Emphasis on the role of macro- and micronutrients as substrates and catalysts for metabolic pathways, and the role of these pathways in maintaining human health at the cellular, organ, and whole body levels. Prereq: general biochemistry. (Also offered as NUTR 850.)

**ANSC 851 - Cell Culture****Credits: 5.00**

Principles and technical skills fundamental to the culture of animal and plant cells, tissues and organs. Introduction to the techniques of subculturing, establishing primary cultures, karyotyping, serum testing, cloning, growth curves, cryopreservation, hybridoma formation and monoclonal antibody production, and organ cultures. An interdisciplinary course with emphasis on the application of cell culture to contemporary research in the biological sciences. Prereq: general microbiology; permission. (Also offered as MICR 851 and PBIO 851.) Lab.

**ANSC 854 - Molecular Diagnostics****Credits: 4.00**

To introduce advanced undergraduate and graduate students in chemistry, biochemistry, molecular biology, medical laboratory science, physics, and engineering to the basic concepts and principles of biotechnology-based diagnostic

and detection methods. These include immunoassay, nucleic acid probes, biosensors, and microarrays. Also introduces advanced students to the basic concepts of applied R & D and product development. Provides a fundamental understanding of biotechnology-based diagnostic methods and the basic steps necessary to develop a product based on a laboratory concept.

**ANSC 895 - Investigations**

**Credits:** 1.00 to 4.00

Investigations in genetics, nutrition, management, diseases, histology, equestrian management/agribusiness, physiology, cell biology, microbiology, dairy management, or teaching experience. May be repeated. Prereq: permission.

**ANSC 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Master's students must enroll for a total of 6 credits of this course. Students may enroll in 1-6 credits per semester. Permission required. Cr/F.

**ANSC 900 - Contemporary Topics in Animal, Nutritional, and Biomedical Sciences**

**Credits:** 1.00

An informal forum for graduate students to gain experience in evaluating the current literature of a contemporary topic. (Also offered as NUTR 900.) May be repeated for a maximum of 2 credits. Offered both fall and spring semesters. Cr/F.

**ANSC 901 - Philosophy and Practice of Research in the Life Sciences**

**Credits:** 4.00

Designed to acquaint graduate students with the theory, principles, facilities, and tools for understanding, designing, conducting, and communicating research in the life sciences. Readings and discussion on issues such as: What is research? How is it performed? How is validity determined? How are isolated findings integrated into a coherent system? What is the social context?

**ANSC 904 - Amino Acid Metabolism**

**Credits:** 2.00

Intermediary metabolism and interorgan transport of amino acids and nitrogenous compounds in the mammalian system. Prereq: ANSC 905. (Offered first half of the semester.)

**ANSC 906 - Methods in Protein Nutrition and Metabolism**

**Credits:** 2.00

Survey and evaluation of common techniques in the study of protein nutrition and metabolism. Prereq: ANSC 904. (Offered second half of the semester.)

**ANSC 909 - Contemporary Trends in Reproductive Physiology**

**Credits:** 4.00

Comprehensive survey of recent developments in the areas of comparative mammalian reproduction and animal biotechnology. Prereq: ANSC 801 or permission. May be repeated.

**ANSC 913 - Contemporary Topics in Immunobiology**

**Credits:** 2.00

Topical lectures, seminars, and assigned reading emphasizing recent advances in immunology. May be repeated for a maximum of 4 credits. (Offered in alternate years.)

**ANSC 995 - Nonthesis Investigations in Animal Science**

**Credits:** 1.00 to 4.00

Advanced investigations in a research project, exclusive of thesis project. Elective only after consultation with the instructor. May be repeated for a maximum of 4 credits. Offered both fall and spring semesters.

**ANSC 997 - Animal and Nutritional Sciences Seminar**

**Credits:** 1.00

Graduate student and faculty presentations on current topics in the animal, nutritional, and biomedical sciences. Most graduate students are expected to present one seminar per year, enroll in one semester of seminar credit per year, and attend all seminars during all semesters. May be repeated. Cr/F. (Offered both fall and spring

**ANSC 999 - Doctoral Research**

**Credits:**

Cr/F.

## Arts/History & Studio

### **ARTS 832 - Advanced Drawing**

**Credits:** 4.00

Complex compositional problems of image making will be addressed. Students will explore a broad range of solutions to pictorial problems to reinforce and expand individual concepts of image and technique. Along with structured in-class work, graduate students will be required to develop sustained out of class projects in consultation with the instructor. May be repeated for a total of 8 credits. Prereq: permission.

### **ARTS 846 - Advanced Painting**

**Credits:** 4.00

Development and refinement of technical skills leading to more advanced conceptual problems will be emphasized. Along with structured in-class work, graduate students will be required to develop sustained out of class projects in consultation with the instructor. May be repeated for a total of 8 credits. Prereq: permission.

### **ARTS 884 - Dutch Genre Painting**

**Credits:** 4.00

An intensive study of Dutch genre painting in the 17th century, focusing especially on the art of Vermeer and his contemporaries in the third quarter of the century. In addition to the individual artists and their works, attention will be paid to aspects of their social background such as the emergence of privacy and the nuclear family, to parallels with the early novel, and to general themes governing realism as an artistic mode. Prereq: one 400- or 500 level art history course and instructor's permission. (Also offered as ARTS 784).

### **ARTS #886 - European Colonialism and Visual Culture**

**Credits:** 4.00

An examination of the interrelationship of European colonialism and the visual arts from the late eighteenth to the twentieth century. The approaches of Said, Bhabha, Nochlin, Solomon-Godeau, Pinney, and others provide the theoretical foundation for unmasking the pictorial strategies and cultural biases in visual representations of non-European peoples and places. These visual representations and their dissemination will be studied in relation to imperial history and to the changing concepts of race, from Rousseau's "noble savage" to the racial "types" created for anthropology, ethnography, and geography.

### **ARTS 895 - Methods of Art History**

**Credits:** 4.00

Essential bibliography and the methodology of research; the variety of approaches to art historical scholarship. Readings, discussion, and projects in connoisseurship, iconography, and other art historical methods. Open to advanced students with a strong art history background. Prereq (for non-art history majors): permission. (Usually offered fall semester only.) Also offered as ARTS 795.

### **ARTS 897 - Seminar in Art History**

**Credits:** 4.00

Topics and prerequisites to be announced before preregistration. May be repeated with permission instructor. (Also offered as ARTS 799.)

### **ARTS 932 - Graduate Drawing**

**Credits:** 6.00

Structured to emphasize developing skills and to explore techniques to create invented and observed space. Drawing will be considered as an inventive tool to extend the students' repertoire of ideas. May be repeated for a total of 12 credits. Prereq: advanced drawing; permission.

### **ARTS 996 - Independent Study in the Visual Arts**

**Credits:** 1.00 to 6.00

C01 - Drawing; D01 - Painting; E01 - Printmaking; I01 - Art History. An opportunity for independent study in the above listed disciplines. The content and structure of the course will be developed through collaboration of the graduate student and the supervising faculty member. May be repeated for a total of 18 credits in any one area. Prereq: undergraduate degree in studio art and permission.

**ARTS 997 - Graduate Painting Thesis**

**Credits:** 10.00

The Graduate Painting Thesis is the culmination of the MFA student's graduate work in painting. The course requires: 1) continued work in the studio under supervision of graduate faculty; 2) a more formal midterm critique with graduate faculty (oral summarization of thesis work); 3) extensive work with The Art Gallery in preparation for the MFA Thesis Exhibition (including hanging the exhibition); 4) the thesis exhibition itself; and 5) an oral presentation to the faculty during the thesis exhibition.

**ARTS 998 - Graduate Painting Seminar**

**Credits:** 6.00

Students will meet on a weekly basis with the instructor focusing on and expanding their awareness of the artist's place in the world at the end of the 20th century. Readings, presentations, gallery and museum visits, discussions, and critiques will be required. Prereq: acceptance to MFA program.

## Biochemistry

### **BCHM 802 - Endocrinology**

**Credits:** 4.00

Biochemical and molecular structure and function of vertebrate endocrine systems. Influence of endocrine systems on the physiology of vertebrates, with special reference to mammals. Current investigations of the endocrine systems as a regulator and integrator of body functions including such systems as growth, reproduction, metabolism, differentiation, and behavior. Prereq: general biochemistry or principles of biochemistry;/ or permission. (Also offered as ANSC 802.) Special fee.

### **BCHM 811 - Genomics and Bioinformatics**

**Credits:** 4.00

The methods, applications, and implications of genomics--the analysis of whole genomes. Microbial, plant and animal genomics are addressed, as well as medical, ethical and legal implications. The lab provides exposure and experience of a range of bioinformatics approaches--the computer applications used in genome analysis. Prereq: Principles of Genetics. (Also offered as GEN 811 and MICR 811.) Lab.

### **BCHM 850 - Physical Biochemistry**

**Credits:** 3.00

Structure, interactions, and physical-chemical properties of biomolecules. Thermodynamic, kinetic, and spectroscopic methods for the study of proteins and nucleic acids. Prereq: 2 semesters organic chemistry, 1 semester of calculus;/ or permission.

### **BCHM 851 - Principles of Biochemistry**

**Credits:** 4.00

In-depth survey of biochemistry: macromolecule structure; structure and function of proteins, nucleic acids, carbohydrates, and lipids. Prereq: organic chemistry, general biochemistry or permission.

### **BCHM 852 - Principles of Biochemistry**

**Credits:** 4.00

Continuation of in-depth survey of biochemistry: metabolism of amino acids, nucleotides, carbohydrates and lipids; macromolecules synthesis and regulation; molecular biology of the eukaryotic cell. Prereq: BCHM 851 or permission.

### **BCHM 854 - Laboratory in Biochemistry and Molecular Biology of Nucleic Acids**

**Credits:** 5.00

Application of modern techniques to the analysis of biomolecules, with an emphasis on nucleic acids; includes DNA isolation and analysis, cloning and sequencing and analysis of gene products. No credit if credit has been received for microbial genetics. Prereq: general biochemistry, principles of biochemistry or permission. (Also offered as GEN 854 and PBIO 854.) Special fee. (Not offered every year.)

### **BCHM 855 - Laboratory in Biochemistry and Molecular Biology**

**Credits:** 5.00

Application of modern techniques to the characterization and purification of biomolecules, with an emphasis on proteins and nucleic acids; analysis of enzyme kinetics; and basic techniques used in molecular biology. Prereq: BCHM 851-852;/ or permission. BCHM 852 may be taken concurrently with BCHM 855. Special fee.

**Co-requisites:**

### **BCHM 861 - Cell Signaling Transduction in Health and Disease**

**Credits:** 3.00

Signal transduction and the regulation of metabolism, cell growth, and cellular activation. Emphasis will be on the molecular basis of cellular communication, sensory signal transduction and cancer. Prereq: principles of or general

biochemistry;/ or permission.

### **BCHM 863 - Biochemistry of Cancer**

**Credits:** 3.00

Molecular mechanisms of viral and chemical carcinogenesis; role of oncogenes in normal cell growth, development, and differentiation. Biochemical basis of cancer chemotherapy. Critical reviews of research papers and an advanced research paper required. Prereq: general biochemistry or BCHM 851 or permission. Credit/Fail.

### **BCHM 866 - Environmental Genomics**

**Credits:** 4.00

The field of environmental genomics uses existing and developing high throughput genomic-scale technologies to investigate ecological and evolutionary theory, and so provides a more complete understanding of how organisms respond to environmental change at the molecular genetic level. Course covers an array of systems involved in this emerging field, with the central aim of understanding the effects of environmental change on genome structure, gene expression, and adaptive evolutionary change. Information is derived from the primary literature in the field and covers practical and technical concepts as well as the underlying theoretical basis for the major research themes. Prereq: principles of genetics;/ or permission. (Also offered as GEN 866.)

### **BCHM 871 - Molecular Genetics**

**Credits:** 4.00

Structure, organization, replication, dynamics, and expression of genetic information in eukaryotes. Focus on molecular genetic mechanisms of gene expression and its control; molecular genetics methods; molecular genetic control of cell division and differentiation during development. Prereq: a general biochemistry or principles of biochemistry course; a course in principles of genetics;/ or permission. (Also offered as GEN 871.)

### **BCHM 882 - Developmental Genetics**

**Credits:** 3.00

The molecular genetic basis of metazoan development. Course focuses on how genes direct the process of development and how this problem is analyzed in model organisms using molecular genetic approaches. Topics include: control of cell division, maternal factors, cell-cell interactions, differential gene expression. Prereq: principles of genetics. (Also offered as GEN 882.)

### **BCHM 890 - Current Topics in Biomedicine**

**Credits:** 4.00

The dramatic advances in molecular biology and biochemistry during the last two decades have led to explosive growth in the accumulation of biomedical knowledge. To "discover" the literature is an essential element of training in any molecular discipline in biology. The first phase of the course will cover the use of literature search tools, and how to read scientific papers, write a review and make presentations effectively. The bulk of the time will be spent on current topics in biomedicine selected by the class. With guidance from the instructor, the class will derive reading lists, discuss the literature, and then write short essays on each topic. Participants will also prepare a "term" project for audiovisual presentation to the class in the final two weeks. Prereq: BCHM 751 or instructor permission.

### **BCHM 894 - Protein Structure and Function**

**Credits:** 4.00

Analysis of how the three-dimensional architecture of soluble and membrane proteins contributes to their biochemical function. Topics include methods for determining the structure of proteins, protein folding, protein targeting, and mechanisms of enzyme catalysis. Computer resources will be used for protein modeling and structural prediction. Prereq: general biochemistry or principles of biochemistry.

### **BCHM 895 - Investigations**

**Credits:** 1.00 to 4.00

Independent study in various areas including but not limited to: genetics, signal transduction, gene regulations, molecular evolution, biochemistry of cancer, biophysics of macromolecules, endocrinology, and glycobiology. May include readings, laboratory work, organized seminars and conferences. Prereq: permission. Not more than 4 total credit

hours can be applied to BCHM or major electives.

**BCHM 899 - Master's Thesis**

**Credits:** 1.00 to 10.00

Cr/F.

**BCHM 902 - Endocrine Disruptors/Neuroendocrinology**

**Credits:** 3.00

Biochemical and molecular mechanisms of neurohormones; endocrine disruptors, mechanisms of actions of chemicals mimicking or interfering with the action of hormones; potential health effects of endocrine disrupting chemicals; developmental neuroendocrinology; gene regulation by hormones.

**BCHM 942 - Biochemical Regulatory Mechanisms**

**Credits:** 3.00

Nonreplicative functions of DNA; transcription and translational control of protein synthesis; quantitative regulation of proteins; regulation of metabolism by hormones, allosteric regulation and repression; regulatory mechanisms operating during development and differentiation. Prereq: BCHM 852 or permission. (Also offered as GEN 942.)

**BCHM 950 - Macromolecular Interactions**

**Credits:** 3.00

Interactions between macromolecules are central to all biological processes. Focuses on the structures and energetics that underlie these processes. Topics include self-associations, hetero assembly, cooperativity, ligand linkage and methods for their analysis. Prereq: physical chemistry I, II or BCHM 850. May be repeated.

**BCHM 960 - Advanced Topics in Signal Transduction**

**Credits:** 3.00

Examination of current topics in signal transduction mechanisms, with emphasis on sensory transduction. Pathways involving receptor activation, G-protein activation, regulation of effector enzymes, and changes in second messengers covered, along with mechanisms for short- and long-term desensitization of cellular responses. Prereq: BCHM 860 or permission.

**BCHM #991 - Advanced Topics in Molecular Genetics**

**Credits:** 3.00

Selected topics of current research in molecular genetics including gene structure and function, chromosome structure, and gene expression. Emphasis on eukaryotic model organisms such as worms, flies, zebra fish and mice. Prereq: permission. (Also offered as GEN 991.) May be repeated to a maximum of 6 credits. Cr/F.

**BCHM #992 - Advanced Topics in Molecular Biology**

**Credits:** 3.00

Selected topics of current research on the molecular biology of gene regulation, protein interaction, and the AIDS virus. Emphasis on eukaryotic systems such as yeast and mammals. Prereq: permission. (Also offered as GEN 992.) May be repeated to a maximum of 6 credits. Cr/F.

**BCHM #993 - Advanced Topics in Enzyme Regulatory Mechanisms**

**Credits:** 3.00

Selected topics of current research in the molecular basis of enzyme regulation. Emphasis on biochemical and molecular biological approaches to determining the mechanisms by which key regulatory enzymes are controlled. Prereq: permission.

**BCHM 997 - Seminar**

**Credits:** 1.00

Prereq: permission. Cr/F.

**BCHM 998 - Seminar**

**Credits:** 1.00

Prereq: permission. Cr/F.

**BCHM 999 - Doctoral Research**

**Credits:**

Cr/F.

## **Biology**

### **BIOL 811 - Applied Biostatistics II**

**Credits:** 4.00

### **BIOL 895 - Biology Special Investigations**

**Credits:** 1.00 to 4.00

### **BIOL 896 - Special Investigations**

**Credits:** 1.00 to 4.00

## Chemical Engineering

### **CHE 801 - Introduction to Polymer Engineering**

**Credits:** 4.00

Principles of polymer chemistry, polymerization kinetics, polymer rheology, and material characteristics. Design and analysis of polymer reactors, extruders, molding machines, and other forming operations. Lab.

### **CHE 805 - Natural and Synthetic Fossil Fuels**

**Credits:** 4.00

Study of the U.S. and foreign reserves of coal, oil, and natural gas. Petroleum processing and refining. Coal, oil, shale, and tar sand. Gasification and liquefaction of coal. Lab. (Not offered every year.)

### **CHE 809 - Fundamentals of Air Pollution and Its Control**

**Credits:** 4.00

The origin and fate of air pollutants. Fundamentals of atmospheric meteorology, chemistry, and dispersion phenomena. Control of air pollutants and the related equipment. Current issues. Prereq: differential equations with linear algebra; general chemistry. Lab.

### **CHE 812 - Introduction to Nuclear Engineering**

**Credits:** 4.00

Development of nuclear reactors; binding-energy; radioactivity; elements of nuclear reactor theory; engineering problems of heat transfer, fluid flow, materials selection, and shielding; environmental impacts. (Not offered every year.)

### **CHE 844 - Corrosion**

**Credits:** 4.00

Fundamentals of corrosion processes in industrial and environmental settings; thermodynamics, kinetics, and mass transport in local corrosion cells; protection by electrochemical, chemical, surface modification, or barrier methods; instrumental methods in corrosion science. Lab. (Not offered every year.)

### **CHE 851 - Process Simulation and Optimization**

**Credits:** 4.00

Techniques for computer-aided analysis of chemical processing systems. Development of mathematical models to describe process behavior. Application of optimization techniques. Prereq: knowledge of FORTRAN programming. Lab. (Not offered every year.)

### **CHE 852 - Process Dynamics and Control**

**Credits:** 4.00

Dynamic behavior of chemical engineering processes described by differential equations; feedback control concepts and techniques; stability and analysis. Lab.

### **CHE #854 - Graphical, Numerical, and Finite Element Applications in Chemical Engineering**

**Credits:** 4.00

Computational methods for solving differential equations resulting from the modeling of a process or physical phenomenon. Graphical display of results of data and curve-fitted equations. Use of interactive graphics and the solution of boundary-value problems. Applications of finite element analysis and discussion of other software available. Prereq: permission; knowledge of FORTRAN programming. (Not offered every year.)

### **CHE 861 - Biochemical Engineering**

**Credits:** 4.00

Immobilized enzyme technology, microbial biomass production, transport phenomena in microbial systems, biological

reactor design, process instrumentation and control, applications in separation and purification processes. Lab. (Not offered every year.)

### **CHE 862 - Biomedical Engineering**

**Credits:** 4.00

Transport phenomena and chemical reactions in physiological systems. Formulation and interactions of biomaterials. Artificial kidney, vascular prosthesis, drug delivery, protein and cell adhesion. Introduction to tissue engineering. Lab.

### **CHE 872 - Physicochemical Processes for Water and Air Quality Control**

**Credits:** 4.00

Origin and characterization of pollutants. Controls, including filtration, sedimentation, coagulation and flocculation, absorption and adsorption. Applied fluid mechanics, mass transfer, and kinetics. Thermal pollution, chemical treatment, oil spills on water, and aeration. Lab. (Not offered every year.)

### **CHE 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Cr/F.

### **CHE #904 - Radiative Heat Transfer**

**Credits:** 3.00

Heat transmission in high-temperature operations and interaction of radiative and other transport mechanisms; radiation geometry; application of matrix algebra to radiative transfer in enclosures; zoning methods of temperature measurements. Analytical and empirical approximations of engineering use. Quantitative design of several furnaces and high-temperature systems. (Not offered every year.)

### **CHE 913 - Advanced Fluid Mechanics**

**Credits:** 3.00

Basic equations describing behavior of static and dynamic fluid systems. The equations of motions and application to laminar and turbulent flow. Momentum and energy equations for advanced problems associated with flow inside conduits. Flow of compressible fluids and boundary layer phenomena.

### **CHE #914 - Fluidization Engineering**

**Credits:** 3.00

Fluidization regimes, fluid mechanics of particle suspensions, motion of single and multi-bubbles in fluidized beds. Heat and mass transfer and gas solid reactions in fluidized beds. Applications in design of noncatalytic reactors and heat transfer equipment. (Not offered every year.)

### **CHE 915 - Heat Transfer**

**Credits:** 3.00

Steady-state and transient heat conduction in solids; heat convection; analytical solutions, similarity relations, boundary layer methods; radiation.

### **CHE 916 - Diffusive Mass Transfer**

**Credits:** 3.00

Physical aspects of diffusion; theories of diffusion in dilute gases, dense gases, liquids, and solids; surface diffusion; mixing processes. Simultaneous heat and mass transfer.

### **CHE 923 - Advanced Chemical Engineering Thermodynamics**

**Credits:** 3.00

The multicomponent open system; the volumetric and phase behavior of pure substances and of multicomponent systems at physical and chemical equilibrium, fugacity and activity; thermal properties of equilibrium, chemically reacting systems; introduction to statistical thermodynamics.

### **CHE 932 - Advanced Chemical Engineering Kinetics**

**Credits:** 3.00

Specialized applied kinetics problems; catalysis; fast reaction and shock tubes; combustion and detonation processes; nonisothermal kinetics; heat and mass transfer in nonequilibrium, chemically reacting systems.

**CHE #990 - Literature Report**

**Credits:** 1.00

Instruction in the use of the library for chemical engineering research, culminating in the preparation of a literature report on a topic of mutual interest to the student and the chemical engineering faculty.

**CHE 996 - Graduate Independent Study**

**Credits:** 2.00 to 4.00

Directed reading or investigation at the advanced level on topics in chemical engineering.

**CHE 999 - Doctoral Research**

**Credits:**

Cr/F.

## Chemistry

### **CHEM 800 - Chemistry Teaching Seminar**

**Credits:** 1.00

Introduction for graduate students to their role as chemistry teaching assistants: professional responsibilities, safety, and ethics; theory-based teaching, learning, and assessment; reflective practice. Presemester sessions and periodic seminars during semester. Cr/F.

### **CHEM 808 - Spectroscopic Investigations of Organic Molecules**

**Credits:** 1.00 to 4.00

Selected instrumental and chemical methods used in chemical research for the separation, identification, and structural analysis of chemical compounds. Typical topics include mass spectroscopy, NMR spectroscopy, IR and UV spectroscopy, and chromatographic methods.

### **CHEM 855 - Advanced Organic Chemistry**

**Credits:** 3.00

An overview of organic chemistry at the intermediate levels. Aspects of synthetic organic chemistry and physical organic chemistry, including stereochemistry, are covered.

### **CHEM 862 - Instrumental Methods of Chemical Analysis**

**Credits:** 3.00

Theory, instrumentation, and application of methods such as atomic absorption, coulometry, emission spectrography, gas and liquid chromatography, IR and UV-VIS absorption spectrophotometry, and mass spectrometry to chemical analysis. Prereq: quantitative analysis; physical chemistry as a pre- or co requisite;/ or permission.

### **CHEM 874 - Inorganic Chemistry**

**Credits:** 3.00

Intermediate level overviews of modern inorganic chemistry including structure, bonding, and reactivity. Prereq: organic chemistry; physical chemistry;/ or permission.

### **CHEM 876 - Physical Chemistry III**

**Credits:** 3.00

Application of quantum theory to atomic electron structure, spectroscopy, and molecular structure. Lab.

### **CHEM 895 - Special Topics**

**Credits:** 2.00 to 4.00

New or specialized topics not covered in regular course offerings. May be repeated. Prereq: permission. Lab.

### **CHEM 899 - Thesis/Problems**

**Credits:** 1.00 to 10.00

Conferences, library, and experimental work in some field of chemistry. Cr/F.

### **CHEM 901 - Theoretical Organic Chemistry I**

**Credits:** 4.00

Advanced treatment of organic reaction mechanisms and related topics.

### **CHEM 902 - Theoretical Organic Chemistry II**

**Credits:** 3.00

A continuation of CHEM 901.

### **CHEM 903 - Advanced Inorganic Chemistry I**

**Credits:** 3.00

Survey of important advanced topics in concepts of modern inorganic chemistry.

**CHEM 904 - Advanced Inorganic Chemistry II**

**Credits:** 3.00

Advanced topics for students after CHEM 903: transition metal reaction mechanisms; organometallic chemistry. Overview of current trends in inorganic research.

**CHEM 905 - Advanced Physical Chemistry I**

**Credits:** 3.00

Introduction to topics in quantum mechanics and group theory, which form the background of all areas of modern chemistry. (Not offered every year.)

**CHEM #906 - Advanced Physical Chemistry II**

**Credits:** 3.00

Wave mechanics and quantum chemistry, spectroscopy, molecular structure, and statistical thermodynamics. Prereq: one year of physical chemistry. (Not offered every year.)

**CHEM 907 - Introduction to Research**

**Credits:** 2.00

Introduces the doctor of philosophy student to the planning, experimental methods, and interpretation of a research problem. Student presents and defends an original research proposal before a faculty committee. Must be completed satisfactorily by all doctoral students. Cannot be used for credit by master of science candidates. Cr/F.

**CHEM #908 - Applied Multi-Nuclear Magnetic Resonance Spectroscopy**

**Credits:** 3.00

Survey of basic theory, instrumentation, and practical techniques of NMR spectroscopy; interpretation of 1D and 2D hydrogen-1 and carbon-13, and multinuclear NMR spectra of organic, inorganic, and organometallic compounds in the solution of problems of structure and dynamics. Prereq: a knowledge of basic NMR at the undergraduate level.

**CHEM 911 - Synthetic Organic Chemistry I**

**Credits:** 3.00

Fundamentals of synthetic organic methodology and applications in multiple syntheses. Fourth hour recitation session.

**CHEM 917 - Special Topics in Organic Chemistry**

**Credits:** 2.00 to 4.00

Advanced courses dealing with specialized subdisciplines of organic chemistry.

**CHEM 918 - Special Topics in Organic Chemistry**

**Credits:** 2.00 or 3.00

See description for CHEM 917.

**CHEM 926 - Physical Chemistry of Solutions**

**Credits:** 3.00

Thermodynamics and kinetics of solution chemistry. (Not offered every year.)

**CHEM #927 - Theoretical Chemistry I**

**Credits:** 3.00

**CHEM 930 - Advanced Optical Methods**

**Credits:** 3.00

Techniques of chemical identification and analysis utilizing optical instrumentation from the standpoint of theory and application. Topics include UV-visible absorption, luminescence, atomic spectroscopy, IR, NMR, x-ray methods, and mass spectrometry. Prereq: CHEM 935 or permission. (Not offered every year.)

**CHEM 931 - Advanced Electrochemical Methods****Credits:** 2.00

Theory and application of important electrochemical techniques such as potentiometry, polarography, and voltammetry. Prereq: CHEM 935 or permission. (Not offered every year.)

**CHEM #932 - Statistics and Experimental Design****Credits:** 2.00

Confidence intervals, analysis of variance, regression analysis, sampling statistics, optimization procedures. Examples are drawn primarily from the analytical chemistry literature. (Not offered every year.)

**CHEM 933 - Chemical Separations****Credits:** 3.00

The use of various separation techniques prior to analysis; separations as methods of analysis. Prereq: CHEM 934 or permission. (Not offered every year.)

**CHEM 934 - Chemical Equilibria****Credits:** 3.00

Formulation and solution of chemical equilibrium problems of relevance to analytical chemistry. (Not offered every year.)

**CHEM 935 - Analytical Instrumentation****Credits:** 3.00

Introductory electronics for chemists. Emphasis placed on how electronic components and circuits affect acquisition, manipulation, and quality of chemical information. Includes optical transducers and detectors and signal processing.

**CHEM 947 - Inorganic Biochemistry****Credits:** 3.00

Introduction to the inorganic chemistry and biochemistry of the interactions of metals with proteins, nucleic acids, and other biomolecules. Relevant small metal complexes (model compounds) and synthetic chelating agents are also covered. Prereq: CHEM 903 or permission.

**CHEM 971 - Teaching and Learning Chemistry****Credits:** 3.00 to 4.00

Issues, activities, and research in chemical education, including history of curricula, student and teacher knowledge and beliefs, epistemologic and cognitive bases of science learning, and related instructional approaches. Extensive reading, writing, discussion, and reflection. Not open to students who have completed GRAD 971. Prereq: permission. (Not offered every year.)

**CHEM 995 - Colloquium****Credits:** 1.00 to 4.00

A) Inorganic Chemistry; B) Organic Chemistry; C) Theoretical Organic Chemistry; D) Physical Chemistry; E) Analytical Chemistry; F) Chemical Education. Sections of the course may be taken to a total of 12 credits.

**CHEM 996 - Colloquium****Credits:** 1.00 to 4.00

See description for CHEM 995.

**CHEM 997 - Seminar****Credits:** 1.00

Presentation and discussion of recent investigations in chemistry. Cr/F.

**CHEM 998 - Seminar****Credits:** 1.00

See description for CHEM 997. Cr/F.

**CHEM 999 - Doctoral Research**

**Credits:**

Cr/F.

## Civil Engineering

### **CIE 821 - Pavement Design**

**Credits:** 3.00

Flexible and rigid pavements and bases for highways, airports, city streets, and industrial floors; pavement selection, construction methods, materials, specifications. Prereq: CIE 665 or permission.

### **CIE 822 - Properties and Production of Concrete**

**Credits:** 3.00

Basic properties of hydraulic cements and mineral aggregates and their interactions in the properties of plastic and hardened concrete; modifications through admixtures; production handling and placement problems; specifications; quality control and acceptance testing; lightweight, heavyweight, and other special concretes. Prereq: CIE 622 or permission.

### **CIE 823 - Bituminous Materials and Mixtures**

**Credits:** 3.00

Considerations of major types of bituminous materials, asphalt cements, cutback asphalts, asphalt emulsions, and tars; influence of chemical composition on physical properties; desirable aggregate characteristics for bituminous mixtures; construction techniques; current practices for determining optimum asphalt contents. Prereq: CIE 622 or permission.

### **CIE #834 - Project Analysis**

**Credits:** 3.00

Methods of analysis for decision making used in the planning, design, and management of various engineering systems involving chance and uncertainty. Topics in applied probability and statistics used for risk analysis and for investigating system performance and reliability. Prereq: CIE 633, MATH 644; or permission.

### **CIE #839 - Industrial Wastewater Treatment**

**Credits:** 3.00

Engineering consideration of the origin, characteristics, and treatment of industrial wastewater; the theory and application of unit operations unique to the treatment and disposal of industrial wastes. Prereq: ENE 645 or permission.

### **CIE 840 - Public Health Engineering**

**Credits:** 3.00

Proper application of environmental engineering and sanitation principles in disease prevention and control is discussed. Special emphasis will be given to rural communities and areas of the world where communicable and related diseases have not yet been brought under control, and to what can happen in the more advanced countries when basic sanitary safeguards are relaxed. Topics covered: vector-borne diseases and control, safe water supply development and treatment, and on-site wastewater disposal systems. Prereq: MATH 425, ENE 520.

### **CIE 841 - Open Channel Flow**

**Credits:** 3.00

Energy and momentum principles in open channel flow; flow resistance; channel controls and transitions; unsteady flow concepts and dam failure studies. Modeling with HEC programs. Prereq: CIE 642 or permission.

### **CIE 842 - Solid and Hazardous Waste Engineering**

**Credits:** 3.00

A thorough examination of the problems which exist in hazardous and solid waste management will be presented in terms of the current regulations and engineering approaches used to develop solutions. Topics will include risk-based decision making, transport and fate of contaminants, and the fundamental physical, chemical and biological concepts which make up the basis for technological solutions to these waste management problems. Case studies will be used

throughout the course to highlight key concepts and provide real-world examples. Pre- or Coreq: ENE 645 or permission.

### **CIE 845 - Engineering Hydrology**

**Credits:** 3.00

Hydrologic cycle, probability theory related to hydrology and the design of water resources structures, water flow, flood discharge prediction, hydrograph development, hydraulic and hydrologic river routing, reservoir routing, theory of storage, reservoir operations, hydropower development, modeling of watershed hydrology with program HEC-1, HEC-HMS, multipurpose projects.

### **CIE 847 - Introduction to Marine Pollution and Control**

**Credits:** 3.00

Introduction to the sources, effects, and control of pollutants in the marine environment. Dynamic and kinetic modeling; ocean disposal of on-shore wastes, shipboard wastes, solid wastes, dredge spoils, and radioactive wastes; and oil spills. Prereq: ENE 645 or permission.

### **CIE 848 - Solid and Hazardous Waste Design**

**Credits:** 4.00

Selection, design, and evaluation of unit processes employed in the treatment of solid wastes and hazardous wastes will be studied. Topics include design of materials recovery facilities, landfills, waste-to-energy facilities and hazardous waste site remedial technologies. A group term project taken from a real-world project will be required. An oral presentation by the group and preparation of a final written engineering report including alternative evaluation, permits, scheduling and economic analysis will be required from each group. Prereq: ENE 742 or permission.

### **CIE 849 - Water Chemistry**

**Credits:** 4.00

Emphasizes the use of chemical equilibrium principles and theory, calculations, and applications of ionic equilibrium stresses. Topics include thermodynamics, kinetics, acid/base, complexation, precipitation/dissolution, and redox equilibria. Computer equilibrium modeling is presented. Prereq: general chemistry or equivalent.

### **CIE 850 - Ecohydrology**

**Credits:** 3.00

Introduction to ecohydrological concepts in terrestrial and riverine systems. Topics include the historical practices, resources management impacts, hydrologic variability and the relationships among water and ecology, vegetation, biology, geomorphology, and water quality. Prereq: CIE 845 or ESCI 805; or permission.

### **CIE 854 - Transportation Engineering and Planning**

**Credits:** 3.00

Fundamental relationships of traffic speed, density, and flow applied to public and private modes of transport. Principles of demand forecasting and urban systems planning. Prereq: permission.

### **CIE 855 - Design of Water Transmission Systems**

**Credits:** 4.00

Pressure, sewer, and open channel system design. Theory developed for individual components to large complex systems. Topics include closed conduit flow, open channel flow, groundwater flow, valves and meters, pump selection, system planning and layout, system operation and maintenance. Pressure system modeling with program EPANET. Rainfall runoff calculations with US SCS TR55 model. Prereq: CIE 642 or permission.

### **CIE 856 - Environmental Engineering Microbiology**

**Credits:** 4.00

Concepts of environmental engineering microbiology including microbial metabolism, growth kinetics, bioremediation applications, mass transfer kinetics and effects of environmental parameters. Coursework includes reading and discussion of the microbial literature. Laboratories cover microbiological monitoring and biological treatment experiments. Prereq: ENE 645 or permission. Special fee. Lab.

### **CIE 857 - Coastal Engineering and Processes**

**Credits:** 3.00

Introduction to small amplitude and finite amplitude wave theories. Wave forecasting by significant wave and wave spectrum method. Coastal processes and shoreline protection. Wave forces and wave-structure interaction. Design of coastal structures. Introduction to mathematical and physical modeling. Prereq: CIE 642 or permission. (Also offered as ME 857 and OE 857.)

### **CIE 860 - Foundation Design I**

**Credits:** 4.00

Foundation design based on subsurface investigation and characterization using current methods of laboratory and in situ testing. Use of consolidation theory and bearing capacity theory for the design of shallow foundations, including footings and rafts. Basic design of pile foundations. Earth pressure theory applied to design of retaining walls. Slope stability theory and applications. Prereq: CIE 665 or permission.

### **CIE 861 - Foundation Design II**

**Credits:** 3.00

Advanced pile and pier design under vertical and lateral loads. Slope stability by circular and noncircular arc methods. Design of flexible bulkhead walls and mechanically stabilized walls. Excavation and dewatering. Soil and site improvement. Prereq: CIE 860 or permission.

### **CIE 862 - Introduction to Geotechnical Earthquake Engineering**

**Credits:** 3.00

Overview of earthquake source mechanisms; magnitude and intensity; seismicity of the U.S.A. Dynamics of simple structures; response spectra. Selection of design parameters; source, magnitude, input records. Measurement of dynamic characteristics of soils; site response, liquefaction, and ground deformation. Prereq: CIE 860 or permission.

### **CIE #863 - Geological Engineering**

**Credits:** 3.00

Functional classification of rocks and rock masses. Stereographic projection. Engineering properties of rocks. Rock mechanics. The influence of geology in the design of underground excavations, tunneling, foundations, and rock slope engineering. Prereq: ESCI 401 or permission.

### **CIE 866 - Introduction to Geo-Environmental Engineering**

**Credits:** 3.00

Soil composition and structure; hydrogeology; attenuation and contaminant transport; containment design including landfills, geosynthetics for liners and covers, leachate collection systems, vertical cutoff walls, and stability analyses; geo-environmental site characterization and investigation using geotechnical and geophysical methods; ground water, soil and gas monitoring, and sampling; remediation including in-situ and ex-situ techniques and treatment methods. Prereq: CIE 665 or permission.

### **CIE 874 - Reinforced Concrete Design**

**Credits:** 4.00

Introduction to the design of reinforced concrete structural members by the strength method and considering deflection performance. Includes loads, approximate analysis, slabs, beams, and columns. Prereq: CIE 622, 681; or permission.

### **CIE #878 - Issues in Engineering Practice and Management**

**Credits:** 3.00

Non-technical professional engineering topics including: participation in multidisciplinary teams, interpersonal and human resource skills, verbal and written communication skills, project management, marketing, ethics, professional licensure, professional liability, and contract administration.

### **CIE 882 - Timber Design**

**Credits:** 3.00

Introduction to the design of timber structures. Structural properties of wood. Determination of horizontal and vertical loads. Horizontal and vertical load-resisting systems. Design of horizontal diaphragms, shear walls, beams, and

columns. Bolted, screwed, and nailed connections. Prereq: CIE 681 or permission.

### **CIE 883 - Matrix Structural Analysis and Modeling**

**Credits:** 3.00

Modeling and analysis of determinate and indeterminate structures by matrix computer methods. Creation of matrix elements using compatibility, equilibrium, and consecutive relationships. Plane trusses, beams, frames, and space trusses. Prereq: CIE 681 or permission.

### **CIE 885 - Introduction to Structural Vibrations**

**Credits:** 3.00

Dynamic analysis of single- and multi-degree-of-freedom systems. Simple beam and frame structures. Earthquake analysis and design. Pre - or Coreq: CIE 783.

### **CIE 886 - Introduction to Finite Element Analysis**

**Credits:** 3.00

Topics include basic matrix theory, Galerkin method, direct stiffness method, development of finite element theory, and modeling techniques. Applications in solid mechanics, heat transfer, fluids, and dynamics using commercially available codes. Prereq: CIE 681, 783; or permission.

### **CIE #889 - Project Management**

**Credits:** 3.00

Project management concepts including labor, material, and equipment usage; cost estimation; financing and economic evaluation of projects; scheduling; and quality control and safety during construction. Existing projects are integrated in class discussions and homework. An understanding of systems analysis is assumed.

### **CIE 891 - Prestressed Concrete**

**Credits:** 3.00

Analysis and design of prestressed and post-tensioned concrete sections in flexure and shear. Strength, deflection, and losses in flexural members. Optimization of section and prestressing force selection. Prereq: CIE 874 or permission.

### **CIE 892 - LRFD Bridge Design**

**Credits:** 3.00

AASHTO LRFD Bridge Design Specifications using SI units. Design objectives, loads, load case analysis and selection, load distributions, static analysis, and design for axial loads, flexure, and shear. Design of slender columns, composite beams, and plate girders. Prereq: CIE 874 or permission.

**Co-requisites:** CIE 893

### **CIE 893 - Structural Design in Steel**

**Credits:** 3.00

The design of members and connections: tension, members, columns, beams, plate girders, bolted joints, and welded joints. Introduction to plastic design of beams and frames. Prereq: engineering materials, classical structural analysis or permission.

### **CIE 895 - Independent Study**

**Credits:** 1.00 to 4.00

A limited number of qualified graduate students will be permitted to pursue independent studies under faculty guidance. May be repeated.

### **CIE 896 - Special Topics**

**Credits:** 1.00 to 4.00

Advanced or specialized topics not normally covered in regular course offerings. May be repeated, but not in duplicate areas. Prereq: permission.

### **CIE 897 - Special Topics in Environmental Engineering**

**Credits:** 1.00 to 4.00

Advanced or specialized topics not normally covered in regular course offerings. May be repeated, but not in duplicate areas. Prereq: permission.

**CIE 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Cr/F.

**CIE 900 - Seminar**

**Credits:** 1.00

Topics of interest to graduate students and staff; reports of research ideas, progress, and results; lectures by outside speakers. Continuing course: instructor may assign IA grade (continuous grading) at the end of one semester.

**CIE 940 - Hydrologic Monitoring**

**Credits:** 3.00

Field course designed to familiarize the student with measurement of surface water, vadose zone, and groundwater hydrologic variables. Topics covered include weirs, stream gaging, dilution gaging, sampling of bed and suspended sediments, groundwater/surface water interactions, well monitoring, borehole dilution measurements, groundwater velocity and dispersion, under saturated zone, well construction, and water quality measurements. The class format is one 40-hour week of lectures (1/2 days in class, 1/2 days in field for 5 days) and then six labs to be performed over the subsequent two weeks. Prereq: permission only. Special fee. (Summer session only, in odd numbered years. Interested students should contact the department prior to May 1.)

**CIE 942 - River Mechanics**

**Credits:** 3.00

Geomorphic principles, erosion and sediment transport problems, sediment transport mechanics in open channels, sediment measurement techniques, sediment sources and yields, control methods, effects of structures on riverine systems, design of hydraulic structures. Prereq: CIE 642 or permission.

**CIE 943 - Advanced Hazardous Waste and Environmental Sampling and Analysis**

**Credits:** 4.00

Laboratory and field techniques for the sampling and analysis of hazardous waste. Lecture covers theory behind techniques. Prereq: general chemistry, ENE 645. Lab. Special fee.

**CIE 944 - Advanced Physicochemical Treatment Design**

**Credits:** 4.00

Selection, design, and evaluation of advanced unit processes employed in physicochemical treatment of waters, wastewaters, and hazardous wastes. Discussion on preparation of alternative designs and economic analysis. Emphasis on treatment schemes based on experimental laboratory or pilot studies. Prereq: ENE 645 or permission. Special fee. Lab.

**CIE 945 - Advanced Groundwater Topics**

**Credits:** 3.00

Review of Darcy's Law for confined and unconfined aquifers, linearization techniques, draw down computations under varying boundary conditions, solutions to the inverse problem, drainage theory, recharge theory, two-phase flow, succession of steady states modeling, and borehole geophysics. Prereq: ESCI 810.

**CIE 946 - Advanced Bioenvironmental Engineering Design**

**Credits:** 4.00

Theoretical and experimental examination of the fundamental parameters used in selection, design, and operation of biological treatment processes for waters, wastewaters, and hazardous wastes. Topics include design and evaluation of aerobic and anaerobic processes, suspended and fixed-film processes, and advanced biological water and wastewater treatment processes. Prereq: CIE 856, 943; or permission.

**CIE 960 - Advanced Soil Mechanics**

**Credits:** 3.00

Stresses and stress spaces. Introduction to constitutive models for sands and clays. Recent developments in strength and compressibility analysis of soils. Prereq: CIE 860 or permission.

**CIE 961 - In Situ Geotechnical Testing**

**Credits:** 3.00

In situ geotechnical testing methods for site characterization; theory and practice. Geotechnical testing methods include the piezocone, the pressuremeter, the flat plate dilatometer, the field vane, and the standard penetration test. Includes sampling techniques, geophysical exploration, and recent innovations in site and soil characterization. Prereq: CIE 960 or equivalent.

**CIE 962 - Laboratory Geotechnical Testing**

**Credits:** 3.00

Modern techniques for measuring mechanical properties of soils in the laboratory. Instrumentation. Static shear strength and consolidation. Dynamic properties. Prereq: CIE 960 or permission.

**CIE #981 - Advanced Structural Analysis**

**Credits:** 4.00

Advanced structural theory and analysis with computer applications, including multistory structures, beam columns, frames with variable moment of inertia, arches, rings, continuous curved beams, and curved frames.

**CIE 995 - Problems**

**Credits:** 2.00 to 4.00

The study and investigation of problems selected to meet the needs of the students.

**CIE 999 - Doctoral Research**

**Credits:**

Cr/F.

## Communication Sci&Disorders

### **COMM 875 - Advanced Language Acquisition**

**Credits:** 3.00

Careful examination of theoretical perspectives and landmark studies provides the foundation for the exploration of advanced topics in language acquisition. Current approaches to child language research guide students to approach the course context from a scientific perspective. Prereq: COMM 522.

### **COMM 876 - Ethical and Professional Issues in Communication Sciences and Disorders I**

**Credits:** 1.00

Introduction to ethical and professional issues that professionals will encounter in various work settings including regulatory, billing practices, service delivery models, and the role of advocacy for client services.

### **COMM 877 - Ethical and Professional Issues in Communication Sciences and Disorders II**

**Credits:** 1.00

Advanced discussion of ethical and professional issues encountered in practicum experiences . Students will problem-solve ethical/professional dilemmas. Prereq: COMM 876.

### **COMM 880 - Diagnosis of Speech and Language Disorders**

**Credits:** 3.00

Principles and practice for diagnosis of speech and language disorders; examination procedures and measurement techniques.

### **COMM 890 - Adv Audiology Spch-Lang Pathol**

**Credits:** 3.00

A clinical foundation in diagnostic and rehabilitative information. This course covers foundation materials that apply to both children and adults, and includes recent academic, clinical, and ethical developments in the profession of audiology that impact speech-language pathologists. Prereq: COMM 521, COMM 704, 705, introduction to speech science, and introduction to hearing science.

### **COMM 895 - Special Topics**

**Credits:** 1.00 to 3.00

Advanced study in specific areas; involves an independent project. Prereq: permission. May be repeated.

### **COMM 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Prereq: permission. Cr/F.

### **COMM 900 - Articulatory and Phonological Disorders in Children**

**Credits:** 3.00

Phonological theories as they relate to analysis and remediation of articulation disorders.

### **COMM 901 - Dysphagia**

**Credits:** 3.00

This course addresses swallowing problems occurring in the preparatory, oral, and pharyngeal stages of the swallow. Assessment and treatment are discussed. Permission required.

### **COMM 902 - Stuttering**

**Credits:** 3.00

Theoretical and therapeutic considerations of the stuttering syndrome; emphasis on clinical management. Prereq: speech pathology II or permission.

**COMM 903 - Therapy Process****Credits:** 2.00

An introduction to the clinical process. Part I emphasizes the theory and practice of intervention. Part II addresses oral and written communication involved in the clinical process, the importance of clinical writing, and common reports/documents. Prereq: COMM 910.

**COMM 904 - Aphasia in Adults****Credits:** 3.00

Principles concerning etiologies, evaluation, classification, and methods of clinical management including the team approach to rehabilitation of aphasia in adults. Prereq: KIN 806.

**COMM 905 - Motor Speech Disorders****Credits:** 3.00

Neurological bases, diagnosis, and treatment of motor speech disorders including cerebral palsy, acquired dysarthria, and apraxia of speech. Prereq: KIN 806 or permission.

**COMM 906 - Voice Disorders****Credits:** 3.00

Types, causes, and characteristics of functional and organic voice disorders. Specific evaluation of deviant vocal characteristics; treatment techniques for children and adults.

**COMM 907 - Advanced Seminar in Aural Rehabilitation****Credits:** 3.00

Current issues in therapeutic techniques and management considerations for the hard-of-hearing child. Speech perception by the hearing impaired, use of amplification systems, counseling approaches, and modification of the listening environment and language considerations, and the development of IEPs. Prereq: basic audiology, introduction to auditory perception and aural rehabilitation, speech and hearing science;/ or equivalent.

**COMM 908 - Language and Learning Disabilities in School-Age Children****Credits:** 3.00

Examination of language-based learning disabilities; relation between language and learning; current assessment and treatment strategies. Prereq: permission.

**COMM 910 - Clinical Practicum****Credits:** 1.00 to 3.00

Practicum provides graduate students with the opportunity to apply advanced theoretical knowledge in clinical setting with speech-, language-, and hearing-impaired individuals. Diagnostic and therapy experience is supervised. Prereq: permission. May be repeated up to 6 credits--a minimum of 3 credits is required for the M.S. degree. Variable. Special fee.

**COMM 911 - Off-Campus Clinical Practicum****Credits:** 1.00 to 3.00

Application of advanced theoretical knowledge in an off-campus clinical setting. Prereq: permission. A minimum of 6 credits is required for the M.S. degree. IA (continuous grading).

**COMM 912 - Language Disorders Birth to Five****Credits:** 3.00

Transdisciplinary examination of interrelationships between early language, social, and cognitive development, with emphasis on collaborative models of assessment and intervention. Reviews implications for special populations (e.g., mentally retarded, autistic, sensory impaired, and limited English proficiency.)

**COMM 913 - Cognitive Communication Disord****Credits:** 3.00

This course addresses the nature of cognitive-communicative impairments in children and adults with acquired brain

injury and links theory and practice to community reintegration. Prereq: KIN 806.

**COMM 914 - Augmentative & Alternative Cmn**

**Credits:** 3.00

An overview of how augmentative and alternative communication systems can be used to foster the participation, interaction, and inclusion of children and adults for whom speech is not a primary mode of communication. Students are exposed to a broad variety of assessment and intervention techniques, some of which involve the use of assistive technology.

**COMM 920 - Graduate Seminar**

**Credits:** 1.00 to 6.00

Current topics, recent investigations, and library research. May be repeated up to 9 credits barring duplication of subject matter. A minimum of 2 credits is required for M.S. degree.

## Computer Science

### **CS 800 - Internship**

**Credits:** 1.00

Provides an opportunity to apply academic experience in settings associated with future professional employment. A written proposal for the internship must be approved by the department chair. The proposal must specify what the student will learn from the internship, why the student is properly prepared for the internship, and what supervision will be available to the student during the internship. A midsemester report and a final report are required. Permission required. Cr/F.

### **CS 812 - Compiler Design**

**Credits:** 3.00

Formal languages and formal techniques for syntax analysis and parsing; organization of the compiler and its data structures; problems presented by error recovery and code generation. Classical top-down and bottom-up techniques currently in wide spread use, general discussion of LL (k) and LR (k) parsers; automatic methods of compiler generation and compilers. Students required to define a simple, nontrivial programming language and to design and implement its compiler. Prereq: assembly language programming and machine organization; and programming language concepts and features.

### **CS #818 - Software Engineering**

**Credits:** 3.00

Design approaches, implementation methodologies, and management techniques required to develop large, reliable software systems including applications-oriented systems. Team programming projects. Prereq: data structures.

### **CS 819 - Object-Oriented Methodology**

**Credits:** 3.00

Object-oriented system design. Object-oriented programming. Languages for object-oriented programming. Prereq: strong programming skills; experience with C programming is highly desirable.

### **CS 820 - Operating System Programming**

**Credits:** 3.00

Detailed discussion of operating system concepts and features. Practical examples and exercises that utilize advanced operating system features, including interprocess communication, synchronization, client-server communication, shared memory, threads, remote procedure calls, and device-level I/O. Discussion of POSIX 1003.1 Part I Standards. Prereq: operating system fundamentals or equivalent.

### **CS 821 - Operating System Kernel Design**

**Credits:** 3.00

Design and implementation of an operating system kernel, using LINUX as an example. Detailed discussion of the data structures and algorithms used in the kernel to handle interrupts, schedule processes, manage memory, access files, deal with network protocols, and perform device-level I/O. The course is project-oriented, and requires the student to make modifications and additions to the LINUX kernel. Prereq: CS 820, or permission.

### **CS 824 - Distributed Operating Systems**

**Credits:** 3.00

Fundamental concepts, algorithms, and design principles that form the basis of distributed and multiprocessor operating systems. Architectural overview, design, and implementation methodology of several real distributed systems.

### **CS 825 - Computer Networks**

**Credits:** 3.00

Introduction to local, metropolitan, and wide area networks using the standard OSI reference model as a framework. Introduction to the Internet protocol suite and to network tools and programming. Discussion of various networking technologies.

### **CS 830 - Introduction to Artificial Intelligence**

**Credits:** 3.00

In-depth introduction to artificial intelligence concentrating on aspects of intelligent problem-solving. Topics include situated agents, advanced search techniques, knowledge representations, logical reasoning techniques, reasoning under uncertainty, advanced planning and control, and learning. Prereq: data structures.

### **CS 835 - Introduction to Parallel and Distributed Programming**

**Credits:** 3.00

Programming with multiple processes and threads on distributed and parallel computer systems. Introduces programming tools and techniques for building applications on such platforms. Course requirements consist primarily of programming assignments. Prereq: Undergraduate course in operating systems fundamentals and computer organization; or permission.

### **CS 845 - Formal Specifications and Verification of Software Systems**

**Credits:** 3.00

Functional and non-functional properties of software systems can be specified and verified using formal techniques and logically based description languages. Course focuses on assertional reasoning and presents different notions (Hoare logic, behavioral specifications, temporal logic) for different classes of systems (transformational, object-oriented, reactive). Prereq: Students are expected to be knowledgeable in logic and to be able to write symbolic proofs in predicate calculus. A basic understanding of the notions of assertion, precondition, and postcondition is also assumed.

### **CS 859 - Theory of Computation**

**Credits:** 3.00

Models of computation, Church's thesis, completeness, undecidability. Time and space complexity of Turing machines. Savitch's theorem and hierarchy theorems. NP-completeness and Cook's theorem. Prereq: introduction to the theory of computation.

### **CS 860 - Introduction to Human-Computer Interaction**

**Credits:** 3.00

Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. Prereq: operating systems fundamentals.

### **CS 865 - Introduction to Computational Linguistics**

**Credits:** 3.00

Introduction to computational analysis of natural language, with a focus on semantic representations and the resolution of ambiguity. Provides an elementary working knowledge of linguistic and artificial intelligence methods as motivated by examples of potential input text. Topics include parsing, formal grammars, representation of knowledge and memory, inference, and interpretation of nonliteral language. Prereq: elementary knowledge of LISP or permission.

### **CS 867 - Interactive Data Visualization**

**Credits:** 3.00

Detailed discussion of how an understanding of human perception can help us design better interactive displays of data. Topics include: color, space perception, object perception and interactive techniques. Students write interactive programs, give presentations and undertake a project designing and evaluating a novel display technique. Prereq: Introductory level C or C++ programming course. (Also listed as OE 867.)

### **CS 870 - Computer Graphics**

**Credits:** 3.00

Input-output and representation of pictures from hardware and software points of view; interactive techniques and

their applications; three-dimensional image synthesis techniques. Prereq: data structures.

### **CS 875 - Database Systems**

**Credits:** 3.00

Database analysis, design, and implementation. Focus on the relational model. Data description and manipulation languages, schema design and normalization, file and index organizations, data integrity and reliability. Usage of selected DBMS. Prereq: data structures; mathematical proof.

### **CS 880 - Topics**

**Credits:** 3.00

Material not normally covered in regular course offerings. May be repeated.

### **CS 898 - Master's Project**

**Credits:** 3.00

### **CS 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Cr/F.

### **CS 900 - Graduate Seminar**

**Credits:** 1.00

Regularly scheduled seminars presented by outside speakers, UNH faculty, and graduate students. Topics include reports of research ideas, progress, and results. Cr/F.

### **CS #912 - Advanced Compiler Design**

**Credits:** 3.00

In-depth study of automatically generated syntactic error recovery, intermediate representation, machine independent and machine dependent optimization, code generation, register allocation. Tools for generating code generators and Graham-Glanville style instruction selectors. Examples of production code generators. Prereq: CS 812 or equivalent.

### **CS #920 - Advanced Operating Systems**

**Credits:** 3.00

Study of the design and analysis of advanced operating systems, including distributed and multiprocessor operating systems. Lectures focus on the principles used in the design of operating systems, algorithms and data structures used in their implementation, and techniques for evaluating them. The topics covered include synchronization, mutual exclusion, distributed algorithms, security, fault-tolerance, modeling and performance, and distributed resource management. Prereq: operating systems fundamentals or equivalent.

### **CS 925 - Advanced Computer Networks**

**Credits:** 3.00

Design and analysis of computer networks. Modeling and performance evaluation, queuing theory applied to computer networks. Traffic flow management and error control. Routing algorithms and protocols. Switch and router architectures. Selected issues in high-speed network design. Optical networks. Prereq: CS 825 or equivalent.

### **CS #929 - Collaborative Computing**

**Credits:** 3.00

The goal of collaborative computing is to assist groups in communicating, in collaborating, and in coordinating their activities. Study of computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment. Investigation of several sample collaborative applications, like the World-Wide Web, virtual reality, video conferencing and work flow systems, along with related protocols and languages. Prereq: CS 825 and CS 860. Credit/Fail.

### **CS #930 - Artificial Intelligence**

**Credits:** 3.00

Current approaches to machine intelligence and the simulation of human cognitive processes, including an introduction

to recursive functions and programming with the LISP language. Heuristic programming, programs for game playing and natural language understanding, elementary theory of computability. Individual computer project required. Prereq: programming experience.

### **CS #934 - Logic Programming**

**Credits:** 3.00

Introduction to the foundation, implementations, and application of logic programming. Emphasis on the study of example applications. Application areas include compilers, databases, and expert systems.

### **CS 941 - Design and Analysis of Algorithms**

**Credits:** 3.00

Principles of design of efficient algorithms. Methods studied include recursion, divide and conquer, dynamic programming, greedy techniques, and data structure selection. Correctness and analysis of algorithms. Examples are drawn from problems in the areas of graphs, sorting, searching, pattern matching, and polynomials. Prereq: introduction to theory of computation.

### **CS 970 - Advanced Computer Graphics**

**Credits:** 3.00

Advanced image synthesis techniques and photorealism. Ray tracing. Complex shading and lighting models. Antialiasing. Texture mapping. Surface generation and display.

### **CS 975 - Object-Oriented Database Systems**

**Credits:** 3.00

Introduction to object-oriented database systems, concepts and design; object-oriented data models and languages; implementation issues and mechanisms. Prereq: CS 875.

### **CS 980 - Advanced Topics**

**Credits:** 3.00

### **CS 981 - Advanced Topics in Database Systems**

**Credits:** 3.00

### **CS #982 - Advanced Topics in Computer Networks**

**Credits:** 3.00

### **CS #983 - Advanced Topics in Artificial Intelligence**

**Credits:** 3.00

### **CS #984 - Advanced Topics in Computer Science Theory**

**Credits:** 3.00

### **CS #985 - Advanced Topics in Operating Systems**

**Credits:** 3.00

### **CS 986 - Advanced Topics in Formal Specification and Verification**

**Credits:** 3.00

This course explores more thoroughly some of the material introduced in CS 845. It focuses on concurrent and reactive systems and on temporal logics. Topics include safety and liveness properties, asynchronous communication, and compositional reasoning. Support tools, like interactive theorem provers and model-checkers, are presented and used in class. Prereq: introduction to formal specification and verification.

### **CS #987 - Advanced Topics in Computational Linguistics**

**Credits:** 3.00

### **CS #988 - Advanced Topics in Computer Graphics**

**Credits:** 3.00

**CS 989 - Advanced Topics in Algorithms**

**Credits:** 3.00

**CS 998 - Independent Study**

**Credits:** 1.00 to 6.00

**CS 999 - Doctoral Research**

**Credits:**

Cr/F.

## Electrical&Comp Engineering

### **ECE 804 - Electromagnetic Fields and Waves II**

**Credits:** 4.00

Loop antennas; aperture and cylindrical antennas; self and mutual impedance; receiving antennas and antenna arrays; bounded plane waves; rectangular and cylindrical waveguides; waveguide discontinuities and impedance matching; solid state microwave sources.

### **ECE 811 - Digital Systems**

**Credits:** 4.00

Principles and procedures related to the design and implementation of microprocessor-based embedded systems. Topics will include: microprocessor technologies; management of the development cycle; implementation methodologies such as printed circuit boards and system integration; design considerations related to manufacturing and testing of digital systems; and analysis of implementation limitations related to electromagnetic noise, grounding/power schemes, timing, device packaging, and heat/power requirements. Students prototype a digital system using CAD tools. Devices such as microprocessors, microcontrollers, network controllers, procedures and tools. Devices such as microprocessors, microcontrollers, network controllers, data acquisition/processing units, application specific integrated circuits, and interface logic are used for the design projects. Projects will reflect the advances in modern digital technologies. Lab.

### **ECE 814 - Introduction to Digital Signal Processing**

**Credits:** 4.00

Introduction to digital signal processing theory and practice, including coverage of discrete time signals and systems, frequency domain transforms and practical spectral analysis, digital filter terminology and design, and sampling and reconstruction of continuous time signals. Laboratory component providing an introduction to DSP design tools and real-time algorithm implementation. Lab.

### **ECE 815 - Introduction to VLSI**

**Credits:** 4.00

Principles of VLSI (Very Large Integration) systems at the physical level. CMOS circuit and logic design, CAD tools, CMOS systems case studies. Students exercise the whole development cycle of a VLSI chip: design, layout, and testing. Design and layout performed during semester I. The chips are fabricated off campus and returned during semester II, when they are tested by students. An IA (continuous grading) grade is given at the end of semester I.

### **ECE 817 - Introduction to Digital Image Processing**

**Credits:** 4.00

Digital image representation; elements of digital processing systems; multidimensional sampling and quantization; image perception by humans, image transformations including the Fourier, the Walsh, and the Hough Transforms; image enhancement techniques including image smoothing, sharpening, histogram equalization, and pseudocolor processing; image restoration fundamentals; image compression techniques, image segmentation and use of descriptors for image representation and classification. Lab.

### **ECE 834 - Network Data Communications**

**Credits:** 4.00

Introduces the basic concepts related to data transmission equipment and physical interfaces, data communication protocols, and the Open Systems Interconnection (OSI) Reference Model. Course material focuses on the physical, layer hardware, signaling schemes, protocol packets, computer interfaces, error detection, and signal integrity. Data transmission protocols relative to both wired and wireless networks. An introduction to both local and wide-area networks, and how a networking system is constructed, tested, and managed. Network design and testing exercises reinforce the material presented in course lectures. Lab.

### **ECE 841 - Nonlinear Systems Modeling**

**Credits:** 4.00

Modeling of hydraulic, pneumatic, and electro-mechanical systems. Solution methods including linearization and computer simulation on nonlinear equations. Methods of generalizing the nonlinear models for design purposes are developed. (Also offered as ME 841.)

### **ECE 845 - Fundamentals of Acoustics**

**Credits:** 4.00

Acoustic wave equation for air; laws of reflection, refraction, and absorption; characteristics and measurement of acoustical sources; human perception of sound, loudness, intensity; microphones; acoustical materials; problems in environmental sound control; ultrasonics; architectural acoustics. Lab.

### **ECE 857 - Fundamentals of Communication Systems**

**Credits:** 4.00

Spectra of deterministic and random signals, baseband and bandpass digital and analog signaling techniques, transmitter and receiver architectures, performing analysis of digital and analog signaling in additive noise channels, carrier and symbol timing synchronization methods. Lab.

### **ECE 858 - Communication System Design**

**Credits:** 4.00

System and circuit level design and implementation of communication hardware including: mixers, RF amplifiers, filters, oscillators and frequency synthesizers, modulators and detectors, carrier and symbol timing recovery subsystems. Issues in software-defined radio transmitter and receiver implementation. Communication link engineering including antenna selection and channel impairment effects. Lab.

### **ECE 860 - Introduction to Fiber Optics**

**Credits:** 4.00

Basic physical and geometric optics; solution of Maxwell's equations for slab waveguides and cylindrical waveguides, of both step index and graded index profiles; modes of propagation and cutoff; polarization effects; ground and phase velocity; ray analysis; losses; fabrication; sources; detectors; couplers; splicing; cabling; applications; system design. Lab.

### **ECE 861 - Optical Engineering**

**Credits:** 4.00

First-order imaging optics, thin and thick lenses, aberrations, mirrors, stops, apertures, gratings, prisms, resolution, interferometry, diffraction, ray tracing, design of optical instruments, image evaluation, modulation transfer function, optical system design by computer. Lab.

### **ECE 872 - Control Systems**

**Credits:** 4.00

Development of advanced control system design concepts such as Nyquist analysis, lead-lag compensation; state feedback; parameter sensitivity; controllability; observability; introduction to non-linear and modern control. Includes interactive computer-aided design and real-time digital control. (Also offered as ME 872.) Lab.

### **ECE 874 - Introduction to Neural Networks**

**Credits:** 4.00

Introduction to theory and application of artificial neural networks. Single- and multi-layer feedforward and recurrent network architectures. Supervised, unsupervised, and reinforcement learning principles. Applications to control and signal processing.

### **ECE 875 - Applications of Integrated Circuits**

**Credits:** 4.00

Design and construction of linear and nonlinear electronic circuits using existing integrated circuits. Limitations and use of operational amplifiers. Laboratory course in practical applications of nondigital integrated circuit devices. Lab.

**ECE 877 - Collaborative Engineering I****Credits:** 4.00

Study of processes in which engineers from diverse disciplines cooperate to specify, design, manufacture, test, market, and maintain a product. Classes are organized in both technical and nontechnical flexible modules. Technical topics are advanced and relevant to project being developed, such as related research, technology, design methodology, and CAD tools. Nontechnical topics include ISO9000 quality system, engineering management, budget considerations, team building, communication and leadership skills, and concurrent engineering principles. The course utilizes collaborative engineering by team development of an engineering project, often a research oriented proof-of-concept prototype. Lab.

**ECE 878 - Collaborative Engineering II****Credits:** 2.00 to 4.00

Continuation of Collaborative Engineering I, in which the proposal submitted in the previous course is developed into a prototype system. Part II emphasizes the development, assembly, testing and evaluation of the verification and industry practices. A formal report documents the semester's work. Prereq: ECE 877.

**ECE 881 - Physical Instrumentation****Credits:** 4.00

Analysis and design of instrumentation systems. Sensors, circuits, and devices for measurement and control. Elements of probability and statistics as applied to instrument design and data analysis. Transmission, display, storage, and processing of information. The design, implementation, testing, and evaluation of a relevant instrument system is an integral part of this course. (Also offered as OE 881.) Lab.

**ECE 884 - Biomedical Instrumentation****Credits:** 4.00

Principles of physiological and biological instrumentation design including transducers, signal conditioning, recording equipment, and patient safety. Laboratory includes the design and use of instrumentation for monitoring of electrocardiogram, eletromyogram, electroencephalogram, pulse, and temperature. Current research topics, such as biotelemetry, ultrasonic diagnosis, and computer applications. Lab.

**ECE 885 - Underwater Acoustics****Credits:** 4.00

Vibrations, propagation, reflection, scattering, reverberation, attenuation, sonar equations, ray and mode theory, radiation of sound, transducers, and small- and large-signal considerations. (Also offered as OE 885.)

**ECE 896 - Special Topics in Electrical or Computer Engineering****Credits:** 1.00 to 4.00

New or specialized courses and/or independent study. Some sections may use credit/fail grading.

**ECE 899 - Master's Thesis****Credits:** 1.00 to 6.00

Cr/F.

**ECE 900 - Seminar****Credits:** 1.00

This seminar course exposes students to advances in various fields of science and technology. Researchers and practitioners from industry and academia present their work. Special fee.

**ECE 901 - Electromagnetic Wave Theory I****Credits:** 3.00

Maxwell's equations; plane wave propagation; reflection and refraction; guided wave propagation; waveguides; simple resonators; elements of microwave circuits, linear and aperture antennas, arrays of dipoles; receiving antennas.

**ECE 902 - Electromagnetic Wave Theory II****Credits:** 3.00

Selected advanced topics in electromagnetic wave theory taken from such areas as antennas, propagation in various media, diffraction and scattering, microwave generation, and waveguide propagation.

### **ECE 915 - Advanced Active Circuits**

**Credits:** 3.00

Investigation of devices and techniques used in advanced circuit design using discrete solid-state devices and integrated circuits. Oscillators, phase-lock systems, low noise techniques, etc.

### **ECE 936 - Biomedical Engineering**

**Credits:** 3.00

Applications of engineering in such areas as surgery, critical-care units, neurophysiology, rehabilitation, modeling, and interaction of waves and biological tissues.

### **ECE 939 - Statistical Theory of Communications**

**Credits:** 3.00

Introduction to probability theory and random waveforms leading to a discussion of optimum receiver principles. Topics include random variables, random processes, correlation, power spectral density, sampling theory, and optimum decision rules.

### **ECE 940 - Information Theory**

**Credits:** 3.00

Introduction to information theory concepts. Topics include message sources, entropy, channel capacity, fundamentals of encoding, Shannon's theorems. Prereq: ECE 939 or permission.

### **ECE 941 - Digital Signal Processing**

**Credits:** 3.00

Digital signal processing theory and practice, including coverage of discrete-time signals and systems, the Z-transform, and the discrete Fourier transform. Brief coverage of digital filters and terminology, random number generators and signal models, the FFT, the pitfalls of using FFT, and applications of digital signal processing including convolution, correlation, and power spectral estimation.

### **ECE 944 - Nonlinear Control Systems**

**Credits:** 4.00

Analysis and design of nonlinear control systems from the classical and modern viewpoints. Liapunov's stability theory, phase space methods, linearization techniques, simulation, frequency response methods, generalized describing functions, transient analysis utilizing functional analysis, and decoupling of multivariable systems. (Also offered as ME 944.)

### **ECE 951 - Advanced Control Systems I**

**Credits:** 3.00

State-space representation of multivariable systems, analysis using state transition matrix. Controllability and observability, pole placement using state and output feedback, Luenberger observers. Introduction to computer-controlled systems (sampling, discrete state representation, hybrid systems), nonlinear analysis (Liapunov, Popov, describing function). (Also offered as ME 951.)

### **ECE 952 - Advanced Control Systems II**

**Credits:** 3.00

Special topics in control theory: continuous and discrete systems; optimal control systems, including calculus of variations, maximum principle, dynamic programming, Weiner and Kalman filtering techniques, stochastic systems, and adaptive control systems. (Also offered as ME 952.)

### **ECE 955 - Estimation and Filtering**

**Credits:** 3.00

Stochastic systems course with application to control and communications. Topics include random variables, noise in linear systems, Bayesian and minimum variance estimation theory, optimal state estimators, Weiner and Kalman

filters, combined estimation and control, prediction, parameter identification, and nonlinear filtering. (Also offered as ME 955.)

### **ECE 960 - Computer Architecture**

**Credits:** 3.00

Advanced topics in computer organization. Parallel and pipeline processing, associative and stack computers, microprogramming, virtual memory, current topics.

### **ECE 961 - Test Engineering and Testable Design**

**Credits:** 3.00

Circuit failures, fault models, test pattern generation, logic and fault simulation. Parametric, structural, and functional characterization of components and subsystems. Test methods, strategies, planning, and economics. Design for testability, scan design, test interfaces, design for built-in self-test (BIST), and design for manufacturability. Test equipment hardware and software. Lab.

### **ECE 962 - Fault Tolerant Computers**

**Credits:** 3.00

Principles of fault tolerant computers. Fundamentals of reliability theory. Faults and their manifestations. Practical reliable systems are studied at two levels: architecture, and packaging. Systems analyzed according to the following sequence: theoretical fundamentals, systems modeling, reliability assessment (HAST), and reliability during useful life. A reliability modelling project of subsystem using CAD tools.

### **ECE 965 - Introduction to Pattern Recognition**

**Credits:** 3.00

Machine classification of data, feature space representation, multispectral feature extraction, Bayes decision theory, linear discrimination functions, parameter estimation, supervised and unsupervised learning, clustering, scene analysis, associative memory techniques, and syntactic methods of recognition.

### **ECE 970 - Introduction to Optical Signal Processing**

**Credits:** 3.00

Theory and application of optical signal processing; foundations of scalar diffraction theory, the angular spectrum of plane waves, Fourier transforming properties of lenses, spatial filtering and optical information processing, the Vander-Lugt filter, holography principles and application, and optical computers. Emphasis on coherent processing.

### **ECE 980 - Opto-Electronics**

**Credits:** 3.00

Advanced survey of light and its interaction with matter at the submicron level. Topics cover: light in its various descriptions including ray optics, wave optics, beam optics, and photons; optical waveguides and resonators; LEDs and lasers; photons in semiconductors; photorefractive materials and liquid crystals; nonlinear optics; acousto-optics; and photon switching.

### **ECE 992 - Advanced Topics in Electrical Engineering**

**Credits:** 1.00 to 3.00

Example of a recent topic: analog VLSI design. May be repeated.

### **ECE 993 - Advanced Topics in Computer Engineering**

**Credits:** 1.00 to 3.00

Example of recent topic: wireless communication networks. May be repeated.

### **ECE 994 - Advanced Topics in Systems Engineering**

**Credits:** 1.00 to 3.00

Examples of recent topics: neural networks, advanced digital telecommunications. May be repeated.

### **ECE 998 - Independent Study**

**Credits:** 1.00 to 3.00

Independent theoretical and/or experimental investigation of an electrical engineering problem under the guidance of a faculty member.

**ECE 999 - Doctoral Research**

**Credits:**

Cr/F.

## Economics

### **ECON 807 - Economics of Sustainable Development**

**Credits:** 4.00

Analysis of the interrelationships among economic growth, technological change, population increase, natural resource use, and environmental problems, e.g., land use change, biodiversity loss, and global climate change.

### **ECON #811 - Economic Fluctuations**

**Credits:** 4.00

Recurrent movements of prosperity and depression; emphasis on causes and public-policy implications.

### **ECON 825 - Mathematical Economics**

**Credits:** 4.00

Principal mathematical techniques and their application in economics. Topics covered: matrix algebra, derivatives, unconstrained and constrained optimization, linear and nonlinear programming, game theory, elements of integral calculus.

### **ECON 828 - Time Series Analysis**

**Credits:** 4.00

Basic and advanced time series models with up-to-date empirical techniques with emphasis on the application of econometric tools to economic issues. Selected topics include stationary ARMA models, unit roots and cointegration, VAR, ARCH dynamic panel data models, structural break models, and non-linear time series models. (Also offered as ADMN 842.) Prereq: ECON 926 and 927 or equivalents.

### **ECON #836 - Seminar in Monetary Theory and Policy**

**Credits:** 4.00

Contemporary developments in monetary theory and the evaluation of policy measures.

### **ECON 841 - Introduction to Public Policy**

**Credits:** 4.00

Explores the basic issues of public sector economics and emphasizes the use of economic theory in predicting the effects of public policy on individual behavior and the overall economy. Specific topics include market failures, collective decision making, cost/benefit analysis, and an evaluation of tax and transfer programs.

### **ECON 842 - Public Economics I**

**Credits:** 4.00

The basic issues of public sector economics. Analyzes economic theory and empirical methods as they relate to public goods, externalities, and regulation. Analyses of taxation, with focus on the effect of taxes on corporate behavior. Economics of technological diffusion and the use of cost-benefit analysis.

### **ECON 843 - Public Economics II**

**Credits:** 4.00

Emphasizes the use of economic theory and empirical methods in predicting the economic effects of a policy. Specific policies analyzed include social insurance programs such as Medicare and Social Security, income/in-kind transfer programs and individual taxation. Issues involving multi-level systems of government also considered.

### **ECON 845 - International Trade**

**Credits:** 4.00

Contemporary issues in international economic theory and policy. Analysis of trade theory, dynamics of world trade and exchange, and international commercial policy.

**ECON 846 - International Finance****Credits:** 4.00

International monetary mechanisms; balance of payments, international investment; exchange rates, adjustment systems international liquidity, foreign aid, multinational corporations.

**ECON 847 - Multinational Enterprises****Credits:** 4.00

The internationalization of economies. Growth and implications of the multinational corporation at the level of systems. Theories of imperialism, international unity/rivalry; theories of direct investment; the exercise of influence and conflict, technology transfer, bargaining with host country; effects on U.S. economy.

**ECON 856 - Labor Economics****Credits:** 4.00

Recent developments in labor market analysis and public policies related to contemporary labor issues. Labor supply, the structure and stratification of labor markets, economic discrimination, unemployment and poverty, inflation, and wage-price controls.

**ECON 868 - Seminar in Economic Development****Credits:** 4.00

An advanced reading seminar. Topics include methodologies underlying economic development theory, industrialization and post-import substitution, state capitalist development, stabilization policies, appropriate technologies, the capital goods sector, agricultural modernization schemes, and attempts at transition to socialism.

**ECON 898 - Economic Problems****Credits:** 2.00 or 4.00

Special topics; may be repeated. Prereq: permission of adviser and instructor.

**ECON 899 - Master's Thesis****Credits:** 1.00 to 8.00

Cr/F.

**ECON 926 - Econometrics I****Credits:** 4.00

Application and theory of statistical and econometric methods to problems in economics. Topics: basic statistical theory, simple and multiple regression, violations of the basic assumptions, generalized least squares, and introduction to simultaneous equation models. Prereq: undergraduate statistics course.

**ECON 927 - Econometrics II****Credits:** 4.00

Simultaneous equation models, nonlinear estimation, qualitative and limited-dependent variables, distributed lag models, introduction to time series (ARIMA) models, pooling of cross-section and time series models. Prereq: econometrics I or its equivalent.

**ECON 957 - History of Economic Thought****Credits:** 4.00

Traces the development of economic thought, with careful examination and critical appraisal of the contributions made by important figures and schools of thought.

**ECON 958 - Topics in Economic Thought and Methodology****Credits:** 4.00

Advanced seminar in a selected topic in economic thought or methodology.

**ECON 972 - Macroeconomics I****Credits:** 4.00

Development of the major macro models and approaches to macroeconomics: classical, Keynes' "General Theory,"

Keynesian, Monetarists, New Classical, and New Keynesian models and views. Introduction to open economy macro and growth models.

**ECON 973 - Macroeconomics II**

**Credits:** 4.00

Theory, empirical specification, and tests of macroeconomic functions. National econometric models. Theories and empirical models of the business cycle and economic growth. Use of models for policy analysis and forecasting.

Prereq: macroeconomics I; econometrics I.

**ECON 976 - Microeconomics I**

**Credits:** 4.00

Survey and applications of modern microeconomic theory. Analysis of households, firms, product and resource markets, and behavior under uncertainty.

**ECON 977 - Microeconomics II**

**Credits:** 4.00

Analysis of stability, cooperative and non-cooperative game theory, information economics, exhaustible resources, disequilibrium, public goods, public choice, and input-output analysis. Prereq: microeconomics I.

**ECON 988 - Graduate Seminar**

**Credits:** 1.00

Required of all first-year graduate students and second-year Ph.D. students. Cr/F.

**ECON 995 - Independent Study**

**Credits:** 1.00 to 6.00

Prereq: permission of adviser and instructor.

**ECON 996 - Research Workshop**

**Credits:** 2.00

Required of all third-year Ph.D. students. Cr/F.

**ECON 999 - Doctoral Research**

**Credits:**

Cr/F.

## Education

### **EDUC 800 - Educational Structure and Change**

**Credits:** 2.00 or 4.00

Organization, structure, and function of American schools; historical, political, social, and cross-cultural perspectives; nature and processes of change in education. A) Educational Structure and Change; B) Education in America: Backgrounds, Structure, and Function; C) Governance of American Schools; D) School and Cultural Change; E) Teacher and Cultural Change; F) Social Perspectives of Conflict in the Schools; G) Nature and Processes of Change in Education; H) What is an Elementary School?; I) Schooling for the Early Adolescent; J) Curriculum Structure and Change; K) Stress and Educational Organizations. Candidates for teacher licensure must take either 4-credit course 800A, or 2 credits each of 800F and 800C. Prereq: EDUC 500.

### **EDUC 801 - Human Development and Learning: Educational Psychology**

**Credits:** 2.00 or 4.00

Child development through adolescence, learning theory, cognitive psychology, research in teaching and teacher effectiveness, cross-cultural variability, and evaluation--all applied to problems of classroom and individual teaching and learning. A) Human Development and Learning: Educational Psychology; B) Human Development: Educational Psychology; C) Human Learning: Educational Psychology; D) Developmental Bases of Learning and Emotional Problems; E) Learning Theory, Modification of Behavior, and Classroom Management; F) Cognitive and Moral Development; G) Evaluating Classroom Learning; H) Deliberate Psychological Education; I) Sex Role Learning and School Achievement; J) The Development of Thinking. 2- and 4-credit courses are offered each semester. 2-credit courses emphasize either development or learning. Candidates for teacher certification are required to have the full 4-credit EDUC 801A or 2 credits each of EDUC 801B and 801C. Prereq: EDUC 500. 801A has a Special fee when taught in Manchester.

### **EDUC 803 - Alternative Teaching Models**

**Credits:** 2.00 or 4.00

Basic teaching models, techniques of implementation, and relationships to curricula. A) Alternative Teaching Models; B) Curriculum Planning for Teachers; C) Alternative Strategies for Maintaining Classroom Control; D) Social Studies Methods for Middle and High School Teachers; F) Teaching Elementary School Science; G) Language Arts for Elementary Teachers; H) Experiential Curriculum; I) Children with Special Needs: Teaching Strategies for the Classroom Teacher; K) Writing Across the Curriculum; L) Learning and LOGO; M) Teaching Elementary School Social Studies. 2- and 4-credit courses are offered. Teacher education students should be aware of the specific course(s) required for their licensure area. EDUC 803F and 803M are required for elementary education candidates. EDUC 803D is required for social studies candidates. EDUC 891 is required for science candidates. For all other secondary education candidates, the appropriate methods course in the department of the major is required. See "The Schoolhouse Book" for specific course listings. Prereq: EDUC 500.

### **EDUC 805 - Alternative Teaching Perspectives on the Nature of Education**

**Credits:** 2.00 or 4.00

Students formulate, develop, and evaluate their own educational principles, standards, and priorities. Alternative philosophies of education; contemporary educational issues. A) Contemporary Educational Perspectives; B) Controversial and Ethical Issues in Education; C) Ethical Issues in Education; D) Concepts of Teaching: Differing Views; E) Curriculum Theory and Development; F) Readings on Educational Perspectives; G) Philosophy of Education; I) Education as a Form of Social Control; K) Schooling and the Rights of Children; L) Education, Inequality, and Meritocracy; M) Readings in Philosophies of Outdoor Education; N) Alternative Perspectives on the Nature of Education; O) Classrooms: The Social Context; P) Teaching: The Social Context; Q) School and Society. 2- and 4-credit courses are offered. Minimum of 4 credits required for teacher certification. Candidates for teacher licensure must choose either 4-credit course 705A, 705B, or 705Q. Prereq: EDUC 500.

### **EDUC 806 - Introduction to Reading in the Elementary School**

**Credits: 4.00**

Methods in reading and writing instruction; current procedures and materials; diagnostic techniques. Course satisfies reading/language includes practicum experience and arts requirement for prospective elementary teachers in the five year teacher education program. Prereq: EDUC 500.

**EDUC 807 - Teaching Reading through the Content Areas****Credits: 2.00**

Approaches and methods for teaching reading through content materials; coursework includes practical applications through development of instructional strategies and materials. Required for candidates seeking licensure in art, biology, chemistry, earth science, general science, home economics, physical education, physics, or social studies.

**EDUC 810A - Concepts of Adult and Occupational Education****Credits: 4.00**

Development of occupational education in the U.S.; socio-economic influences responsible for its establishment; federal and state requirements for secondary and postsecondary schools. Coordination of programs with general education and vocational fields. Focus on selected concepts relevant to adult education. Special attention on the adult as a learner, volunteer management, evaluation and accountability, experiential learning, and adult education. Required of all degree candidates in AOE concentrations.

**EDUC 810B - Microcommunications****Credits: 4.00**

Organization, presentation, and evaluation of micro-lessons in a variety of educational settings. Preliminary experience and practice in communications. Variables of communicating under controlled conditions with videotaping for immediate feedback. Required for majors and minors. Special fee.

**EDUC 810C - Youth Organizations****Credits: 4.00**

Organizational Development: advising youth organizations; teaching parliamentary procedure; developing programs and activities; leadership organizations. FFA/SOEP (Future Farmers of America/Supervised Occupational Experience Programs for high school youth). VICA (Vocational Industrial Clubs of America). 4-H (Cooperative Extension Youth Program).

**EDUC 810D - Planning for Teaching****Credits: 4.00**

Organization of materials of instruction to meet group and individual needs. Techniques of instruction, planning for teaching, function of consulting committees, working with youth groups, program evaluation. Course scheduled concurrently with Educ. Supervised Teaching. Prereq: microcommunications or permission.

**EDUC 810E - Workshop in Adult and Occupational Education****Credits: 1.00 to 4.00**

Modularized instruction of in-service education. Focus varies with the needs of the student. May be repeated for up to 8 credits. Special fee.

**EDUC 810F - Investigations****Credits: 1.00 to 4.00**

Topics may include career education, secondary education, post-secondary education, adult education, extension education, exemplary education, cooperative education, disadvantaged and handicapped education, international agriculture, or teaching experience. Student-selected in one of the areas listed. Elective after consultation with instructor. Hours arranged. May be repeated.

**EDUC 810G - Seminar in Adult and Occupational Education****Credits: 1.00 to 2.00**

Discussion of current issues, problems, and research and development in vocational/technical and adult education. Students, faculty, and other personnel serve as discussion leaders. Required of departmental graduate students. (Fall

semester only.)

### **EDUC 811 - Youth, Culture, and Society in Comparative Perspective**

**Credits:** 4.00

This course examines lifestyles, social identities, and subcultures of youth in a variety of sociocultural and historical settings. Students will develop an understanding of the conditions that foster the formation of social identity and the emergence of age-based subcultures. The course explores the relationship between individual and social identity, and between youth subcultures and dominant cultural systems. (Also listed as ANTH 710.)

### **EDUC 817 - Growing up Male in America**

**Credits:** 4.00

An integrative view of growing up male in the American culture from birth through adulthood. Analysis of major perspectives on male development and the implications in parenting with specific emphasis on male education. Participants are expected to develop awareness of their own development as a male or alongside males, using current male development perspectives as a guide. They will also create an awareness of how this will affect their behavior toward boys in their classrooms.

### **EDUC 820 - Introduction to Computer Applications for Education**

**Credits:** 4.00

Major issues related to classroom computer applications: historical development; computer functioning; methods of instruction, problem solving, educational software development and evaluation, psychological and sociological impact of the computer on children and learning. A practical approach is stressed. Lab.

### **EDUC #821 - Application of Multimedia Technology in Education**

**Credits:** 2.00

This half semester course gives preservice and inservice teachers the opportunity to master two pieces of software that are often used in constructing multimedia projects. Students develop two projects--a product that can be used in multimedia authoring programs and a multimedia project. Class discussions and reflection papers based upon readings about integrating technology into the classroom.

### **EDUC 833 - Introduction to the Teaching of Writing**

**Credits:** 4.00

Development of writers, child to adult; ways to respond to writing, and the organization of the classroom for the teaching of writing. Persons taking the course will need to have access to students to carry out course requirements. Prereq: permission.

### **EDUC 834 - Children's Literature**

**Credits:** 4.00

Interpretive and critical study of literature for children in preschool and elementary settings. Methods of using literature with children.

### **EDUC 835 - Young Adult Literature**

**Credits:** 4.00

Critical study of the fiction and nonfiction genres that constitute literature written for the adolescent reader. Emphasis will be on literary analysis of young adult literature and its pedagogical uses in the middle/junior high/high school curriculum.

### **EDUC 841 - Exploring Mathematics with Young Children**

**Credits:** 4.00

A laboratory course offering those who teach young children mathematics, and who are interested in children's discovery learning and creative thinking; offers chance to experience exploratory activities with concrete materials, as well as mathematical investigations, on an adult level, that develop the ability to provide children a mathematically rich environment, to ask problem-posing questions, and to establish a rationale for doing so.

### **EDUC 850 - Introduction to Exceptionality**

**Credits: 4.00**

A life span perspective of the social, psychological, and physical characteristics of individuals with exceptionalities including intellectual, sensory, motor, health, and communication impairments. Includes implications for educational and human service delivery.

**EDUC 851A - Educating Exceptional Learners: Elementary****Credits: 4.00**

Foundations of special education and an introduction to a variety of service delivery models with an emphasis on educating all learners in heterogeneous classrooms. Instructional strategies and supports for all students, particularly those with mild and moderate disabilities, will be the primary focus.

**EDUC 851B - Educating Exceptional Learners: Secondary****Credits: 4.00**

Foundations of special education and an introduction to a variety of service delivery models with an emphasis on educating all learners in heterogeneous classrooms. Instructional strategies and supports for all students, particularly those with mild and moderate disabilities, will be the primary focus. Preparation for students' transitions to post-secondary life will be included.

**EDUC 851C - Educating Exceptional Learners: Related Services****Credits: 4.00**

An overview of special education and related services in an educational setting. Focus on support services provided to general education and special education teachers, including laws relating to special populations, how related services interact with classroom and special educators, IEPs, and other topics that impact services provided to students with special needs.

**EDUC 852 - Contemporary Issues in Learning Disabilities****Credits: 4.00**

Critical analysis of current and historical conceptions of learning disability in the areas of definition, supporting theories, assessment practice, and teaching methodologies. Focus will be on contemporary issues in the field that relate to working with students labeled as learning disabled at both elementary and secondary levels.

**EDUC 853 - Contemporary Issues in Behavioral Disabilities****Credits: 4.00**

Nature and scope of emotional and behavioral disabilities in students from elementary through secondary levels. Theoretical perspectives, characteristics, assessment and educational intervention strategies will be included.

**EDUC 854 - Contemporary Issues of Developmental Disabilities****Credits: 4.00**

The casual factors, physical and psychological characteristics, and educational and therapeutic implications of mental retardation, cerebral palsy, epilepsy, autism, and related conditions. A life span perspective will be included, with major emphasis on the school age population.

**EDUC 855 - Fostering Social Relationships for Students who Experience Significant Disabilities****Credits: 2.00**

This course will focus on the supports students with significant disabilities need in order to have a wide variety of satisfying social relationships. Students will learn to identify and facilitate the factors essential to the development of friendships such as: full inclusion; valued membership and belonging; shared experiences; an effective means of communication understood by everyone; and access to typical school, extracurricular, and community environments and activities. Additionally, students will learn to identify and mitigate the barriers to friendships, such as: low expectations; devaluing of differences; age-appropriate experiences; and educational practices, such as pull-out and separate special education programs. Students will learn about appropriate relationship supports, especially relating to the facilitation of communicative interactions.

**EDUC 860 - Introduction to Young Children with Special Needs****Credits: 4.00**

The needs of children (birth to eight years) with developmental problems or who are at risk for disabilities. Strengths and special needs of such children; causes, identification, and treatment; current legislation; parent and family concerns; program models.

### **EDUC 867 - Students, Teachers, and the Law**

**Credits:** 4.00

Our public schools play a vital role in our society. What shall be taught and who shall teach our children are perennial questions. This course explores how the law impacts the educational lives of students and teachers, including issues of church-state relations, free speech, dress codes, and search and seizure. (Also offered as JUST 867.)

### **EDUC 876 - Reading for Learners with Special Needs**

**Credits:** 4.00

Techniques and procedures for teaching reading to learners with special needs. Emphasis is placed on reading instruction in the least restrictive alternative.

### **EDUC 880 - Belize/New Hampshire Teacher Program**

**Credits:** 4.00

International course involving teams of teachers from Belize and New England. The program will offer teachers in both countries the opportunity to work collaboratively on developing effective teaching practices, develop an understanding of each other's cultural and educational perspectives, extend the experience to other teachers and students upon return. Special fee.

### **EDUC 881 - Introduction to Statistics: Inquiry, Analysis, and Decision Making**

**Credits:** 4.00

An applied statistics course that covers introductory level approaches to examining quantitative information. Students spend about half of class time in the computer lab analyzing real data from the behavioral and social sciences. An emphasis is placed on the role of statistics in making empirically-based policy decisions.

### **EDUC 885 - Educational Assessment**

**Credits:** 4.00

Theory and practice of educational assessment; uses of test results and authentic assessment strategies in classroom teaching.

### **EDUC 891 - Methods of Teaching Secondary Science**

**Credits:** 4.00

Application of theory and research findings in science education to classroom teaching with emphasis on inquiry learning, developmental levels of children, societal issues, integration of technology, critical evaluation of texts and materials for science teaching, and planning for instruction. Lab.

### **EDUC 894 - Proseminar in Teacher Leadership**

**Credits:** 2.00

This course will help experienced teachers to establish a framework for collaboration and inquiry focused on questions about teaching, learning, and school reform. Students will develop an academic and research agenda tied to their professional development as educators. Coursework will emphasize approaches to action research and the teacher-as-researcher.

### **EDUC 896 - Summer Institute in Environmental Education**

**Credits:** 8.00

An intensive, team-taught experience that immerses students in a process of inquiry explicitly designed to connect and integrate work in the Environmental Education Program's three focus areas: Pedagogy, Environmental Science, and Human Patterns and Environmental Transformations. A four week program, meeting four days/weeks for six-eight hours/day, with out-of-class assignments that make it a full-time commitment for students. Classroom and field-based activities help students experience the interdisciplinary nature of environmental education firsthand, while giving students the opportunity to explore materials, research methods, and instructional approaches appropriate to their

specific educational context. Prereq: Bachelor's degree, permission. (Also offered as NR 896.)

**EDUC 897 - Seminar in Contemporary Educational Problems**

**Credits:** 1.00 to 4.00

Issues and problems of special contemporary significance, usually on a subject of recent special study by faculty member(s). Prereq: permission. May be repeated for different topics. Special fee on topic: Picturing Writing, Fostering Literacy through Art.

**EDUC 899 - Master's Thesis**

**Credits:** 1.00 to 10.00

Prereq: permission of the department. Cr/F.

**EDUC 900A - Internship and Seminar in Teaching**

**Credits:** 3.00 or 6.00

A two semester, full-time, supervised internship consisting of less-than-full-time teaching responsibility in selected educational settings and programs. Weekly seminars and occasional workshops held concurrently with internship. Cr/F.

**EDUC 900B - Internship and Seminar in Early Childhood Education**

**Credits:** 3.00

A two semester, supervised internship with a weekly seminar. Admission by Application.

**EDUC 900C - Internship and Seminar in Special Education**

**Credits:** 3.00 or 6.00

A two semester, supervised internship with a weekly seminar. Admission by application. Cr/F.

**EDUC 900D - Internship and Seminar in Adult and Occupational Education**

**Credits:** 3.00 to 6.00

Internship in a field of vocational/technical and adult education either in methodology of teaching or in technical subject matter. Students may elect internship only after completing the qualifying examinations for the master's degree, with permission of their major adviser. May be repeated up to 6 credits. Cr/F.

**EDUC 901A - Internship and Seminar in Teaching**

**Credits:** 3.00 or 6.00

A two semester, full-time, supervised internship consisting of less-than-full-time teaching responsibility in selected educational settings and programs. Weekly seminars and occasional workshops held concurrently with internship. Cr/F.

**EDUC 901B - Internship and Seminar in Early Childhood Education**

**Credits:** 3.00

A two semester, supervised internship with a weekly seminar. Admission by Application.

**EDUC 901C - Internship and Seminar in Special Education**

**Credits:** 3.00 or 6.00

A two semester, supervised internship with a weekly seminar. Admission by application. Cr/F.

**EDUC #901D - Internship and Seminar in Adult and Occupational Education**

**Credits:** 3.00 to 6.00

Internship in a field of vocational/technical and adult education either in methodology of teaching or in technical subject matter. Students may elect internship only after completing the qualifying examinations for the master's degree, with permission of their major adviser. May be repeated up to 6 credits. Cr/F.

**EDUC 902 - Doctoral Proseminar**

**Credits:** 4.00

Introduces students to the range of scholarly inquiry undertaken in doctoral programs. Students develop a broad

understanding of educational studies and analyze various research paradigms in terms of assumptions, methods, and outcomes. Coursework includes developing a proposal. Matriculated doctoral students only.

### **EDUC 903 - Normative Inquiry in Education**

**Credits:** 4.00

Introduces the student to a critical study of some of the central ethical concepts, theories, and assumptions that shape contemporary educational theory, policy, and practice. Students read both classical and contemporary ethical theory and undertake to critically appraise these theories while using them to resolve moral problems. Prereq: EDUC 905 or permission.

### **EDUC 904 - Qualitative Inquiry in Education**

**Credits:** 4.00

Course will offer both a theoretical and practical background for conducting qualitative inquiry in education. Focused efforts toward understanding how the type or tradition of qualitative inquiry shapes the design of the study. Through comparative analysis of different qualitative traditions, students will be prepared to make informed decisions about what approaches to use in their studies and why they are using them. Prereq: permission.

### **EDUC 905 - Critical Inquiry in Education**

**Credits:** 4.00

Designed for advanced students to study philosophical methods needed for critical inquiry in education. Primary emphasis on practical mastery of: the construction and assessment of cogent argumentation; identification of common fallacies in reasoning; conceptual analysis; the appraisal of definitions, slogans, and metaphors in educational thought; and the disentangling of conceptual, factual, and normative claims associated with practical educational issues. Investigation of the difference between critique and criticism. Prereq: permission.

### **EDUC #906 - Language Arts through Reading and Writing**

**Credits:** 4.00

Teaching practices in reading, writing, listening, and oral language. Language development and application to school learning environments.

### **EDUC 907 - Foundations of Literacy Instruction**

**Credits:** 4.00

Overview of the nature of the reading/writing process and the continuum of instruction from emergent literacy through the primary and intermediate elementary grades. Emphasis is placed on validated instructional practices and issues of classroom organization and management of literacy instruction.

### **EDUC 908 - Clinical Diagnosis and Remediation of Reading Difficulties and Disabilities**

**Credits:** 4.00

Examination of theories and procedures for the diagnosis and remediation of moderate to severe disabilities in reading and writing through case studies, discussions, demonstrations, and practice. Clinical experience each semester. Prereq: EDUC 907; 910;/or permission.

### **EDUC 909 - Clinical Diagnosis and Remediation of Reading Difficulties and Disabilities**

**Credits:** 4.00

See description for EDUC 908.

### **EDUC 910 - Reading and Writing Methods in the Middle/Secondary School**

**Credits:** 4.00

Overview of literacy programs in middle/secondary school with emphasis on (1) developing an integrated literacy curriculum and (2) planning and providing literacy instruction in the content areas to improve students' reading and writing skills across the curriculum.

### **EDUC 913 - Field Practicum in Reading**

**Credits:** 4.00

Field-based experience focusing on roles of the reading specialist in organizing and managing literacy programs in

school settings; weekly seminar. Prereq: permission.

**EDUC 914 - Seminar in Reading Research**

**Credits:** 4.00

Analysis of qualitative and quantitative research paradigms as the basis for understanding and constructing research in reading and the related language arts. Topical study of current research base in emergent literacy, word analysis, comprehension, elementary and secondary/content reading diagnosis/remediation. Prereq: permission.

**EDUC 918A - Seminar on Research in Literacy Instruction**

**Credits:** 2.00

See description for EDUC 918.

**EDUC 918B - Seminar on Research in Literacy Instruction**

**Credits:** 2.00

See description for EDUC 918.

**EDUC #918C - Seminar on Research in Literacy Instruction**

**Credits:** 2.00

See description for EDUC 918.

**EDUC #918D - Seminar on Research in Literacy Instruction**

**Credits:** 2.00

See description for EDUC 918.

**EDUC 919 - Counseling Practicum: Professional and Ethical Orientation**

**Credits:** 4.00

Introduction to the field of counseling and development of fundamental counseling skills. Includes a skills-based practicum and seminars addressing contemporary professional issues. Legal and ethical responsibilities of counselors are examined.

**EDUC 920 - Counseling Theory and Practice**

**Credits:** 4.00

Provides a survey of major contemporary theories and techniques of counseling. The counseling process, various theoretical approaches, and an introduction to professional issues in counseling diverse populations are examined.

**EDUC 921 - Psychology of Career and Personal Development**

**Credits:** 4.00

Examines the interrelationship between career and personal development. An overview of theories, tools, and research that underlie career assessment is provided. Individual and group career counseling processes and skills are applied to career education models.

**EDUC 922 - Assessment in Counseling**

**Credits:** 4.00

Surveys evaluative instruments and methods that have particular use in counseling. Explores systematic procedures for measuring human behavior and statistical concepts that underlie psychological testing. Assessment is viewed from the perspectives of its use in the counseling process as well as in providing accountability for diagnosis and treatment planning.

**EDUC 923 - Group Counseling**

**Credits:** 4.00

Reviews theoretical and applied processes of group counseling. Class includes a laboratory experience to examine interactive behavior as a group member and facilitator. Pre- or Coreq: EDUC 919 or 920.

**EDUC 924 - Psychological Disorders and Variations in Human Development**

**Credits:** 4.00

Examines the development of effective and ineffective human functioning. Behavior patterns that pose the most common problems encountered by counselors are reviewed, with an emphasis on the concepts and processes of adaptation. Pre- or Coreq: EDUC 920.

**EDUC 925 - Counseling Internship I**

**Credits:** 4.00

Seminar accompanies supervised field experience at approved field site. Orientation to the diverse roles and functions of counselors in school and agency settings. Discussion and educational supervision of students' counseling and consultation activities at field site. Pre- or Coreq: EDUC 919, 920, 923, 924.

**EDUC 926 - Counseling Internship II**

**Credits:** 4.00

Seminar accompanies introductory supervised field experience at approved internship site. Small group format uses audiotaped samples of counseling sessions, providing critiques and educational supervision of counseling and consulting activities. Prereq: EDUC 925.

**EDUC 927 - Theories of Personality**

**Credits:** 4.00

Examines the structure of personality and the dimensions along which individuals may vary. Considers implications of personality variables for the counseling process.

**EDUC 928 - Family Counseling and Consultation**

**Credits:** 4.00

Introduction to current theories, processes, and goals of counseling and consultation with families and educational and community systems. Prereq: EDUC 920.

**EDUC 929 - Advanced Counseling Internship**

**Credits:** 4.00

Seminar accompanies supervised field experience at approved internship site. Weekly critiques of audiotaped samples of counseling sessions emphasize self-awareness and the application of advanced skills in counseling and consultation. Students provide layered supervision to first year GPC graduates. Prereq: EDUC 926.

**EDUC 930 - Research in Counseling**

**Credits:** 4.00

Provides an overview of research design and methodology in social and behavioral sciences. Emphasis on the responsibility of counselors as critical consumers of published research. Students develop research projects to enhance professional knowledge in educational or community settings. Prereq: EDUC 922.

**EDUC 931 - Clinical Diagnosis and Treatment Planning in Counseling**

**Credits:** 4.00

Reviews assessment and treatment planning strategies for major DSM-IV classifications. Class discussion of benefits and limitations of various diagnostic systems. Best practices and brief treatment models are examined in assigned readings, lectures, and case vignettes. Pre - or Coreq: EDUC 922, 924.

**EDUC 932 - Society and Culture: Contemporary Issues in Counseling**

**Credits:** 4.00

Examines the current social and cultural contexts of counseling. Emphasis on preparing counselors to address the needs of a pluralistic population characterized by diverse racial/ethnic membership as well as gender, sexual orientation, and physical ability.

**EDUC 933 - Developmental Models of Comprehensive School Guidance**

**Credits:** 4.00

Course includes a supervised field experience. Provides a review of child and adolescent psychosocial development as a foundation for learning and high level functioning. Students are expected to develop awareness of their own psychosocial adaptations. State and national guidelines provide a framework for teaching prosocial skills models.

Prereq: EDUC 919, 920, 925.

### **EDUC 935A - Seminar and Practicum in Teaching**

**Credits:** 4.00

For new graduate students admitted to the M.Ed. or M.A.T. program in the Department of Education. In-school experiences to develop introductory skills in observation and teaching. On-site seminars for analysis and evaluation. Assessment and advising related to teaching as a career. Prerequisite for further work toward a teacher licensure. Minimum of 7 hours a week, plus travel time, required. Prereq: permission. Cr/F.

### **EDUC 935B - Seminar and Practicum in Teaching**

**Credits:** 4.00

An exploratory practicum, which is an integrated part of the Live, Learn, & Teach (LLT) Summer Program. Designed to explore teaching as a career and to prepare, eventually, for a teaching internship. LLT includes preparation in curriculum and instruction; practical and theoretical approaches to experiential education; interpersonal and group skill development, approaches to classroom management; and exploration of the many aspects of teaching and learning. Students develop and co-teach summer classes for children or adolescents with advisement from experienced educators. Prereq: admission to Live, Learn, and Teach Summer Program. Cr/F.

### **EDUC 938 - Advanced Seminar in Special Education**

**Credits:** 4.00

Weekly seminar on current and/or controversial topics related to special education services. Possible topics include service delivery systems, classification and labeling, assessment, instructional techniques, classroom management, consultation, and the special educator as researcher. Prereq: matriculated student or permission.

### **EDUC 939 - Assessment and Teaching of Children with Learning Difficulties**

**Credits:** 4.00

A two-semester course to develop teacher competency to analyze learners and learning environments; specify learner characteristics; and design, implement, and evaluate appropriate educational interventions in the areas of language, mathematics, reading, behavior, and social skills. Focus on children with mild and moderate learning difficulties in regular classrooms. Prereq: EDUC 850; 851 and permission.

### **EDUC 940 - Assessment and Teaching of Children with Learning Difficulties**

**Credits:** 4.00

See description for EDUC 939.

### **EDUC 941 - Diversity and Child Development**

**Credits:** 4.00

Focus on typical child development from birth to age eight. Considers theories of child development and assessment from historical and contemporary perspectives, with emphasis on observation during naturally occurring activities as a means of learning about child development. Includes child study. Prereq: permission.

### **EDUC 942 - Sociocultural Perspectives on Teaching and Learning**

**Credits:** 4.00

Considers the growing body of knowledge on the role of play in children's development; includes examination of contemporary constructive theory. Organized around theme of teacher researcher. Assignments include research review and student-designed study of child development issue. Prereq: EDUC 941 or permission.

### **EDUC 943 - Changing Contexts in Early Education**

**Credits:** 4.00

Forum for exchange of knowledge on developmentally appropriate environments for young children. Considers interface between characteristics of the environment (physical and social as well as organizational) and children being served. Includes field visits to settings appropriate for typically developing children as well as those with special needs. Prereq: EDUC 941 or permission.

### **EDUC 944 - Inclusive Curriculum for Young Children**

**Credits:** 4.00

Classroom applications of constructivist theory. Curriculum planning and implementation; overview of research and theory related to teaching and learning of specific content areas, with emphasis on integrated approach to early childhood curriculum. Stresses the reciprocal nature of student-teacher relationship. Prereq: permission.

### **EDUC 947 - Curriculum for Young Children with Special Needs: Evaluation and Program Design**

**Credits:** 4.00

Overview of evaluation and intervention issues relevant to early childhood special education, focusing on ages three through eight. Norm-referenced and criterion-referenced assessment tools. Judgment-based evaluation and observation skills. Translation of evaluation information into goals and objectives for individual education programs. Developing appropriate programs in inclusive settings.

### **EDUC 948 - Leadership and Advocacy in Early Childhood Education**

**Credits:** 4.00

Examination of roles and responsibilities of early childhood professionals, with emphasis on action research skills, analysis of contemporary problems, strategies for advocacy, and program leadership skills.

### **EDUC 949 - Supporting Families of Individuals with Exceptionalities**

**Credits:** 4.00

An introduction to family system theory and the implications for families having members with exceptionalities. Issues addressed include diagnosis and prognosis, coping strategies, communication and team collaboration, cross-cultural competence, and agency and school delivery of services. Emphasis is on proactive collaboration with family members.

### **EDUC 950 - Research in Culture, Behavior, and Development**

**Credits:** 4.00

Study of child development from comparative perspective, considering race, gender, and disabling conditions as dimensions of diversity. Cross-cultural research examined as challenge to contemporary theories of child development. Ethnopsychology of child development. Use of anthropological methods in study of child development. Implications for educational theory and practice. Prereq: permission.

### **EDUC 951 - Laws and Regulations Affecting the Education of Students with Disabilities**

**Credits:** 4.00

Analysis of current federal and state policies affecting students with disabilities. Focus on Section 504 and IDEA. The role of policy making and constitutional and ethical issues discussed.

### **EDUC 952 - Inclusive Assessment, Curriculum, Instruction, and Communication Supports**

**Credits:** 4.00

One of sequence of courses that leads to New Hampshire certification in Mental Retardation. Meets some of the requirements for certification of the Council for Exceptional Children. This advanced course provides knowledge and skills in assessment, curriculum development/modification, and instruction. It is also expected that graduate students will use their knowledge of alternative/augmentative communication in developing assessment and instructional activities for students with significant special needs.

### **EDUC 953 - Seminar in Curriculum Study**

**Credits:** 4.00

Analysis of recent trends in public school curriculum; structures, philosophy, development, change, and evaluation. Primarily for experienced teachers and administrators. Prereq: teaching experience.

### **EDUC 954 - Leadership and Systems Change in Inclusive Education**

**Credits:** 2.00

One of a sequence of courses that leads to New Hampshire certification in Mental Retardation. Meets some of the requirements for certification of the Council for Exceptional Children. Leadership and advocacy are vital skills for teachers of students with significant disabilities. This course provides the knowledge and skills for graduates to begin to initiate change processes within schools to benefit students with and without disabilities.

**EDUC 955 - Mentoring New Teachers****Credits:** 2.00

This course introduces the concept of mentoring and explores the role of the mentor in education. Includes role play, reflective dialogue, simulations, and oral presentations. Topics may include: communication skills the role of feedback, modeling, peer coaching, cognitive coaching, classroom management, and relationship building. Required for certificate in mentoring.

**EDUC 956 - Learning to Listen: Developing Positive Behavior Supports for Students with Challenging Behaviors****Credits:** 4.00

One of a sequence of courses that leads to New Hampshire certification in Mental Retardation. Meets some of the requirements for certification of the Council for Exceptional Children. Behavioral challenges are the most frequent reason students with significant disabilities are excluded from inclusive settings in schools and communities. Course provides knowledge and skills in behavior as communication, utilization of functional assessments, and development of strategies to support students who experience challenging behaviors.

**EDUC 957 - Collaborative Models of Supervision for Cooperating Teachers****Credits:** 4.00

Becoming an outstanding supervisor and leader within school and professional communities is a complex process which includes learning to build productive relationships with supervisee's, developing competence in observing supervisee's and providing constructive feedback to supervisee's. Designed around a framework of six focus areas which guide the students in their practice and inquiry. Truly excellent supervisors must be familiar with and skilled at using multiple strategies. Provides the cooperating teacher with skills and knowledge about the supervision process and what is good teaching. Prereq: permission.

**EDUC 958 - Analysis of Teaching****Credits:** 4.00

Examination of and reflection on the nature of teaching will serve as the basis for analysis. A variety of strategies for analysis of teaching will be explored and implemented. Student-initiated inquiry into specific aspects of teaching will provide practical application of course material. Prereq: teaching experience.

**EDUC #959 - Curriculum and Instruction in Secondary Special Education****Credits:** 4.00

Analysis of forces and factors affecting secondary special education. Analysis of forces and factors affecting secondary special education curriculum, the theoretical constructs of curriculum models, and the practical aspect of development and modification of curriculum for meeting the needs of learners with educational disabilities. Discussion of transition and school to work issues included.

**EDUC 960 - Mentoring New Teachers****Credits:** 2.00

Induction into professional practices is often critical to success. This course prepares experienced teachers to assume the role of mentor to new teachers.

**EDUC 961 - Public School Administration****Credits:** 4.00

Introductory course to school leadership; major issues and trends in policy making, theories in school management, personnel, public relations, finance, decision making, ethics, and research in school administration.

**EDUC 962 - Educational Finance and Business Management****Credits:** 4.00

Principles of financing education, budgetary procedures, computer simulations, and business management. Analysis of N.H. school funding system. Handling practical school finance problems is part of the project work.

**EDUC 964 - Human Resources in Education****Credits:** 4.00

Problems arising from the communications process. Implications of group problem-solving processes. Interpersonal relations and group dynamics among students, faculty, staff, administration, and the community. Application of theories.

### **EDUC 965 - Educational Supervision and Evaluation**

**Credits:** 4.00

Theoretical foundations and practical applications of supervisory and instructional practices and procedures; consideration of observation instruments and techniques. Teacher evaluation and supervision reviewed. Each student conducts a field supervision project. Prereq: teaching experience or permission.

### **EDUC 967 - Legal Aspects of School Administration**

**Credits:** 4.00

Relationship of law to public education. Emphasis on federal constitution, New Hampshire statutes, and case law related to public interests served by elementary and secondary education. Special topics: church-state relationship, due process, desegregation, teacher employment, discrimination, negotiations, student rights, tort liability.

### **EDUC 968 - Collective Bargaining in Public Education**

**Credits:** 4.00

An examination of collective bargaining as practiced by school boards, administrators, and teacher organizations. Consideration is given to collective bargaining statutes, case law, employee relations boards, unit determinations, exclusive representation, union security provisions, scope of bargaining, good faith, grievance procedures, bargaining strategies, strikes, public interest, mediation, fact finding, arbitration, and the administration of the negotiated contract.

### **EDUC 969 - Practicum in Educational Administration**

**Credits:** 4.00

Supervised practical experience in planning and implementing graduate student-initiated field projects in school administration. Prereq: all core requirements.

### **EDUC 970 - Change Process in Education**

**Credits:** 4.00

Role of change agent and the change process in education as related to school personnel; structural characteristics of the school culture; change theory and systems analysis techniques. Students are required to apply some of the theories in an institutional setting.

### **EDUC 971 - School Facilities Management**

**Credits:** 4.00

Techniques and procedures involved in the long-range planning of school facilities: for example, school population projections, characteristics of the present and future educational programs, space requirements, evaluation of existing facilities, future use of existing buildings, analysis of financial resources available, identification of reasonable alternatives, and an examination of the probable consequences of such alternatives.

### **EDUC 972 - Educational Program Evaluation**

**Credits:** 4.00

Selected models for educational program evaluation; rationale underlying these models examined and compared; practical applications developed. Program and student assessment techniques reviewed. Prereq: EDUC 953; 961;/ or permission.

### **EDUC 973 - Analysis of Educational Policy**

**Credits:** 4.00

Policy systems and fundamental values shaping the development and enactment of education policy at the federal, state, and local levels.

### **EDUC 974 - Administrative Internship and Field Project**

**Credits:** 6.00

Field-based internship. Administrative experience in one or several educational and community agencies. Participation

in administrative and supervisory work of the agencies. Each intern completes a major field project requiring analysis and action appropriate for resolution of a significant administrative problem at the intern site. Supervision by university faculty. Prereq: permission of graduate adviser. A grade of credit (CR) is given upon successful completion of the internship and field project. Cr/F.

**EDUC 975 - Administrative Internship and Field Project**

**Credits:** 6.00

See description for EDUC 974. Cr/F.

**EDUC 976 - Principalship**

**Credits:** 4.00

Explores the theories and practical realities of the role and function of the public school principal. Reviews in depth leadership in the instructional setting, as a function of culture building, and as a moral craft; and the administration of a school. Students develop a knowledge base about the principalship and apply that knowledge through role playing, in-basket activities, and problem-solving activities. Prereq: two courses in educational administration.

**EDUC 977 - Leadership: The District Level Administrator**

**Credits:** 4.00

Examines the school superintendency and other district level positions of leadership that comprise the administrative team, focusing on the complexity of the current role and relationships, the critical issues facing school leaders, and the skills necessary for success as an educational leader in today's climate. Students analyze contemporary issues of school governance and examine problems of practice to understand the role of school superintendent and other district level administrators from a theoretical, political, and contemporary perspective.

**EDUC 980 - Research in the Teaching of Writing**

**Credits:** 4.00

Review of research in writing instruction, focusing on trends in design, research procedures, the contributions of linguistics, cognitive and developmental psychology, with a view to the conduct of research by participants. Prereq: permission.

**EDUC 981 - Quantitative Inquiry: Methods and Techniques of Educational Research**

**Credits:** 4.00

Conceptual aspects and practical realities of the research process applied to problems in education and human service disciplines. Develops skills necessary to use, as well as conduct, research.

**EDUC 982 - Issues and Methods in Ethnographic Research in Education**

**Credits:** 4.00

Provides theoretical grounding and field experience in ethnography as a deliberate inquiry process. Examines the application of ethnographic fieldwork to educational research.

**EDUC 983 - Advanced Psychology of Human Learning**

**Credits:** 4.00

Review and integration of learning theory, teacher effectiveness, motivation theory, and development through adolescence; application of these to teaching generally and to the areas of specialization of the participants. Prereq: EDUC 801 or equivalent.

**EDUC #984 - Advanced Human Development**

**Credits:** 4.00

Selected principles and skills humankind must consider in the attempt to maximize individual, social, and educational potential; emphasis on personal implementation. Prereq: EDUC 801; introduction to psychology;/ or equivalent.

**EDUC 985 - Contemporary Issues and Theories in Human Learning and Development**

**Credits:** 4.00

This course explores the human drive to know one's world. Although the primary focus is on traditional school-aged learners, views of the learner both in and out of school and across the life-span are considered as well. Theoretical

positions will include: cognitive developmental theory; an analysis of positions implicit in traditional and innovative schooling practices; and theories about the social organization of knowledge. Attention will be given to educational applications of recent advances in contemporary theories of learning and development, as well as changes in pedagogy and assessment. Prereq: EDUC 801, or equivalent introduction to human development and/or educational psychology;/ or permission.

### **EDUC 986 - Philosophy of Education**

**Credits:** 4.00

Seminar in comparative analysis of educational theories and the philosophical foundations upon which they are based. Application of theoretical criteria for evaluating educational practices and for developing one's own philosophy of education. Prereq: permission.

### **EDUC 988 - Alternative Models of Teacher Development**

**Credits:** 4.00

Examines the historical and current directions in the education of teachers with an emphasis on analysis of alternative models of teacher education.

### **EDUC 989A - College Teaching**

**Credits:** 2.00

An analysis of teaching strategies at the collegiate level. The planning, execution, and evaluation of instruction for meeting the needs of the young adult learner. Recommended for all who wish to teach in a collegiate setting. Discussion of lectures selected, distinguished UNH lecturers. Prereq: permission.

### **EDUC 989B - Junior and Vocational/Technical Colleges**

**Credits:** 4.00

Rise and development of community-junior colleges and two-year vocational/technical colleges in American education; their history, potential, philosophy, and functions.

### **EDUC 989C - Programming in Adult Education**

**Credits:** 4.00

Focus on the program development process with particular attention to the design and implementation of educational programs that respond to adult needs. Special attention given to the involvement of adult learners in the programming process and to educational programs in both Cooperative Extension Service and continuing education. Required for master's degree candidates concentrating in adult education.

### **EDUC 990 - Developmental Perspectives on Adulthood**

**Credits:** 4.00

Research and theory about critical life issues; developmental tasks of the life cycle; periods of transition; stages of intellectual, moral, and personality development of the adult; and the design of significant learning experiences for adults within a variety of educational settings and institutions. Prereq: permission.

### **EDUC 991 - Curriculum Theory I**

**Credits:** 4.00

Explores models of curriculum theorizing, the relationship between curriculum and theory and society and school practice, and current curriculum issues and reform initiatives.

### **EDUC 992 - Curriculum Theory II**

**Credits:** 4.00

Seminar in social and philosophic foundations of curriculum theory in which students explore the influence of social, cultural, and institutional contexts on the framing and organization of curricular knowledge; evaluate the social, educational and research implications of dominant knowledge paradigms; and apply a selected theoretic perspective to curricular analysis.

### **EDUC 993 - Epistemology and Education**

**Credits:** 4.00

This course addresses epistemological problems in their general form, and also explores these issues with an eye to their implications for educational theories and practices. Topics include: What is knowledge? How do we justify knowledge claims? What is the relation between knowledge and emotion, values, experience, situatedness? Is truth invisibly and ubiquitously shaped by power? Is there an epistemological justification for multicultural education?

Prereq: EDUC 905 or equivalent; permission.

### **EDUC 995 - Independent Study**

**Credits:** 1.00 to 4.00

Opportunity for intensive investigation of a special problem or issue in the field of education. Prereq: permission. May be repeated to a maximum of 8 credits.

### **EDUC 998 - Special Topics**

**Credits:** 1.00 to 4.00

Study of a particular theoretical, methodological, or policy issue. May be offered off campus as professional development.

### **EDUC 999 - Doctoral Research**

**Credits:**

Cr/F.

## Environmental Education

### **ENED 890 - Environmental Education Summer Institute: Field Ecology, Human Communities, and Curriculum**

**Credits:** 8.00

An intensive, team-taught experience that immerses students in a process of inquiry explicitly designed to connect and integrate work in the Environmental Education Program's three focus areas: Pedagogy, Environmental Science, and Human Patterns and Environmental Transformations. A four week program, meeting four days/weeks for six-eight hours/day, with out-of-class assignments that make it a full-time commitment for students. Classroom and field-based activities help students experience the interdisciplinary nature of environmental education firsthand, while giving students the opportunity to explore materials, research methods, and instructional approaches appropriate to their specific educational context. Prereq: a minimum of two prior life or physical science courses. Permission required.

### **ENED 900 - Seminar and Practicum in Environmental Education**

**Credits:** 4.00

## English

### **ENGL 803 - Advanced Nonfiction Writing**

**Credits:** 4.00

A workshop course for students intending to write publishable magazine articles or nonfiction books. Equal stress on research and writing techniques. Prereq: newswriting; written permission of instructor required. May be repeated for credit with the approval of the department chairperson.

### **ENGL 804 - Advanced Nonfiction Writing**

**Credits:** 4.00

See description for ENGL 803.

### **ENGL 805 - Advanced Poetry Workshop**

**Credits:** 4.00

Workshop discussion of advanced writing problems and submitted poems. Individual conferences with instructor. Prereq: writing poetry or equivalent. Written permission of instructor required for registration. May be repeated for credit with the approval of the department chairperson.

### **ENGL 806 - Researching the Literature of Fact**

**Credits:** 4.00

Many writers think that the heart of creative nonfiction is style, but in truth, the genre's soul is in its content. This course covers tools such as intimate reporting, periodicals, the Internet, and first-hand observation to research people, places, issues, and history. The skills learned will serve graduate students of all kinds of writing, from fiction to academic. Permission of instructor required. Special fee.

### **ENGL 807 - Form and Theory of Fiction**

**Credits:** 4.00

A writer's view of the forms, techniques, and theories of fiction. The novels, short stories, and works of criticism studied vary, depending on the instructor.

### **ENGL 808 - Form and Theory of Nonfiction**

**Credits:** 4.00

A writer's view of contemporary nonfiction, emphasizing the choices the writer faces in the process of research and writing.

### **ENGL 809 - Form and Theory of Poetry**

**Credits:** 4.00

A writer's view of the problems, traditions, and structures of poetry.

### **ENGL 810 - Teaching Writing**

**Credits:** 1.00 to 6.00

An introduction to various methods of teaching writing. Combines a review of theories, methods, and texts with direct observation of teaching practice.

### **ENGL 811 - Editing**

**Credits:** 4.00

A survey of newspaper editing. Intended primarily for students in the graduate nonfiction writing program, the course will cover copy editing, content editing, coaching writers, writing headlines, and ethical and legal issues in journalism. Students will complete editing assignments and act as coaches for undergraduate students in ENGL 621: Newswriting. While much work in the course will involve newspapers, principles applicable to magazine and nonfiction book editing will also be covered. Written permission of the instructor required for registration. Special fee.

**ENGL 813 - Literary Theory****Credits:** 4.00

Major theoretical approaches to literature and its contexts; a range of works from ancient Greece to the present. Questions addressed include: What is literature? What methods might one use to analyze literary texts? What role might cultural and social conditions play in our understanding of literature? How have traditional answers to these and other questions about literature been contested? 813: From Plato to modernism. 814: From modernism to the present. Lecture-discussion format.

**ENGL 814 - Literary Theory****Credits:** 4.00

See description for ENGL 813.

**ENGL 815 - Teaching English as a Second Language: Theory and Methods****Credits:** 4.00

A study of how linguistic, psychological, sociological, and neurological theory influences or determines the choice of methods of language teaching. Research on second language acquisition and bilingualism, language aptitude, and the cultural context of language acquisition. Includes an introduction to standard and exotic methods of language teaching.

**ENGL 816 - Curriculum, Materials and Assessment in English as a Second Language****Credits:** 4.00

A study of the problems in designing an effective teaching program for various types of ESL students. An introduction to competence and aptitude testing and to the choosing and adapting of materials for ESL classes.

**ENGL 817 - World Englishes****Credits:** 4.00

Study of the forms and functions of Englishes in various parts of the world and the linguistic, sociolinguistic, literary, pedagogical, and political implications of the worldwide spread of the language. Topics include language change, language policies, language and power, language and culture, language and identity, literary creativity, and linguistic imperialism.

**ENGL 818 - English Linguistics and Literature****Credits:** 4.00

An introduction to linguistics for students of literature. Includes a survey of the grammar of English (phonology, morphology, syntax, dialect variation, historical change) with application to the analysis of the language of poetry and prose. (Not offered every year.)

**ENGL 819 - Sociolinguistics Survey****Credits:** 4.00

How language varies according to the characteristics of its speakers: age, sex, ethnicity, attitude, time, and class. Quantitative analysis methods; relationship to theoretical linguistics. Focus is on English, but some other languages are examined. Prereq: introduction to linguistics or permission.

**ENGL 827 - Issues in Second Language Writing****Credits:** 4.00

Study of various issues in second language writing theory, research, instruction and administration. Topics include the characteristics and needs of second language writers, second language writing processes, contrastive rhetoric, grammar instruction, teacher and peer feedback, assessment, course design and placement.

**ENGL 829 - Spec Top/Composition Studies****Credits:** 4.00

Advanced course on a topic chosen by the instructor. Precise topics and methods of each section vary. Possible topics include: alternative discourses and rhetorics; contrastive rhetoric; electronic discourse and digital rhetoric; women's rhetorics and feminist pedagogies; Montaigne and the essay tradition; theories of literacy; theories of persuasive

writing; theories of transactional writing; and written discourse analysis. Barring duplication of subject, may be repeated for credit. For details see the course descriptions available in the English Department.

**ENGL #832 - Folklore and Folklife**

**Credits:** 4.00

Examines the materials and methods used to study folklore and folklife, emphasizing the historical context and development of folklore studies in North America and Europe, field research, performance theory, and other topics.

**ENGL 840 - Indigenous New England**

**Credits:** 4.00

An interdisciplinary introduction to the literatures, histories, and cultures of indigenous people located in what is now called New England. Course topics include U.S. American Indian policy, tribal government structures and resistance, the history and forms of indigenous literacy, contemporary sovereignty struggles, popular culture, and film. Curricular activity with regional Native people required - e.g., a visit to a Native community, work with tribal guest speakers, participation in a lecture or film series. Special fee.

**ENGL 841 - Literature of Early America**

**Credits:** 4.00

Prose and poetry of the periods of exploration, colonization, early nationalism, Puritanism, Enlightenment. Individual works and historical-cultural background. (Not offered every year.)

**ENGL 842 - American Literature, 1815-1865**

**Credits:** 4.00

Fiction, nonfiction, and poetry in the period of romanticism, transcendentalism, nationalism. Individual works and cultural background. (Not offered every year.)

**ENGL 843 - American Literature, 1865-1915**

**Credits:** 4.00

Fiction, nonfiction, and poetry in the period of realism, naturalism, industrialism, big money. Individual works and cultural background.

**ENGL 844 - American Literature, 1915-1945**

**Credits:** 4.00

Fiction, poetry, and drama in the period of avant-garde and leftism, jazz age, and depression. Individual works and cultural background.

**ENGL 845 - Contemporary American Literature**

**Credits:** 4.00

A gathering of forms, figures, and movements since 1945. Individual works and cultural background. (Not offered every year.)

**ENGL #846 - Studies in American Drama**

**Credits:** 4.00

Topics vary from year to year. Examples: 20th-century American drama; contemporary playwrights; theatricality in American life. (Not offered every year.)

**ENGL 847 - Studies in American Poetry**

**Credits:** 4.00

Topics vary from year to year. Examples: poets of the road; Pound and his followers; major American poets; contemporary American poetry. (Not offered every year.)

**ENGL 848 - Studies in American Fiction**

**Credits:** 4.00

Topics vary from year to year. Examples: the romance in America; the short story; realism and naturalism; the city novel; fiction of the thirties. (Not offered every year.)

**ENGL 849 - Major American Authors****Credits:** 4.00

Intensive study of two or three writers. Examples: Melville and Faulkner; Fuller, Emerson, and Thoreau; James and Wharton; Dickinson and Frost. (Not offered every year.)

**ENGL 850 - Special Studies in American Literature****Credits:** 4.00

Topics vary from year to year. Examples: the Puritan heritage; ethnic literatures in America; landscapes in American literature; five American lives; pragmatism; American humor; transcendentalism; women regionalists.

**ENGL 851 - Medieval Epic and Romance****Credits:** 4.00

Two major types of medieval narrative; comparative study of works from England, France, Germany, and Iceland, including "Beowulf", "Song of Roland", "Nibelungenlied", Gottfried's "Tristan", Njal's "Saga", and Malory's "Morte d'Arthur". All works read in modern English translations. (Not offered every year.)

**ENGL 852 - History of the English Language****Credits:** 4.00

Evolution of English from the Anglo-Saxon period to the present day. Relations between linguistic change and literary style.

**ENGL 853 - Old English****Credits:** 4.00

Introduction to Old English language and literature through readings of selected poetry and prose.

**ENGL 854 - Beowulf****Credits:** 4.00

A reading of the poem and an introduction to the scholarship. Prereq: ENGL 853.

**ENGL 856 - Chaucer****Credits:** 4.00

A study of "The Canterbury Tales" in its original language. (Not offered every year.)

**ENGL 858 - Shakespeare****Credits:** 4.00

A few plays studied intensively. Live and filmed performances included as available.

**ENGL 859 - Milton****Credits:** 4.00

Milton and his age. Generous selections of Milton's prose and poetry, with secondary readings of his sources and the scholarship. (Not offered every year.)

**ENGL #863 - Continental Backgrounds of the English Renaissance****Credits:** 4.00

Major philosophers, artists, and writers of the continental Renaissance (in translation): Petrarch, Ficino, Pico, Vives, Valla, Castiglione, Machiavelli, Luther, Calvin, Rabelais, Montaigne, Cervantes, Erasmus, and Thomas More, as representative of the early English Renaissance. (Not offered every year.)

**ENGL 864 - Prose and Poetry of the Elizabethans****Credits:** 4.00

Shakespeare and his contemporaries. Major works, including Spenser's "Faerie Queene", Sidney's "Astrophil and Stella", Shakespeare's "Sonnets", Marlowe's "Dr. Faustus": their literary and intellectual backgrounds. (Not offered every year.)

### **ENGL #865 - English Literature in the 17th Century**

**Credits:** 4.00

Major writers of the 17th century, including Donne, Jonson, Herbert, Bacon, and Hobbes. (Not offered every year.)

### **ENGL 867 - Literature of the Restoration and Early 18th Century**

**Credits:** 4.00

Poetry, dramas, fiction, letters, journals, and essays from the period following the restoration of Charles II to the throne of England after the English Civil War. Works by such figures as John Dryden, Aphra Behn, Daniel Defoe, Jonathan Swift, Alexander Pope, and Lady Mary Wortley Montagu studied in historical context. Examples from the colonial world and the continent (in translation) when appropriate. (Not offered every year.)

### **ENGL 868 - Literature Later 18th Century**

**Credits:** 4.00

Poetry, drama, fiction, letters, journals, essays, and biography from the period that culminated in the American and French revolutions. Works by such figures as Henry Fielding, Samuel Johnson, Frances Burney, Laurence Sterne, William Blake, and Mary Wollstonecraft studied in historical context. Examples from the colonial world and the continent (in translation) when appropriate. (Not offered every year.)

### **ENGL 869 - English Romantic Period**

**Credits:** 4.00

Major literary trends and authors, 1798 to 1832. Focus on poetry but attention also to prose works and critical theories. Wordsworth, Coleridge, Lamb, Hazlitt, DeQuincy. (Not offered every year.)

### **ENGL #870 - English Romantic Period**

**Credits:** 4.00

Major literary trends and authors 1798 to 1832. Focus on poetry but attention also to prose works and critical theories. Byron, Shelley, Keats. (Not offered every year.)

### **ENGL 871 - Victorian Prose and Poetry**

**Credits:** 4.00

Major writers; social and cultural history. Selections vary from year to year. (Not offered every year.)

### **ENGL 873 - British Literature of the 20th Century**

**Credits:** 4.00

Poets and novelists of the modernist and postmodernist periods. W.B. Yeats, James Joyce, Virginia Woolf, E.M. Forster, D.H. Lawrence, and other modernists. (Not offered every year.)

### **ENGL 874 - British Literature of the 20th Century**

**Credits:** 4.00

Poets and novelists of the modernist and postmodernist periods. A selection of postmodernist or contemporary writers, such as William Golding, Doris Lessing, John Fowles, Philip Larkin, Seamus Heaney, Margaret Drabble, and others. (Not offered every year.)

### **ENGL 875 - Irish Literature**

**Credits:** 4.00

Survey from the beginnings to the present; works in Irish (read in translation) such as "The Cattle Raid of Cooley", medieval lyrics, and "Mad Sweeney"; and works in English from Swift to the present. Twentieth-century authors: Joyce, Yeats, Synge, O'Casey, Beckett, and Flann O'Brien. (Not offered every year.)

### **ENGL 877 - Postcolonial Novel**

**Credits:** 4.00

Representative novels from writers such as Salman Rushdie, Amitava Ghosh, Bapsi Sidhwa, R.K. Narayan, Raja Rao, Romesh Gunasekara, Arundati Roy, Mahasweta Devi, U.R. Anantamoorthy, and others. Study of the development of the novel in English in South Asia from the mid-nineteenth century to the present day. Focus is on novels originally written in English; English translation from other South Asian languages when appropriate.

**ENGL 879 - Linguistic Field Methods****Credits:** 4.00

Devoted to the study, with use of an informant, of some non-Indo-European language that is unfamiliar to both the students and the instructor at the beginning of the class. The primary aim of the course is to give students a practical introduction to linguistic analysis without the support of a text. Theoretical concepts are introduced as needed. Special fee.

**ENGL 880 - English Drama to 1640****Credits:** 4.00

Development of the drama through the Renaissance, emphasizing the Elizabethan and Jacobean dramatists. (Not offered every year.)

**ENGL 881 - English Drama from 1660 to 1800****Credits:** 4.00

Study of selected plays, their performance and their publication. Works by such figures as William Wycherley, Thomas Otway, Mary Pix, George Lillo, Susanna Centlivre, Richard Sheridan, and Elizabeth Inchbald. Special attention to the new prominence of women in the drama of this period, changes in theater architecture, forms of nondramatic spectacle, and the political and social significance of drama. (Not offered every year.)

**ENGL 882 - Modern Drama****Credits:** 4.00

Major English, American, and (translated) European plays of the modern period by such playwrights as Shaw, Ibsen, Checkov, Strindberg, Pirandello, O'Neill, Brecht, Beckett, Williams, Miller, Pinter. Live and filmed performances studied as available. (Not offered every year.)

**ENGL 883 - English Novel of the 18th Century****Credits:** 4.00

Study of the rise and development of the novel in the eighteenth century. Works by such figures as Daniel Defoe, Eliza Haywood, Samuel Richardson, Henry Fielding, Charlotte Lennox, Laurence Sterne, Frances Burney, and Jane Austen. Focus on writers who published their work in England but with examples from the colonial world and the continent (in translation) when appropriate. (Not offered every year.)

**ENGL 884 - English Novel of the 19th Century****Credits:** 4.00

Representative novels from among Austen, Scott, Dickens, Thackeray, Emily Bronte, Charlotte Bronte, Trollope, George Eliot, Hardy, and Conrad.

**ENGL 885 - Major Women Writers****Credits:** 4.00

Intensive study of one or more women writers. Selections vary from year to year.

**ENGL 886 - 20th Century British Fiction****Credits:** 4.00

Traces the development of the novel from the turn of the century to the present day. Representative novels by Lawrence, Joyce, Conrad, Woolf, West, Forster, Huxley, Waugh, Murdoch, Burgess, and Lessing.

**ENGL 890 - Special Topics in Linguistics****Credits:** 4.00

An advanced course on a topic to be chosen by the instructor. Inquire at the English department office for a full course description each time the course is offered. Topics such as word formation, dialectology, linguistic theory and language acquisition, language and culture, cross-disciplinary studies relating to linguistics. Barring duplication of subject, may be repeated for credit. (Not offered every year.)

**ENGL 891 - English Grammar**

**Credits: 4.00**

A survey of the grammar of English (pronunciation, vocabulary, sentence structure, punctuation, dialect variation, historical change) with special attention to the distinction between descriptive and prescriptive grammar and to the problems students have with formal expository writing.

**ENGL 892 - Teaching Secondary School English****Credits: 4.00**

Methods of teaching language, composition, and literature in grades 7-12. Required of all students in the English teaching major. Open to others with permission.

**ENGL 893 - Phonetics and Phonology****Credits: 4.00**

The sounds and sound systems of English in the context of linguistic theory: comparisons of English to other languages. Prereq: a basic linguistic course or permission. (Not offered every year.)

**ENGL 894 - Syntax and Semantic Theory****Credits: 4.00**

The relationship of grammar and meaning as viewed from the standpoint of modern linguistic theory. Emphasis on the syntax and semantics of English, with special attention to the construction of arguments for or against particular analyses. Prereq: a basic linguistic course or permission.

**ENGL 897 - Special Studies in Literature****Credits: 2.00 to 6.00**

A) Old English Literature; B) Medieval Literature; C) 16th Century; D) 17th Century; E) 18th Century; F) English Romantic Period; G) Victorian Period; H) 20th Century; I) Drama; J) Novel; K) Poetry; L) Nonfiction; M) American Literature; N) A Literary Problem; O) Literature of the Renaissance. The precise topics and methods of each section vary. barring duplication of subject, may be repeated for credit. For details, see the course descriptions available in the English department.

**ENGL 901 - Advanced Writing of Fiction****Credits: 4.00**

Workshop discussion of advanced writing problems and readings of students' fiction. Individual conferences with instructor. Prereq: writing fiction or equivalent. Written permission of the instructor required for registration. May be repeated for credit with the approval of the department chairperson.

**ENGL 910 - Practicum in Teaching College Composition****Credits: 4.00**

Focus on problem issues and methods for teaching writing to first-year students. Open only to teachers in Freshman English program.

**ENGL 911 - Writing for Teachers****Credits: 4.00**

Opportunity for teachers of composition to work intensively on their writing, to read as writers, and to discover the principles appropriate to the writing genre they are teaching. Because of its special focus, this course may not be applied to the M.A. in English/writing option. Topics may vary.

**ENGL 912 - Historical and Theoretical Studies in Rhetoric****Credits: 4.00**

The rhetorical tradition in Western culture, with a special focus on three critical periods: the classical period (Aristotle, Cicero, Quintillian), the eighteenth century (Blair and Campbell), and the modern era (Burke, Booth, Perelman, Ong, Weaver).

**ENGL 913 - Theory and Practice of Composition****Credits: 4.00**

Examination of major theoretical and pedagogical works in the field of composition. To include works on the writing

process, writing development, response to writing, and other topics.

### **ENGL 914 - Special Topics in Composition and Rhetoric**

**Credits:** 2.00 to 6.00

Topics chosen by instructor may include: A) Political, Philosophical, and Ethical Issues in Composition; B) Gender and Writing; C) Cognition and Composition; and D) Ethnographics of Literacy.

### **ENGL 916 - History of Composition**

**Credits:** 4.00

Composition teaching and theory in American colleges and academics from the 18th century to the present.

### **ENGL 918 - Research Methods in Composition**

**Credits:** 4.00

Overview of major research approaches including historical, case study, ethnographic, and textual; special emphasis on research design.

### **ENGL 919 - Teaching the Writing Process**

**Credits:** 2.00 to 6.00

Focus both on the writing of the participants and on the teaching of writing in grades K-12. Special attention is given to strategies for prewriting, revision, evaluation, and conducting writing conferences.

### **ENGL 920 - Issues in Teaching English and the Language Arts**

**Credits:** 1.00 to 6.00

Special topics in the teaching of English and the language arts. Inquire at the English department to see what topics in the teaching of reading, writing, literature, or language arts may be scheduled. Open only to graduate students with a professional interest in teaching or to practicing teachers. 1-6 credits depending on the specific course.

### **ENGL 921 - Practicum in Teaching English and the Language Arts**

**Credits:** 2.00 to 6.00

A site-based course for practicing teachers that features in-class observations and demonstrations, individual consultation, and group meetings in the schools. Prereq: permission. May be repeated to a maximum of 8 credits.

### **ENGL 922 - Advanced Topics in Literacy Instruction**

**Credits:** 1.00 to 6.00

Specialized study of literacy topics that may include: A) Art and the Teaching of Writing; B) Nature journaling; C) Gender and Literacy; D) Portfolio Pedagogy; E) Ethnographics of Literacy; and F) Teacher Research.

### **ENGL 923 - Advanced Essay Writing**

**Credits:** 4.00

Writing and reading course in which students are encouraged to experiment with a variety of styles and forms. Discusses outside reading by focusing on techniques that the student might want to apply to his or her own material. Prereq: permission.

### **ENGL 924 - Bibliography and Methods**

**Credits:** 2.00

Introduction to enumerative and physical bibliography and major research and reference works of the field, to prepare the student for original research in the graduate program and later. Required of all Ph.D. students. Cr/F.

### **ENGL 925 - Graduate Study of Literature**

**Credits:** 4.00

Techniques, resources, and purposes of literary study: close reading; practical criticism; critical theories and their values; pertinence of intellectual and historical backgrounds. Approaches applied to a specific area of literary study, which varies from year to year.

### **ENGL 926 - Seminar: Literary Theory**

**Credits:** 4.00

Major questions and topics in the current theories about literature and contexts. What is literature? What method might one use to analyze literary texts? What role might cultural and social conditions play in our understanding of literature? How have traditional answers to these and other questions about literature been contested? May be repeated.

**ENGL #927 - Seminar: Feminist Criticism Theory and Practice**

**Credits:** 4.00

May be repeated.

**ENGL #928 - Issues in Teaching at the College Level**

**Credits:** 2.00

English 928 helps prepare students to teach general level courses. The seminar explores practical and theoretical issues: responding to students' writing; handling group discussion; designing assignments; developing a syllabus and exploring relationships between critical theory and approaches to instruction. Material useful to teachers interested in community college work. Prereq: graduate students only. Cr/F.

**ENGL #932 - Seminar: Folklore and Folklife**

**Credits:** 4.00

May be repeated.

**ENGL 935 - Seminar: Studies in American Literature**

**Credits:** 4.00

May be repeated.

**ENGL 936 - Seminar: Literature of Early America**

**Credits:** 4.00

May be repeated.

**ENGL 937 - Seminar: Studies in 19th Century American Literature**

**Credits:** 4.00

May be repeated.

**ENGL 938 - Seminar: Studies in 20th Century American Literature**

**Credits:** 4.00

May be repeated.

**ENGL 953 - Seminar: Studies in Old English**

**Credits:** 4.00

May be repeated.

**ENGL #956 - Seminar: Studies in Medieval Literature**

**Credits:** 4.00

May be repeated.

**ENGL 958 - Seminar: Studies in Shakespeare**

**Credits:** 4.00

May be repeated.

**ENGL 959 - Seminar: Studies in Milton**

**Credits:** 4.00

May be repeated.

**ENGL #960 - Seminar: Studies in English Drama**

**Credits:** 4.00

May be repeated.

**ENGL #964 - Seminar: Studies in 16th Century Literature**

**Credits:** 4.00

May be repeated.

**ENGL 965 - Seminar: Studies in Early 17th Century Literature**

**Credits:** 4.00

May be repeated.

**ENGL #968 - Seminar: Studies in 18th Century Literature**

**Credits:** 4.00

May be repeated.

**ENGL 970 - Seminar: Studies in the Romantic Period**

**Credits:** 4.00

May be repeated.

**ENGL 971 - Seminar: Studies in the Victorian Period**

**Credits:** 4.00

May be repeated.

**ENGL 974 - Seminar: Studies in 20th Century British Literature**

**Credits:** 4.00

May be repeated.

**ENGL 981 - Seminar: Studies in Post-Colonial Literatures in English**

**Credits:** 4.00

May be repeated.

**ENGL #990 - Seminar in Linguistics**

**Credits:** 4.00

May be repeated.

**ENGL 994 - Practicum in Teaching English to Speakers of Other Languages**

**Credits:** 2.00 to 6.00

Students have an opportunity to observe and discuss ESL classes and to design and carry out their own lessons, with follow-up evaluation. Cr/F.

**ENGL 995 - Independent Study**

**Credits:** 1.00 to 8.00

To be elected only with permission of the director of graduate studies and of the supervising faculty member.

**ENGL 996 - Reading and Research**

**Credits:** 2.00 to 8.00

Cr/F.

**ENGL 998 - Master's Paper**

**Credits:** 4.00

Cr/F. IA (Continuous grading).

**ENGL 999 - Doctoral Research**

**Credits:**

Cr/F.

## Earth, Oceans, & Space

### **EOS #807 - Global Ecosystem Policy**

**Credits:** 3.00

Scientific and institutional issues pertinent to global change; scientific basis for the global Earth and biogeochemical cycles that maintain Earth's thermostasis; long-term effects of major human perturbations (greenhouse warming of the atmosphere, ozone depletion, deforestation, desertification, and biotic and soil impoverishment) and human-environment feedback mechanisms on the viability of the Earth versus the survival of the human species; effectiveness of existing and alternative national, regional, and international institutions in responding to global change. Prereq: permission.

### **EOS 810 - Introduction to Astrophysics**

**Credits:** 4.00

Review of the sun, stars, Milky Way, external galaxies, and expansion of the universe. Recent discoveries of radio galaxies, quasi-stellar objects, cosmic black-body radiation, x rays, and gamma rays precede a discussion of Newtonian and general relativistic cosmological models, steady-state big-bang theories, and matter-antimatter models. (Also offered as PHYS 810.) Cr/F.

### **EOS 812 - Physics of the Ionosphere**

**Credits:** 4.00

Introduces basic plasma physics using a case study of the Earth's ionosphere and its connection both to the upper atmosphere and to the Earth's magnetosphere. Topics include single particle motion, fluid and kinetic descriptions of ionospheric plasma, wave propagation, and instabilities. Prereq: electrical and magnetic I or equivalent; calculus II. (Also offered as PHYS 812.)

### **EOS 813 - Biogeochemical Dynamics**

**Credits:** 3.00

Examines the influence of biological processes on geochemical transformations and elemental cycles from the molecular to the global scale involving both microorganisms and higher plants and animals; factors that regulate cycles; interactions among biosphere, hydrosphere, lithosphere, and atmosphere; transformations of C, N, S, and trace elements. Prereq: one semester each biology and chemistry.

### **EOS 815 - Global Atmospheric Chemistry**

**Credits:** 3.00

Introduction to the principles of atmospheric chemistry and their relationship to biogeochemical cycles, climate, and global change. Focus is on understanding the basic physical and chemical processes that determine the trace gas distribution in the global troposphere. An introduction to atmospheric vertical structure and global circulation dynamics provides the foundation. Chemical cycles of important C, S, and N molecules examined, including their possible perturbation by human activities. Basic photochemical processes outlined, particularly with respect to reactive nitrogen, hydrocarbons, and the production/destruction of ozone. Prereq: one year college chemistry. (Also offered as ESCI 815.)

### **EOS 816 - Atmospheric Aerosol and Precipitation Chemistry**

**Credits:** 3.00

This course describes and examines the processes determining the chemical and physical characteristics of atmospheric aerosol particles and precipitation. Important foci include the role of aerosol particles in the long-range transport and deposition of geochemical materials, optical properties of these particles and their impact on the global radiative balance, cloud microphysical processes relevant to both radiative effects and precipitation scavenging, and heterogeneous reactions at the solid-liquid, solid-gas, and liquid-gas interfaces in the atmosphere. Major segments of the course are devoted to the removal of gases and particles from the atmosphere by wet and dry deposition processes. Most attention will be paid to processes active in the troposphere, but important differences between the troposphere

and stratosphere, radiative effects of stratospheric aerosol particles, and exchange between the troposphere and stratosphere are addressed. Prereq: one year of college chemistry or permission. (Also offered as ESCI 816.)

### **EOS 817 - Macro-Scale Hydrology I**

**Credits:** 4.00

Focus on the numerous roles of water in the Earth System. Topics include the global water cycle, impacts of the greenhouse effect and other anthropogenic disturbances, hydrologic modeling, soil-vegetation-atmosphere transfer schemes, water quality, GIS and water-related remote sensing tools. based on extensive reading of current scientific literature, the students and instructors jointly select a research topic in macro-scale hydrology which will result in the preparation of a manuscript for publication in a refereed scientific journal. Course designed to be taken two consecutive semesters (fall and spring). Prereq: principles of hydrology or permission. (Also offered as ESCI 817.)

### **EOS 818 - Macro-Scale Hydrology II**

**Credits:** 4.00

A continuation of EOS 817. Students and instructor jointly select a research topic in macro-scale hydrology to be analyzed in-depth during the course of the semester. A primary goal is the preparation of a manuscript for publication in a refereed scientific journal. Extensive library research, reading of recent and relevant scientific literature, technical analysis, writing. Course designed to be taken two consecutive semesters (fall and spring). Prereq: macro-scale hydrology I. (Also offered as ESCI 818.) (Alternate years only.)

### **EOS #824 - Introduction to Ocean Remote Sensing**

**Credits:** 3.00

Introduction to a wide range of remote sensing techniques and applications in oceanography. Surveys a variety of different sensors including satellite imaging systems that operate in the visible and infrared spectral range, both passive and active microwave systems, and airborne remote sensors. The goal is to provide students with an understanding of the physical basis for remote sensing measurements, exposure to image and data analysis techniques, and the variety of remote sensing applications that exist in oceanography. Research on future remote sensing techniques and applications discussed. (Offered every other year.)

### **EOS 830 - Terrestrial Ecosystems**

**Credits:** 3.00

Processes controlling the energy, water, and nutrient dynamics of terrestrial ecosystems; concepts of study at the ecosystem level, controls on primary production, transpiration, decomposition, herbivory; links to earth system science, acid deposition, agriculture. Prereq: forest ecology; introduction to botany or principles of biology;/ or permission. Lab. (Also offered as NR 830.)

### **EOS #831 - Systems Approach to Biological Ocean Science**

**Credits:** 3.00

Broad survey of biological ocean science for advanced undergraduate and graduate students. Uses an interdisciplinary, "systems" approach to focus on major opportunities and challenges for ocean science in the future. Classes meet for one three-hour session each week and include lecture, discussion, demonstration and laboratory sessions appropriate to the subject material with presentations by guest speakers. Focus of the course is different each time it is offered; topics have included temporal and spatial scales of variation, estuarine ecosystem dynamics. May be repeated. Prereq: permission. (Also offered as ZOOL 831.)

### **EOS 850 - Biological Oceanography**

**Credits:** 4.00

Biological processes of the oceans, including primary and secondary production, trophodynamics, plankton diversity, zooplankton ecology, ecosystems and global ocean dynamics. Field trips on R/V Gulf Challenger and to the Jackson Estuarine Laboratory. Prereq: one year of biology or permission of instructor. (Also offered as ZOOL 850, ESCI 850.) Special fee. Lab. (Not offered every year.) May be repeated.

### **EOS 854 - Ocean Waves and Tides**

**Credits:** 4.00

Introduction to waves: small-amplitude, linear wave theory, standing and propagating waves, transformation in shallow water, energy and forces on structures, generation by wind a specification of a random sea, long waves with rotation, and internal waves. Introduction to tides: description of tides in ocean tidal generation forces, equilibrium tide, and tidal analysis. Lab/project: field and lab measurements with computer analysis. Prereq: general physics; differential equations;/ or permission. (Also offered as OE 854.) Lab.

### **EOS #860 - Introductory Dynamic Oceanography**

**Credits:** 3.00

Basic physical laws governing ocean and atmospheric circulation under the influence of Earth rotation, density stratification, and friction. Topics include surface waves, wind-driven and thermohaline ocean circulation, ocean/atmosphere interaction, instabilities, fronts, and climate. Simplified mathematical models demonstrate the important principles. Prereq: college physics and differential equations or permission. (Also offered as ESCI 860.)

### **EOS 864 - Introduction to Paleoclimate Analysis**

**Credits:** 4.00

An overview of paleoclimate indicators for the last one million years in the context of global teleconnections (atmosphere-lithosphere-hydrosphere-cyrosphere) and mathematical tools developed to interpret and link the different records of climate change. Prereq: one year calculus; one year chemistry; basic statistics;/ or permission. (Also offered as ESCI 864.)

### **EOS 865 - Paleoclimatology**

**Credits:** 3.00

Review of past changes in Earth's climate system with emphasis on the nature and causes of climate variability during the Quaternary period (the last ~1.8 million years -- a time interval dominated by cycles of global glaciation). Topics include evidence for climate change, techniques used to reconstruct paleoclimate records, and proposed mechanisms of global climate change. Course incorporates discussion of recent scientific papers from the primary literature. (Also listed as ESCI 865.)

### **EOS 895 - Topics**

**Credits:** 1.00 to 4.00

Study on an individual or group basis of topics not covered by the other listed courses. Topics may include any area relevant to interest in Earth, ocean, atmospheric, and space studies. (May be repeated.) Lab.

### **EOS 896 - Topics**

**Credits:** 1.00 to 4.00

See description for EOS 895.

### **EOS 901 - Seminar**

**Credits:** 1.00

Introduction to the fundamental components of the Earth system, such as the biosphere, cryosphere, hydrosphere, and its environment in space. Basic concepts are presented in a lecture format by selected EOS faculty according to their research specialization. To familiarize the student with the literature in earth, oceans, and space science and engineering, students are expected to contribute to a discussion of current topics of interest in the literature. Cr/F.

### **EOS 930 - Modeling of Forest Ecosystems**

**Credits:** 3.00

Computer modeling of energy, water, and nutrient dynamics of forest ecosystems; review of existing ecosystem models, modification of an existing model. Original programming of new model required as course project. Prereq: EOS 830 or permission. (Also offered as NR 930.)

### **EOS 954 - Solar Wind and Cosmic Rays**

**Credits:** 3.00

The solar wind and its effects on cosmic rays. The basic equations of the solar wind: mass, momentum, angular momentum, and energy balance. Transport processes. Waves, shocks, and instabilities in the solar wind. The basic equations of energetic particle transport. Solar modulation of solar and glactic cosmic rays. Interaction of energetic

particles with shock waves. Salient data are reviewed. (Normally offered every other year.) Also offered as PHYS 954.

### **EOS 955 - Geophysical and Astrophysical Fluid Dynamics**

**Credits:** 3.00

The principles of fluid dynamics and magnetohydrodynamics, applied to the Earth's atmosphere and oceans and to space plasmas. Emphasis on common problems and techniques. Topics include mass, momentum, and energy conservation; static equilibriums; quasigeostrophic flow; wave (acoustic-gravity, planetary, magnetoacoustic); surface waves in the ocean and in space; instabilities (convective, baroclinic Rayleigh-Taylor, Kelvin Helmholtz); boundary layer problems (Ekman layers, Stewartson layers, tearing modes; resonance absorption); supersonic flows (the solar wind, shock waves). Prereq: MATH 845 and 846, or PHYS 931. (Also offered as PHYS 955.) (Not offered every year.)

### **EOS #964 - Advanced Paleoclimate Analysis**

**Credits:** 4.00

Extensive readings and problem solving concerned with the interpretation of climate change focused on new developments in the interpretation of ice core records. Ice core records viewed as a framework for other proxy records of climatic change and as analogs for future change. Prereq: EOS 864 or ESCI 864;/ or permission. (Also offered as ESCI 964.) May be repeated.

### **EOS 987 - Magnetospheres**

**Credits:** 3.00

Introduces plasma physics of the interaction of solar and stellar winds with planets having magnetic fields, most predominately, the Earth. Both MHD and kinetic descriptions of internal and boundary processes of magnetospheres as well as treatment of the interaction with collisional ionospheres. Flow of mass, momentum, and energy through such systems. Prereq: PHYS 951; 952;/ or permission. (Also offered as PHYS 987.) (Normally offered every other year.)

### **EOS 988 - High Energy Astrophysics**

**Credits:** 3.00

One-semester course on the physical principles underpinning the field of high energy astrophysics. Subjects covered include production, detection, and transport processes of neutral and charged high energy particles and photons. Emphasizes the applications of these processes to the detection and measurement problem and theory of telescope design. Uses astrophysical examples to illustrate the subject matter. First part serves as a basis for discussing the astrophysics of the heliosphere, including solar flares, galactic and solar cosmic rays, and the influence of the Earth's magnetic field on cosmic rays. Prereq: PHYS 941; 942; 944. (Also offered as PHYS 988.) (Normally not offered every year.)

### **EOS 995 - Special Topics**

**Credits:** 1.00 to 4.00

### **EOS 996 - Special Topics**

**Credits:** 3.00 to 4.00

See description for EOS 995.

## Earth Sciences

### **ESCI 803 - Fluvial Hydrology**

**Credits:** 4.00

Mechanics of natural open channel flows: forces, the continuity and energy principles, velocity distributions, flow resistance, fluvial erosion and sediment transport, channel form, computation of flow profiles, weirs, hydraulic jumps, and stream flow routing. Lab and field exercises. Prereq: one year each of calculus and physics. Special fee.

### **ESCI 805 - Principles of Hydrology**

**Credits:** 4.00

Physical principles important in the land phase of the hydrologic cycle, including precipitation, snow melt, infiltration and soil physics, and surface and subsurface flow to streams. Problems of measurement and aspects of statistical treatment of hydrologic data. Field trips. Transportation fee. Prereq: one semester of calculus and one year of physics. Special fee. Lab.

### **ESCI 810 - Groundwater Hydrology**

**Credits:** 4.00

Principles for fluid flow in porous media with emphasis on occurrence, location, and development of groundwater, but with consideration of groundwater as a transporting medium. Major topics include well hydraulics, regional groundwater flow, exploration techniques, and chemical quality. Laboratory exercises involve use of fluid, electrical, and digital computer models to illustrate key concepts. Prereq: ESCI 805 or permission. Special fee. Lab.

### **ESCI 815 - Global Atmospheric Chemistry**

**Credits:** 3.00

Introduction to the principles of atmospheric chemistry and their relationship to biogeochemical cycles, climate, and global change. Focus is on understanding the basic physical and chemical processes that determine the trace gas distribution in the global troposphere. An introduction to atmospheric vertical structure and global circulation dynamics provides the foundation. Chemical cycles of important C, S, N molecules are examined, including their possible perturbation by human activities. Basic photochemical processes outlined, particularly with respect to reactive nitrogen hydrocarbons, and the production/destruction of ozone. Prereq: one year college chemistry. (Also offered as EOS 815.)

### **ESCI 816 - Atmospheric Aerosol and Precipitation Chemistry**

**Credits:** 3.00

Description and examination of the processes determining the chemical and physical characteristics of atmospheric aerosol particles and precipitation. Important foci include the role of aerosol particles in the long-range transport and deposition of geochemical materials, optical properties of these particles and their impact on the global radiative balance, cloud microphysical processes relevant to both radiative effects and precipitation scavenging, and heterogeneous reactions at the solid-liquid, solid-gas, and liquid-gas interfaces in the atmosphere. Major segments of the course are devoted to the removal of gases and particles from the atmosphere by wet and dry deposition processes. Most attention will be paid to processes active in the troposphere, but important differences between the troposphere and stratosphere, radiative effects of stratospheric aerosol particles, and exchange between the troposphere and stratosphere are addressed. Prereq: one year college chemistry or permission. (Also offered as EOS 816.)

### **ESCI 817 - Macro-scale Hydrology I**

**Credits:** 4.00

Focus on the numerous roles of water in the Earth System. Topics include the global water cycle, impacts of the greenhouse effect and other anthropogenic disturbances, hydrologic modeling, soil-vegetation-atmosphere transfer schemes, water quality, GIS and water-related remote sensing tools. Based on extensive reading of current scientific literature, the students and instructor jointly select a research topic in macro-scale hydrology which will result in the preparation of a manuscript for publication in a refereed scientific journal. Course designed to be taken two

consecutive semesters (fall and spring). Prereq: principles of hydrology or permission. (Also offered as EOS 817.)

### **ESCI 818 - Macro-scale Hydrology II**

**Credits:** 4.00

Students and instructors jointly select a research topic in macro-scale hydrology to be analyzed in depth during the course of the semester. A primary goal is the preparation of a manuscript for publication in a refereed scientific journal. Extensive library research, reading of recent and relevant scientific literature, technical analysis, writing. Course designed to be taken two consecutive semesters (fall and spring). Prereq: macro-scale hydrology I. (Also offered as EOS 818.) (Alternate years only.)

### **ESCI 825 - Igneous Petrology**

**Credits:** 4.00

The evolution of igneous rocks as determined from field, petrographic, chemical, experimental, and theoretical studies. Application of thermodynamics to igneous petrogenesis. Physical properties of magmas. Prereq: mineralogy; petrography; adequate background in calculus, chemistry, and physics. Field trips. Special fee. Lab. (Offered alternate years with ESCI 826.)

### **ESCI 826 - Metamorphic Petrology**

**Credits:** 4.00

The metamorphism of pelitic, mafic, and calc silicate rocks as determined from field, petrographic, mineral chemistry, experimental, and theoretical studies. Closed- and open-system reactions, multisystems, reaction space. Calculation of pressure, temperature, time paths. Prereq: mineralogy; petrography; adequate background in calculus, chemistry, and physics. Field trips. Special fee. Lab. (Offered alternate years with ESCI 825.)

### **ESCI 832 - Regional Geology and Advanced Structure**

**Credits:** 4.00

Readings, discussion, and field/lab exercises in the tectonic analysis of mountain systems. Emphasis on the northern Appalachian Orogen. Application of modern structural analysis. Prereq: structural geology or permission. Field excursion; lab fee.

### **ESCI 834 - Applied Geophysics**

**Credits:** 4.00

Gravity, magnetic, seismic, and electrical methods of investigating subsurface geology. Fieldwork and use of computers in data analysis. Prereq: one year of calculus; introductory geology; one year of college physics;/ or permission. Special fee. Lab.

### **ESCI 841 - Geochemistry**

**Credits:** 4.00

Thermodynamics applied to geologic processes; geochemical differentiation of the earth; the principles and processes that control the distribution and migration of elements in geological environments; stable and radiogenic isotopes in geologic processes. Prereq: one year of mineralogy or permission.

### **ESCI 845 - Isotope Geochemistry**

**Credits:** 4.00

Discussion of element abundance and isotope formation; radioactive decay as applied to geologic systems, detailed investigation of K-Ar, Rb-Sr, U-Pb, and Sm-Nd systems, and geologic-oceanographic applications of stable isotopes. Lab involves mass spectrometric and chemical techniques of isotopic analysis. Course includes the completion of a laboratory project. Prereq: ESCI 841 or permission. Special fee. Lab.

### **ESCI 846 - Analytical Geochemistry**

**Credits:** 4.00

Introduction to the theory, instrumentation, and applications of analytical methods in geochemistry. Prereq: one year of chemistry or geochemistry;/ or permission. Special fee. Lab.

### **ESCI 847 - Aqueous Geochemistry**

**Credits: 4.00**

Processes that determine the geochemical characteristics of water bodies. Emphasis on the geochemical continuum of terrestrial water and its geochemical evolution. Topics include the influence of cyclic salts, the nature of weathering reactions, the CO<sub>2</sub>-CaCO<sub>3</sub> system, the formation and dissolution of salts and authigenic mineral formation. Prereq: one year of chemistry or geochemistry; or permission. Lab.

**ESCI 850 - Biological Oceanography****Credits: 4.00**

Biological processes of the oceans, including primary and secondary production, trophodynamics, plankton diversity, zooplankton ecology, ecosystems and global ocean dynamics. Field trips on R/V Gulf Challenger and to the Jackson Estuarine Laboratory. Prereq: one year of biology or permission of instructor. (Also offered as ZOOL 850, EOS 850.) Special fee. Lab. (Not offered every year.)

**ESCI 852 - Chemical Oceanography****Credits: 3.00**

Water structure, chemical composition, and equilibrium models; gas exchange; biological effects on chemistry; trace metals; and analytical methods. Prereq: permission. Optional 1 credit lab (see ESCI 852L).

**ESCI #852L - Chemical Oceanography Lab****Credits: 1.00**

Optional lab for ESCI 852. Includes short cruise aboard R/V Gulf Challenger. Special fee.

**Co-requisites:** ESCI 852

**ESCI 854 - Sedimentary Rocks and Stratigraphy****Credits: 4.00**

Examine observational and interpretative techniques to evaluate sedimentary rocks in their stratigraphic context. The relationship between time, space, and deposition is assessed using a problem solving approach based on real geological examples. Topics such as facies analysis, stratigraphic correlation, and basin analysis provide the framework to interpret the stratigraphic record of earth history. Prereq: optical mineralogy and petrography or permission. Special fee. Lab and field trip.

**ESCI 855 - Analytical Techniques for Sediments****Credits: 2.00 to 4.00**

A laboratory course focusing on applied analytical techniques geoscientists use in sediment sampling; coarse- and fine-grained textural analysis, and some aspects of mineralogical composition. Special fee. Lab.

**ESCI 858 - Introduction to Physical Oceanography****Credits: 3.00**

A descriptive treatment of atmosphere-ocean interaction; general wind-driven and thermohaline ocean circulation; waves and tides; continental shelf and near-shore processes; instrumentation and methods used in ocean research. Simplified conceptual models demonstrate the important principles. Prereq: college physics; introduction to oceanography; or permission.

**ESCI 859 - Geological Oceanography****Credits: 4.00**

Major geological features and processes of the ocean floor; geological and geophysical methods; plate tectonics. Prereq: permission. Lab.

**ESCI #860 - Introductory Dynamic Oceanography****Credits: 3.00**

Basic physical laws governing ocean and atmospheric circulation under the influence of Earth rotation, density stratification, and friction. Topics include surface waves, wind-driven and thermohaline ocean circulation, ocean/atmosphere interaction, instabilities, fronts, and climate. Simplified mathematical models demonstrate the important principles. Prereq: college physics and differential equations or permission. (Also offered as EOS 860.)

## **ESCI 862 - Glacial Geology**

**Credits:** 4.00

Survey of glacial processes and glacier dynamics with emphasis on understanding the physics of glaciers, glacial geologic processes, and interpretation of glacial deposits and landscapes. The course includes discussion of the role of glaciers and ice sheets in the Earth's climate system, analysis of glaciological and glacial-geologic data, short field exercises, and one mandatory field trip that explores the glacial landscape of New England. Prereq: ESCI 561 or permission. Special fee. Lab.

## **ESCI 864 - Introductory Paleoclimate Analysis**

**Credits:** 4.00

An overview of paleoclimate indicators for the last one million years in the context of global teleconnections (atmosphere-lithosphere-hydrosphere-cryosphere) and mathematical tools developed to interpret and link the different records of climate change. Prereq: one year calculus; one year chemistry; basic statistics;/ or permission. (Also offered as EOS 864.)

## **ESCI 865 - Paleoclimatology**

**Credits:** 3.00

Review of past changes in Earth's climate system with emphasis on the nature and causes of climate variability during the Quaternary period (the last ~1.8 million years -- a time interval dominated by cycles of global glaciation). Topics include evidence for climate change, techniques used to reconstruct paleoclimate records, and proposed mechanisms of global climate change. Course incorporates discussion of recent scientific papers from the primary literature. (Also listed as EOS 865.)

## **ESCI 870 - Introduction to Ocean Mapping**

**Credits:** 4.00

An introduction to the principles and practice of hydrography and ocean mapping. Methods for the measurement and definition of the configuration of the bottoms and adjacent land areas of oceans, lakes, rivers, estuaries, harbors and other water areas, and the tides or water levels and currents that occur in those bodies of water. (Also listed as OE 870.) Prereq: college physics. Lab.

## **ESCI 871 - Geodesy and Positioning for Ocean Mapping**

**Credits:** 3.00

The science and technology of acquiring, managing, and displaying geographically-referenced information; the size and shape of the earth, datums and projections; determination of precise positioning of points on the earth and the sea, including classical terrestrial-based methods and satellite-based methods; shoreline mapping, nautical charting and electronic charts. Prereq: one year of calculus and one year of college physics. (Also offered as OE 871.)

## **ESCI 895 - Topics**

**Credits:** 1.00 to 4.00

Study on an individual or group basis in geologic, hydrologic, or oceanographic problems, under members of the graduate staff. Topics include: geochemistry, geomorphology, geophysics; glaciology; groundwater, structural, and regional geology; crystallography, mineralogy; petrology; thermodynamics; ore deposits; earth resource policy; paleontology; sedimentation; stratigraphy; water resources management; chemical, physical, and geological oceanography; earth systems; earth science teaching methods. Prereq: permission of staff concerned. May be repeated.

## **ESCI 896 - Topics**

**Credits:** 1.00 to 4.00

See description for ESCI 895.

## **ESCI 897 - Colloquium**

**Credits:**

Presentation of recent research in the earth sciences by guest speakers and department faculty. May be taken four times. Cr/F.

## **ESCI 898 - Directed Research**

**Credits:** 2.00

Research project on a specified topic in the Earth Sciences, guided by a faculty member. Cr/F.

**ESCI 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Cr/F.

**ESCI 903 - Advanced Hydrology**

**Credits:** 3.00

Application of quantitative methods to selected hydrologic problems. Critical examination of deterministic and stochastic models with emphasis on conceptualizing the hydrologic problem, developing appropriate models, obtaining solutions, and evaluating models and solutions in terms of basic assumptions, data requirements, and verification of results. Prereq: ESCI 805; computer methods; basic statistics.

**ESCI #904 - Contaminant Hydrology**

**Credits:** 3.00

Physical mechanisms of the migration and dispersion of miscible and immiscible contaminants through the saturated and unsaturated zone. Deterministic and stochastic models of transport phenomena including both analytical and numerical solutions. Term project. Prereq: groundwater hydrology; college chemistry; and computer methods. (Offered alternate years.)

**ESCI 906 - Statistical Hydrology**

**Credits:** 4.00

Application of statistical principles to hydrologic problems. Covers laws of probability; parameter estimation; discrete and continuous distributions of importance in hydrology, inference, regression and multivariate analysis, and elementary time series analysis. Prereq: ESCI 805; basic statistics;/or permission. (Offered alternate years with ESCI 803.)

**ESCI 907 - Geostatistics**

**Credits:** 3.00

Introduction to statistical methods of quantifying spatial variability with emphasis on the application of these methods to the earth and environmental sciences. Topics including sampling strategy; variography; kriging; simulation; and Monte Carlo techniques. Prereq: basic statistics or permission. (Offered alternate years.)

**ESCI #934 - Advanced Applied Geophysics**

**Credits:** 4.00

Exploration methods including gravity, magnetics, electromagnetics, and seismics at an advanced level. Modern methods of interpretation as well as basic physics and geological applications. Prereq: ESCI 834; elementary computer programming; differential equations recommended. Lab. (Not offered every year.)

**ESCI 952 - Advanced Chemical Oceanography**

**Credits:** 3.00 or 4.00

Readings on physical, chemical, and biological processes that affect the distribution of chemical components in estuaries and the open ocean. Lab includes projects investigating selected processes. Prereq: ESCI 852 or permission.

**ESCI #958 - Dynamical Oceanography**

**Credits:** 3.00

The hydrodynamics of such ocean phenomena as waves, tides, and ocean turbulence; wind-driven circulation on the continental shelf and deep ocean is treated in detail. Prereq: ESCI 858; ME 807;/ or permission. (Not offered every year.)

**ESCI #959 - Data Analysis Methods in Ocean and Earth Sciences**

**Credits:** 4.00

Methods of analysis of oceanographic, geophysical, geological, and environmental data. Introductory tutorial on important mathematical concepts precedes the development of the bases for a number of data analysis techniques;

digital filtering, regression analysis, cross-spectral analysis, objective analysis, and elementary inversion theory, etc. Students use these techniques on real data. Prereq: differential equations or equivalent.

**ESCI #964 - Advanced Paleoclimate Analysis**

**Credits:** 4.00

Extensive readings and problem solving concerned with the interpretation of climate change focused on new developments in the interpretation of ice core records. Ice core records viewed as a framework for other proxy records of climatic change and as analogs for future change. Prereq: ESCI 864 or EOS 864;/ or permission. (Also offered as EOS 964.) May be repeated.

**ESCI 972 - Hydrographic Field Course**

**Credits:** 4.00

A lecture, lab, and field course on the methods and procedures for the acquisition and processing of hydrographic and ocean mapping data. Practical experience in planning and conducting hydrographic surveys. Includes significant time underway (day trips and possible multi-day cruises) aboard survey vessel(s). Prereq: Introduction to Ocean Mapping; Geodesy and Positioning for Ocean Mapping; or permission. Special fee. (Also listed as OE 972.)

**ESCI 973 - Seafloor Characterization**

**Credits:** 3.00

Remote characterization of seafloor properties using acoustic (echo sounders, sub-bottom profilers, side-scan, multibeam and interferometric sonars) and optical (video and laser linescanner) methods. Models of sound interaction with the seafloor will be explored as well as a range of possible geologic, geotechnical, morphologic, acoustic, and biologic descriptors. Prereq: permission. (Also listed as OE 973.)

**ESCI 993 - Advanced Seminar**

**Credits:** 1.00

Focused seminar in a discipline of earth sciences: earth, ocean, atmosphere, or hydrology. May be repeated.

**ESCI 994 - Advanced Seminar**

**Credits:** 1.00

See description for ESCI 993.

**ESCI 995 - Advanced Topics**

**Credits:** 1.00 to 4.00

Advanced work on an individual or group basis. Prereq: permission. May be repeated.

**ESCI 996 - Advanced Topics**

**Credits:** 1.00 to 4.00

Advanced work on an individual or group basis. Prereq: permission. May be repeated.

**ESCI 997 - Seminar in Earth Sciences**

**Credits:** 1.00

Readings, discussion, and presentation of recent investigations in the earth sciences. Required of all M.S. students in Earth Sciences. Cr/F.

**ESCI 998 - Proposal Development**

**Credits:** 1.00

Introduction to research in the earth sciences and development of thesis and directed research proposals. Required of all M.S. students in Earth Sciences.

**ESCI 999 - Doctoral Research**

**Credits:**

Cr/F.

## Family Studies

### **FS 807 - Practicum**

**Credits:** 1.00 to 6.00

Supervised in-depth experience in teaching, research, or advocacy in a professional setting to increase the student's understanding of children, families, or consumer issues. A) Child; B) Family; C) Consumer Studies. Prereq: permission. Cr/F.

### **FS 808 - Child and Family Center Internship**

**Credits:** 1.00 to 6.00

Supervised positions within the UNH Child and Family Center nursery school programs. A) videotape assistant; B) assessment assistant; C) toddler assistant; D) 3-5 year old assistant. Can be repeated up to a total of 9 credits. Prereq: permission. Cr/F.

### **FS 809 - Child Study and Development Center Internship**

**Credits:** 1.00 to 6.00

Supervised positions within the UNH Child Study and Development Center child care programs. A) videotape assistant; B) assessment assistant; C) infant assistant; D) toddler assistant; E) 3-5 year old assistant; F) kindergarten assistant; G) health issues assistant. May be repeated up to a total of 9 credits. Prereq: human development, developmental perspectives on infancy and early childhood, teaching/learning in social constructivist classrooms, permission. Cr/F.

### **FS 810 - Community Internship**

**Credits:** 1.00 to 6.00

Supervised position in community early childhood settings. A) infant-toddler assistant; B) preschool-child care assistant; C) kindergarten assistant. May be repeated up to a total of 8 credits. Cr/F.

### **FS 833 - Supervising Programs for Young Children**

**Credits:** 4.00

Philosophical bases and theoretical rationales of various programs for young children; program alternatives and resources; issues in administration including supervision, finances, and regulations. Prereq: permission. (Fall semester only.)

### **FS 834 - Curriculum for Young Children**

**Credits:** 4.00

Designing and implementing developmentally appropriate activities for young children; assessing the effectiveness of activities; evaluating materials and equipment. Prereq: FS 833; permission. (Spring semester only.)

### **FS 841 - Marital and Family Therapy**

**Credits:** 4.00

Introduction to the theory and practice of marital and family therapy; major approaches to be examined include strategic, transgenerational, structural, experiential/humanistic, and behavioral. Prereq: family relations or equivalent; permission.

### **FS 843 - Families, Schools, and Community**

**Credits:** 4.00

Emphasis on the critical value of effective family-school-community partnerships in enhancing the education of young children. The literature assessing the interactive nature of the parent and school resources with cultural influences examined. Current models of family-school-community partnerships explored. Students required to participate in parent/school/community activities within early childhood education centers and schools. Prereq: permission. (Fall semester only.)

**FS 846 - Human Sexuality****Credits:** 4.00

Investigations of physiological, psychological, and sociological aspects of human sexuality. Particular attention to various social practices, policies, and programs that affect sexual attitudes and behaviors.

**FS 850 - Contemporary Issues in Adolescent Development****Credits:** 4.00

This seminar focuses on contemporary adolescents and their development within the contexts of families, schools, and the larger community. The course will familiarize students with major theoretical perspectives regarding adolescent development and provide an overview of current research on critical issues facing adolescents, their parents, and professionals who work with adolescents. Problems and risks will be addressed, but the major emphasis will be on maximizing strengths and opportunities.

**FS 857 - Race, Class, Gender, and Families****Credits:** 4.00

Explores the intersection of race, class, and gender in family life in the United States. Theory, research and other relevant literature used to examine the variety of family configurations in our society today and the diverse experiences that families have as the result of existing social, political, and economic institutions. The strengths various family types considered, as well as the particular challenges these families may encounter in contemporary society. Prereq: permission.

**FS 860 - Family Programs and Policies****Credits:** 4.00

Analysis of the connection between family support programs and family policy. Program planning, implementation and evaluation are stressed. The research, theory, history, and current status of model family programs are examined.

**FS 871 - Observation and Assessment of Young Children****Credits:** 4.00

A comprehensive view of various observation techniques for determining children's strengths and emerging skills. Exploration of issues regarding the use of formal assessments and testing with young children, retention and transitional placements, and the parent's role in testing. Prereq: human development, developmental perspectives on infancy and early childhood, teaching/learning in early childhood settings, permission. (Fall semester only.)

**FS 872 - International Approaches to Child Advocacy****Credits:** 4.00

Investigation into the rationales for advocacy, types of advocacy, advocacy techniques and strategies, and current domestic and international advocacy issues and approaches. Prereq: permission.

**FS 873 - International Perspectives on Children and Families****Credits:** 4.00

Investigation of historical and modern conceptions of children and families in selected African, Asian, European, and Latin countries. Emphasis placed on the contribution of these populations to the changing ethnic portrait of America. Prereq: permission.

**FS 888 - Student Teaching Young Children****Credits:** 8.00

Supervised teaching experience. Students spend a minimum of 20 hours per week in a selected program for young children working with a cooperating teacher. Prereq: permission. Cr/F. (Spring semester only.)

**FS 894 - Families and the Law****Credits:** 4.00

Exploration of laws that affect families as members interact with each other and with society in general. Prereq: management and decision making; family relations; and permission.

**FS 897 - Special Topics****Credits:** 1.00 to 4.00

Highly focused examination of a particular theoretical, methodological, or policy issue. Prereq: permission.

**FS 898 - Marriage and Family Therapy Practicum****Credits:** 1.00 to 8.00

Clinical experience under direct faculty supervision. Trainees develop competency in treating individuals in the context of their families and larger systems. Prereq: permission. May be repeated. Special fee.

**FS 899 - Master's Thesis****Credits:** 1.00 to 6.00

Cr/F.

**FS 911 - Graduate Specialization Internships****Credits:** 2.00 to 6.00

Advanced, supervised internships in professional setting. A) Female Adolescent Development; B) Poverty and Welfare Policy; C) Child Advocacy; D) Families At-Risk Due to Incarceration. May be repeated to up a total of 6 credits. Prereq: permission. Cr/F.

**FS 942 - Advanced Systems of Marital and Family Therapy****Credits:** 4.00

Critical analysis and integration of selected systems of marital and family therapy. Prereq: FS 841; permission.

**FS #943 - American Families in Poverty****Credits:** 4.00

Seminar in contemporary issues related to economic deprivation in families. Exploration of causes and effects of poverty in American families. Prereq: permission. (Not offered every year.)

**FS #944 - Children in the Family****Credits:** 4.00

Advanced seminar focusing on the family environment as a context for child development; relationships between parents and children, current theories, and research. Prereq: permission. (Not offered every year.)

**FS 945 - Family Therapy Practice I****Credits:** 4.00

Designed to develop beginning practice skills in structural, strategic, systematic family therapies; and assessment and treatment skills necessary to manage specialized problems (e.g., divorce, remarriage, substance abuse, suicidal behavior) encountered in practice. Prereq: permission.

**FS 946 - Critical Problems in Family Life****Credits:** 4.00

Evaluation of the needs and resources of families with critical problems; maturational and situational sources of stress influencing the contemporary American family; students demonstrate mastery of theoretical concepts by developing self-help strategies to be used by families experiencing stress. Prereq: permission.

**FS 947 - Family Therapy Practice II****Credits:** 4.00

Designed to develop advanced skills in integrating structural, strategic, and systematic family therapies; sensitivity to gender differences and cultural diversity; and assessment and treatment skills necessary to manage specialized problems (e.g., physical, emotional, and sexual abuse; sexual dysfunction) encountered in practice. Prereq: permission.

**FS 991 - Professional Issues for Family Specialists****Credits:** 4.00

Exploration of major ethical, legal, and professional issues facing child, family, and consumer specialists. Focus on ethical decision making, values clarification, and development of professional identity. Prereq: permission.

**FS 993 - Theoretical Approaches to Family Studies****Credits:** 4.00

Scientific knowledge and the scientific method, the relationship between theory and research as it applies to family studies; why and how theories change; major theories in historical context. Prereq: permission.

**FS 994 - Research Seminar****Credits:** 4.00

Introduction to social science research methods; analysis of research reports and other professional papers in family and consumer studies; development and evaluation of research proposals. Prereq: FS 993 and permission.

**FS 995 - Seminar and Special Problems****Credits:** 2.00 to 4.00

A) Consumer Research; B) Family Relations; C) Education; D) Family Resource Management; and E) Human Development. The student contributes to a selective review and critical evaluation of the research and current literature and an examination of issues and trends. Independent projects may be a part of the experience. These seminars are open to graduate students with sufficient background and are not scheduled every semester. One or more semesters, maximum of 4 credits in one area. Prereq: permission.

**FS #997 - Advanced Research Seminar****Credits:** 4.00

Interdisciplinary approach to research in child, family, and consumer studies. Emphasis on the multidimensionality of family problems, appropriate research strategies, and critical analysis of current literature. Prereq: permission.

## Genetics

### **GEN 804 - Genetics of Prokaryotic Microbes**

**Credits:** 4.00

Expression and transfer of genetic elements (chromosomal and nonchromosomal) in prokaryotic and eukaryotic microorganisms; consideration of factors influencing public health, industry, the environment, and society. Students earning credit for PBIO 754/854; BCHM 854/854; GEN 754/854 may not receive credit for MICR 704/804. Prereq: general microbiology; biochemistry (Also offered as MICR 804.) Lab.

### **GEN 805 - Population Genetics**

**Credits:** 4.00

An exploration of the forces affecting the frequency and distribution of allelic variation in natural populations. The relative role of mutation, selection, random drift, and inbreeding in structuring genetic variation. Quantification of the genetic structure of populations. Prereq: principles of genetics; applied biostatistics I recommended. (Also offered as ZOOL 805.) Special fee. (Not offered every year.)

### **GEN 806 - Human Genetics**

**Credits:** 3.00

The genetic basis of human traits and diseases. New understanding added by molecular genetic approaches. Human genome project, gene therapy. Discussion of genetic components of quantitative and behavioral traits in human evolution. (Not offered every year.) (Also offered as ANSC 806.)

### **GEN 811 - Genomics and Bioinformatics**

**Credits:** 4.00

The methods, applications, and implications of genomics--the analysis of whole genomes. Microbial, plant and animal genomics are addressed, as well as medical, ethical and legal implications. The lab provides exposure and experience of a range of bioinformatics approaches--the computer applications used in genome analysis. Prereq: Principles of Genetics. (Also offered as BCHM 811 and MICR 811.) Lab.

### **GEN 815 - Molecular Evolution**

**Credits:** 4.00

Rates and patterns of evolutionary change in biomolecules. Forces affecting the size and structure of genomes. Molecular mechanisms of organismal evolution. Emphasis on integrating evidence from biochemistry, molecular genetics and organismal studies. Methods for reconstructing phylogeny from molecular sequences. Prereq: principles of genetics. Some knowledge of statistics and familiarity with personal computers is recommended. (Also offered as ZOOL 815.) Special fee. Lab. (Not offered every year.)

### **GEN 823 - Quantitative Genetics**

**Credits:** 4.00

Analysis of continuous variations in populations simultaneously segregating at multiple loci. Genetic and nongenetic factors and the complex interactions between them. Models and methods of analysis for both theoretical and practical applications. Prereq: principles of genetics; applied biostatistics I, strongly suggested. (Also offered as ZOOL 823.) Special fee. Lab. (Not offered every year.)

### **GEN 853 - Cytogenetics**

**Credits:** 4.00

Chromosome structure, function, and evolution. Eukaryotic genome organization. Theory of, and laboratory techniques for, cytogenetic analysis in plants and animals. Prereq: principles of genetics. (Also offered as PBIO 853.) Special fee. Lab. (Not offered every year.)

### **GEN 854 - Laboratory in Biochemistry and Molecular Biology of Nucleic Acids**

**Credits: 5.00**

Application of modern techniques to the analysis of biomolecules, with an emphasis on nucleic acids; includes DNA isolation and analysis, cloning, sequencing, and analysis of gene products. No credit if credit has been received for MICR 804. Prereq: BCHM 658/659; 751, or permission. (Also offered as BCHM 854 and P BIO 854.) Special fee. Not offered every year.

**GEN 866 - Environmental Genomics****Credits: 4.00**

The field environmental genomics uses existing and developing high throughput genomic-scale technologies to investigate ecological and evolutionary theory, and so provides a more complete understanding of how organisms respond to environmental change at the molecular genetic level. Course covers an array of systems involved in this emerging field, with the central aim of understanding the effects of environmental change on genome structure, gene expression, and adaptive evolutionary change. Information is derived from the primary literature in the field and covers practical and technical concepts as well as the underlying theoretical basis for the major research themes. Prereq: principles of genetics;/ or permission. (Also offered as BCHM 866.)

**GEN 871 - Molecular Genetics****Credits: 4.00**

Structure, organization, replication, dynamics, and expression of genetic information in eukaryotes. Focus on molecular genetic mechanisms of gene expression and its control; molecular genetics methods; molecular genetic control of cell division and differentiation during development. Prereq: a general biochemistry or principles of biochemistry course; a course in principles of genetics;/or permission. (Also offered as BCHM 871.)

**GEN 872 - Evolutionary Genetics of Plants****Credits: 4.00**

Mechanisms of genetic change in plant evolution, domestication, breeding, and genetic engineering. Topics include Darwinian theory; speciation and hybridization; origins and co-evolution of nuclear and organelle genomes; gene and genome evolution; transposable elements, chromosome rearrangements, polyploidy. Lab: DNA techniques, sequence analysis programs, phylogenetic trees. Special fee. Prereq: principles of genetics or equivalent; introductory botany or principles of biology I and II or equivalent. (Also offered as P BIO 872.)

**GEN 874 - Plant Biotechnology and Genetic Engineering****Credits: 3.00**

Plant transformation and regeneration, gene isolation and identification, structure and regulation of plant genes, current applications of plant genetic engineering, environmental and social implications. Prereq: BIOL 604 or permission. (Also offered as P BIO 874.)

**Co-requisites:** GEN 875

**GEN 875 - Plant Biotechnology and Genetic Engineering Lab****Credits: 2.00**

Techniques for genetic transformation and selection of plants, analysis of foreign gene expression, and plant cell and tissue culture. Coreq: P BIO or GEN 874. (Also offered as P BIO 875.) Special fee. (Not offered every year.)

**Co-requisites:** GEN 874

**GEN 882 - Developmental Genetics****Credits: 3.00**

The molecular genetic basis of metazoan development. Focuses on how genes direct the process of development and how this problem is analyzed in model organisms using molecular approaches. Topics include: control of cell division, maternal factors, cell-cell interactions, and differential gene expression. Prereq: principles of genetics; general biochemistry; BCHM 851. (Also offered as BCHM 882.)

**GEN 899 - Master's Thesis****Credits: 1.00 to 10.00**

Cr/F.

### **GEN #904 - Advanced Microbial Genetics**

**Credits:** 4.00

Advanced studies in expression, regulation, recombination, and transmission of genetic information in prokaryotic microorganisms. Prereq: GEN 804; permission. (Also offered as MICR 904.) Special fee. Lab. (Not offered every year.)

### **GEN 942 - Biochemical Regulatory Mechanisms**

**Credits:** 3.00

Nonreplicative functions of DNA; transcription and translational control of protein synthesis; quantitative regulation of proteins; regulation of metabolism by hormones, allosteric regulation and repression; regulatory mechanisms operating during development and differentiation. Prereq: BCHM 852 or permission. (Also offered as BCHM 942.)

### **GEN #991 - Advanced Topics in Molecular Genetics**

**Credits:** 3.00

Selected topics of current research in molecular genetics including gene structure and function, chromosome structure, and gene expression. Emphasis on eukaryotic model organisms such as worms, flies, zebra fish, and mice. Prereq: permission. (Also offered as BCHM 991.) May be repeated to a maximum of 6 credits. Cr/F.

### **GEN #992 - Advanced Topics in Molecular Biology**

**Credits:** 3.00

Selected topics of current research on the molecular biology of gene regulation, protein interactions, and the AIDS virus. Emphasis on eukaryotic systems such as yeast and mammals. Prereq: permission. (Also offered as BCHM 992.) May be repeated to a maximum of 6 credits. Cr/F.

### **GEN 995 - Special Topics**

**Credits:** 2.00 to 4.00

Intended for study in specialty areas not ordinarily included in other courses. May involve formal classes, discussions, or independent investigations. Prereq: permission.

### **GEN 996 - Special Topics**

**Credits:** 2.00 to 4.00

See description for GEN 995.

### **GEN 998 - Genetics Seminar**

**Credits:** 1.00

Presentation and discussion of selected genetic topics. May be repeated. Cr/F.

### **GEN 999 - Doctoral Research**

**Credits:**

Cr/F.

## Graduate School

### **GRAD 800 - Continuing Enrollment**

#### **Credits:**

All continuing graduate students who are not enrolled for course credits, thesis credits, Doctoral Research (999) or Master's Continuing Research (GRAD 900), and are not in residence, are required to register for GRAD 800 each semester of the academic year (or each summer for students in MATH M.S.T., and English M.S.T. and College Teaching M.S.T. programs). Students registered for GRAD 800 are considered part-time. Not graded.

### **GRAD 885 - Graduate Foreign Exchange**

#### **Credits:** 1.00 to 9.00

Graduate students may spend a semester at participating institutions. Eligibility requirements include United States citizenship, good academic standing, and permission of their graduate program committee. For information contact the Center for International Education. Special fee. Cr/F.

### **GRAD 900 - Master's Continuing Research**

#### **Credits:**

Master's students who have completed all course requirements, registered for the maximum number of thesis or project credits, and are in residence completing their master's program must register for Master's Continuing Research. Students registered for GRAD 900 are considered full-time. Not graded.

### **GRAD 930 - Ethics in Research and Scholarship**

#### **Credits:** 2.00

Individual, professional, institutional, and social issues related to the ethical conduct of research and scholarship. Uses case studies to demonstrate the application of pertinent regulations, policies, and guidelines. Cr/F.

### **GRAD 940 - Foundations in College Teaching**

#### **Credits:** 2.00

Formal consideration of effective teaching approaches. Topics include course design, presentation, and evaluation. Introduction to multiple pedagogies and their application in higher education.

### **GRAD 941 - Teaching Methods in Higher Education**

#### **Credits:** 2.00

Formal consideration of specific teaching methods including the lecture, class discussion, and writing. The selection and use of specific teaching methods to achieve desired learning outcomes.

### **GRAD 942 - Role of the College Professor**

#### **Credits:** 2.00

Examination of the perspectives of major scholars related to teaching, the role of the professor as teacher and scholar, and the multiple cultures encountered in higher education.

### **GRAD 945 - Advanced Seminar in College Teaching**

#### **Credits:** 2.00

Capstone course for experienced faculty. The development and review of a course portfolio that demonstrates the knowledge and use of best teaching practices in higher education. Includes a formal examination on the scholarship of teaching.

### **GRAD 950 - Issues in College Teaching**

#### **Credits:** 1.00

Issues faced within the classroom including evaluation methods, classroom climate and diversity, instructional approaches, teaching and learning resources, and student behavior. Case studies. Prereq: permission. Cr/F.

**GRAD 951 - Teaching with Writing****Credits:** 2.00

Examination of the issues, principles, and practices of using writing to enhance learning. Appropriate for all fields and disciplines. Participants design and field test assignments. Seminar requires field work and independent research. Cr/F.

**GRAD 952 - College Teaching Mentorship****Credits:** 1.00

Individual interaction with a senior professor to develop insights related to college-level teaching. Students observe and analyze instructional approaches based upon the professor's teaching philosophy and teaching traditions within a specific field or discipline. Micro teaching may be required. Prereq: permission. May be repeated for a maximum of 2 credits. Cr/F.

**GRAD #953 - Readings in College Teaching****Credits:** 1.00 to 2.00

Seminar involving perspectives offered by specific scholars related to teaching and learning in higher education. Selected works include scholars from the many fields including the social and natural sciences, humanities, and applied and professional fields. A major paper is required. Prereq: permission. Cr/F.

**GRAD 959 - Advanced Issues in College Teaching****Credits:** 1.00

Advanced seminar examining issues involved in teaching and learning faced within the classroom. Examines the relationship between theory and practice. Prereq: GRAD 950 or permission. May be repeated barring duplication of subject matter. Cr/F.

**GRAD 961 - Cognition, Teaching, and Learning****Credits:** 2.00

Cognitive theories and their application to classroom instruction. Examination of historical relation between cognition and education as well as current application of cognitive theory in the learning process. Cognitive skills involved in the learning process. Teaching strategies that enhance the use of cognitive skills and improve learning and teaching effectiveness. Prereq: permission.

**GRAD 962 - Academic Citizenship****Credits:** 2.00

Issues facing professors as a group within today's academic world. Topics include: defining "higher education" in contemporary terms; the variety of American academic institutions, their diverse missions, and associated career paths; the academic ethic; and the status of academic freedom in today's climate. Examination of the rights and responsibilities of the contemporary professor. Prereq: permission.

**GRAD 963 - College Students and the Undergraduate Culture****Credits:** 2.00

Examination of the cultures for learning and teaching, created by faculty members, administrators, and undergraduates. Consideration of recent research on the relationship of such cultures to the quality of teaching and learning. Content includes research on the learning needs of students, the importance of cultural artifacts in the classroom, and related topics.

**GRAD 965 - Classroom Research and Assessment Methods****Credits:** 2.00

Examination of methods used in classroom assessment and classroom research. The focus is on the improvement of teaching and learning in a teacher's own classroom. Research project is required. Prereq: permission.

**GRAD 970 - Special Topics in College Teaching****Credits:** 2.00 to 4.00

Formal courses in college teaching: A) field studies; B) disciplinary studies, C-Z other. Prereq: permission. May be

repeated to a maximum of 10 credits.

### **GRAD 971 - Teaching and Learning in Science**

**Credits:** 3.00 to 4.00

Issues, activities, and research in science education, including history of curricula, student and teacher knowledge and beliefs, epistemological and cognitive bases of science learning, and related instructional approaches. Extensive reading, writing, discussion, and reflection are included. Not open to all students who have completed CHEM 971. Prereq: permission.

### **GRAD 972 - Laboratory and Field Experience in the Sciences**

**Credits:** 2.00

Case studies of curriculum innovations in college science and mathematics. Students analyze materials and observe instruction. Examination of intended outcomes.

### **GRAD 974 - Teaching Sociology Seminar**

**Credits:** 4.00

Helping graduate students deal with teaching issues, explore teaching techniques, and improve their teaching skills. Topics include setting course goals, designing lectures, evaluating student work, leading discussion, and experimenting with innovative teaching techniques. Not open to students who have completed SOC 990. May be repeated to a maximum of 8 credits.

### **GRAD 975 - College Teaching in the Life Sciences and Agriculture**

**Credits:** 2.00

An overview of teaching strategies identified at the college level. The planning, execution, and evaluation of instruction for meeting the teaching needs of undergraduate students. Recommended for those who want to teach in a college setting. Not open to students who have completed LSA 900. Prereq: permission. May be repeated for a maximum of 4 credits.

### **GRAD 976 - Seminar in the Teaching of Social and Behavioral Science**

**Credits:** 3.00

Examination of issues and strategies related to teaching introductory level courses in the social sciences. Seminar focuses on both practical and theoretical issues of significance in the teaching/learning process at the college level. Not open to students who have completed PSYC 991 or 992. Prereq: permission. May be repeated.

### **GRAD 977 - Physics Teaching Seminar**

**Credits:** 1.00

Course for new graduate students provides an introduction to their role as teaching assistants. The course is designed to raise awareness of professional responsibilities, to provide instruction on theory-based teaching and learning, and to provide opportunities for reflective practice. Not open to students who have completed PHYS 901. Cr/F.

### **GRAD 978 - Teaching Economics**

**Credits:** 4.00

Analysis of the content, methodology, and pedagogy in college economics courses. Effects upon college students of economics. Exploration of relevance of other social sciences, the humanities, the natural sciences, and mathematics for undergraduate economic education. Not open to students who have taken ECON 898. Prereq: permission.

### **GRAD 979 - Issues in Teaching and Learning Physics**

**Credits:** 1.00 to 3.00

Issues in teaching and learning physics including cognitive models of learning; assessment tools; meta-cognition issues; role of mathematics; effectiveness of labs; issues in problem solving; misconceptions studies. Extensive readings, writing, discussion and reflection is required. Not open to students who have completed PHYS 902. (Also offered as PHYS 902.) Cr/F.

### **GRAD 980 - Preparing to Teach a Psychology Course**

**Credits:** 2.00

Preparation for teaching in psychology. Examination of issues and models involving course design and interaction with students. Products from the course will include a complete course syllabus, a preliminary statement of teaching philosophy, and the first three teaching models of a course. An IA (continuous grading) grade may be awarded.

**GRAD 981 - Graduate Seminar in Teaching History**

**Credits:** 2.00

Introduction of fundamental issues in the teaching of history at the college level. Topics include basic pedagogical issues, such as leading effective discussions, evaluating student's work, and lesson planning, and also concerns related to history teaching, e.g., developing students' historical consciousness, use of media, and so forth. Required of all entering Ph.D. students and applicable to the Cognate in College Teaching. (Also offered as HIST 970.) Cr/F.

**GRAD 990 - College Teaching Praxis**

**Credits:** 3.00 to 4.00

Formal experience in teaching a college level course. Development of a teaching portfolio. Prereq: permission. May be repeated for a maximum of 12 credits.

**GRAD 995 - Independent Study**

**Credits:** 1.00 to 4.00

Faculty supervised independent studies in college teaching. Prereq: permission. May be repeated to a maximum of 12 credits.

## Health & Human Services

### **HHS 840 - Collaborative Services for Children with Special Needs**

**Credits:** 4.00

Teachers and therapists need to collaborate to provide quality service for children and youth when working in a school setting. Designed for students in any professional area who plan to work with children, this course focuses on team development to plan integrated education and related services for children with a variety of special needs including autism/PDD, ADHD, learning disability, cerebral palsy, speech and language disorders, and multiple disabilities. Students will learn team development skills, how to collaborate with other professionals to write an IEP and provide services, and how to address needs frequently seen in common pediatric conditions.

### **HHS 898 - Special Topics**

**Credits:** 1.00 to 8.00

## History

### **HIST 800 - Advanced Explorations**

**Credits:** 1.00 to 4.00

See department listings for semester topic. Barring duplication of subject, may be repeated for credit up to 12 credits.

### **HIST 801 - Seminar in Religious Texts**

**Credits:** 4.00

Close study of sacred text(s) from a particular religious tradition (Islam, Christianity, Buddhism, Judaism, etc.) or a thematic selection of texts across religions.

### **HIST 803 - European Conquest of North America**

**Credits:** 4.00

A study of the social consequences of colonization, migration, and war in America, 1500-1775. Emphasis on the interaction of British colonists with competing European cultures (French, Dutch, Portuguese, and Spanish), with Native Americans, and with African and Afro-American slaves.

### **HIST 805 - Revolutionary America, 1750-1788**

**Credits:** 4.00

Examines the social, political, and cultural transformation of thirteen British colonies into the United States, up to the adoption of the Constitution.

### **HIST 806 - History of the Early Republic**

**Credits:** 4.00

Explorations in the histories of people and institutions that transformed the new United States from a coastal republic of largely independent freeholders to a transcontinental democracy increasingly driven by class. Topics include slavery, the family, reform movements, and the formulations of national identity.

### **HIST 809 - United States Legal History Special Topics**

**Credits:** 4.00

In-depth thematic exploration of the role of law in American life. Topics include Race and Equality in American Law; Community, Pluralism, and American Law; Property, Liberty, and Law; Gender and Law. May be repeated for credit with instructor's permission. Consult department listing for topics.

### **HIST 811 - Civil War Era**

**Credits:** 4.00

A survey of the period from the presidency of Andrew Jackson to the end of the Reconstruction, focusing on the causes, course, and consequences of the Civil War. Topics include slavery in the Old South, antebellum reform movements, creation and breakdown of the Second Party System, social and economic (as well as military) events during the war, and major developments during Reconstruction after the war.

### **HIST 812 - Emergence of Industrial America**

**Credits:** 4.00

Investigates the economic transformation of 19th-century America from a rural, agricultural to an urban, industrial society. Explores the sweeping economic changes, focusing on such topics as changes in work and leisure, westward expansion and its effects on native Americans, shifts in gender roles, growth of a consumer culture, rise of labor unions and populism, immigration, movements for reform and regulation, growth of American imperialism, and intellectual developments.

### **HIST 815 - United States Progressivism to the New Deal**

**Credits:** 4.00

United States from 1900 to 1941; cultural, political, and social factors causing major changes in American life.

### **HIST 816 - United States Since World War II**

**Credits:** 4.00

United States since 1941; cultural, political, and social factors causing major changes in American life.

### **HIST 817 - Vietnam War**

**Credits:** 4.00

An advanced interdisciplinary study of the American experience in Vietnam which uses fiction, film, music, and historical analysis to examine such matters as how and why the United States became involved in Vietnam, went to war there, and failed to win, as well as the consequences and legacies of that fateful conflict. It is strongly suggested that students first complete courses in modern American history.

### **HIST 818 - American Environmental History**

**Credits:** 4.00

This course examines how nature has been a factor in American history and how Americans have wrestled with the concepts of nature and culture. Topics include industrialization, evolution, conservationism, environmentalism, and environmental diplomacy.

### **HIST 819 - Foreign Relations of the United States**

**Credits:** 4.00

The history of American diplomacy from the colonial era to the present, with the dividing point at 1900. The focus will be on both the foreign and domestic influences that shaped American diplomacy.

### **HIST 820 - Foreign Relations of the United States**

**Credits:** 4.00

See description for HIST 819.

### **HIST #821 - History of American Thought**

**Credits:** 4.00

Advanced study in the history of American thought. Significant American thinkers considered in their social context. 1600-1860.

### **HIST 822 - History of American Thought**

**Credits:** 4.00

Advanced study in the history of American thought. Significant American thinkers considered in their social context. 1860-present.

### **HIST #823 - Early American Social and Cultural History**

**Credits:** 4.00

This course is designed to give students the opportunity to explore some of the recent findings of scholars who have studied Early American social and cultural history. It focuses on the experiences of Anglo-American and on the experiences of many of the other people with whom Anglo-Americans were frequently in contact, and who also shaped Early America. The course will include consideration of the pan-Atlantic context of Early America, cross-cultural contacts, family and gender, labor systems, religious observations, crime, and other themes explored in recent social and cultural theory.

### **HIST 824 - Topics in Modern United States Social History**

**Credits:** 4.00

Advanced study of topics in U.S. social history since the Age of Jackson. Topics will vary; and may include such examples as slavery and the antebellum South; reform movements in U.S. history; family history; labor history; the impact of war on American society; race in recent U.S. history. May be repeated as topics change.

### **HIST #825 - Southern History and Literature since the Civil War**

**Credits:** 4.00

Equal focus on the history and literature of the South since the Civil War. Topics include reconstruction, the age of segregation, and the Civil Rights Movement. Literary focus is on the period since 1920, including the "Southern Renaissance"; authors include William Faulkner, Robert Penn Warren, Flannery O'Connor, and Zora Neale Hurston.

### **HIST 831 - History of Brazil**

**Credits:** 4.00

Brazil has the fifth largest territory, the sixth largest population, and the eighth largest industrial economy in the world. Its colorful history has many distinctive features: the only country in the Americas to have been the capital of a European monarchy and then to have its own emperor for most of the last century; an outwardly peaceful image masking internal violence and turmoil; a suspicion of foreigners balanced by a desire to be accepted by them as equals; seemingly benevolent racial attitudes that serve to keep people of color on society's lower range; a tremendous cultural creativity that has given the world samba, film star Carmen Miranda, composer Heitor Villa Lobos, songwriter Antonio Carlos Jobim, poet Vinicims de Moraes, and novelist Jorge Amado. The course also examines the roles of the various elites; political, social, economic, in a country, where, it has been said "the unexpected always happens."

### **HIST 832 - Topics in Latin American History**

**Credits:** 4.00

Topics vary (see department listing for current semester). Seminar involves reading, discussion, and research on literature and documents related to the selected topic. It provides students with the opportunity to do research under close direction.

### **HIST #839 - Christian Monasticism in the Medieval West**

**Credits:** 4.00

Multi-faceted exploration of Christian monastic life in western Europe from its origins in pre-Christian history, through the early Desert Fathers and Mothers, St. Augustine and St. Benedict, to its flowering in the Clunaic, Cisterian, and mendicant reforms. Focus on intellectual, artistic, and pastoral aspirations and achievements of medieval monastics.

### **HIST 840 - Holy War in the Holy Land: The Medieval Crusades**

**Credits:** 4.00

Survey of medieval military expeditions organized by Christians to secure the Holy Land during the 12th and 13th centuries. Topics considered include the formulation of a "just war" theory, political, intellectual, religious, and military interactions between Christians, Jews, and Muslims; the Crusader State of Jerusalem; and the histories of individual crusades.

### **HIST 841 - Europe After the Black Death**

**Credits:** 4.00

Explores the dramatic changes that characterized Western Europe as it rebounded in the fifteenth through the seventeenth centuries from the ravages of the Black Death of 1348. Examines the social, political, and artistic developments in late medieval and Renaissance Italy before "crossing the Alps" to trace the expansion of Renaissance culture in Northern Europe. Topics covered in the course include the humanist movement, new patterns of social organization, the revival of classical antiquity in the arts, architecture, religion and political theory, the effects on European society of the encounter with the "New World," shifting roles for men and women in early modern European societies, and religious war and conflict.

### **HIST 842 - Religious Conflict in Early Modern Europe**

**Credits:** 4.00

The religious, social, and political maps of Europe were profoundly and permanently altered in the sixteenth and seventeenth centuries due to the split of the Protestant churches from the Roman Catholic church initiated in 1517 by Martin Luther. Explores the background to the Protestant Reformation of the sixteenth century and then investigates the various personalities--the Protestant and Catholic reformers, the Princes, the artisans and peasants, the Anabaptist radicals--that shaped this era of religious change and conflict. Also explores the important effects of religious change on European society and culture, including changes in gender roles, family life, and popular cultural practices such as magic and witchcraft in the sixteenth and seventeenth centuries.

### **HIST 843 - British Empire**

**Credits:** 4.00

This course examines the cultural and social history of the British Empire from the nineteenth century to the period of de-colonization after 1945. Looking at issues of racial "otherness", gender difference, and popular participation in the culture of Empire, students will be asked to think about the appeal of Empire for British men and women as well as its devastating impact upon the peoples of Africa and Asia. There will be a strong emphasis on reading, class discussion and written assignments.

### **HIST 844 - Victorian Britain**

**Credits:** 4.00

The Victorian Era was a time of contrasts. Upon the throne sat Queen Victoria, a monarch known for her moral uprightness, sexual probity and rigid sense of decorum. The streets of London, however, teemed with prostitutes, pickpockets and impoverished Irish immigrants whose lives seemed untouched by either the prosperity or moral stringency that characterized the age. In this class we will explore the varieties of Victorian experience both at home and in the global empire Britain had amassed during the nineteenth century. Examining sources such as the novels of Charles Dickens, the decorative arts of William Morris, and the scientific writings of Charles Darwin, we will attempt to uncover the many-faceted culture, society and political life of Victorian Britain. The instructor will place a strong emphasis on reading, class participation and writing.

### **HIST 847 - Early Modern France**

**Credits:** 4.00

An exploration of the culture and politics of early modern French society. Popular culture, religion, gender relations, the family, state-building, political theory, and revolution will be emphasized. Primary documents in translation will be read and discussion encouraged.

### **HIST 848 - Modern France**

**Credits:** 4.00

Advanced study of French society from Napoleon to Mitterand, including the Revolution of 1848 and the Paris Commune; world wars and the Vichy regime; existentialism, DeGaulle, and the revolt of May-June 1968.

### **HIST #849 - Comparative Topics in the History of Early Modern Europe**

**Credits:** 4.00

Topics will vary, but may include enlightenment and revolution; the peasantry; gender and the family; crime and deviance; science and society. May be repeated for a maximum of 8 credits.

### **HIST #850 - History of European Socialism**

**Credits:** 4.00

History of socialist thought and movements in Europe in the 19th and 20th centuries. Examines Utopian Socialism, development of Marxism, emergence of the New Left, and new socialist developments in the late 20th century.

### **HIST #851 - Topics in European Intellectual History**

**Credits:** 4.00

Explores major developments such as the Enlightenment, Russian intellectual history, ancient world views and cosmologies, and the relationship between gender and intellectual history. Includes topics up to the Scientific Revolution. Because topics may vary, students should check the department newsletter or office for course theme in any given term. May be repeated for credit as topics change.

### **HIST 852 - Topics in European Intellectual History**

**Credits:** 4.00

Explores major developments such as the Enlightenment, Russian intellectual history, ancient world views and cosmologies, and the relationship between gender and intellectual history. Includes topics since the Renaissance. Because topics vary, students should check the department newsletter or office for course themes in any given term. May be repeated for credit as topics change.

### **HIST 854 - Topics in History of Science**

**Credits:** 4.00

Study of a selected topic in the history of European science since the Renaissance.

### **HIST #855 - British History 1688-1832**

**Credits:** 4.00

Examines British history from the Glorious Revolution to the passage of the First Reform Bill. Topics include the consolidation of parliamentary democracy, the rise of the middle class family, the emergence of a broad-based consumer society. Also the integration of England, Scotland, and Ireland into a single British state, as well as the consequences of Britain's growing imperial power in North America, India, and Africa.

### **HIST 856 - 20th Century Europe**

**Credits:** 4.00

Advanced study of 20th-century Europe. World War I, European totalitarianism, World War II, the loss of European primacy, and the search for a new Europe.

### **HIST #859 - History of Spain and Portugal**

**Credits:** 4.00

Advanced study of Iberian states and their peoples from the coming of liberalism to the present. Failure of Iberian and liberal government. Political and social change, imperial and intellectual movements, influence of western European thought and activity.

### **HIST 861 - England in the Tudor and Stuart Periods**

**Credits:** 4.00

Advanced study of England during the Tudor and Stuart periods. Political, religious, socioeconomic, and intellectual forces for change at work in England from the accession of Henry VII to the revolution of 1688-89.

### **HIST 862 - England in the Tudor and Stuart Periods**

**Credits:** 4.00

See description for HIST 861.

### **HIST #863 - Russia: Origins to 1905**

**Credits:** 4.00

Russia from its foundations through the revolution of 1905. Political, social, and economic developments; intellectual and ideological currents.

### **HIST 864 - Russia: Modernization through Soviet Empire**

**Credits:** 4.00

The challenges of modernization; experience and legacy of Leninist and Stalinist revolutions; Soviet consolidation and decline through the Gorbachev era.

### **HIST #865 - Themes in Women's History**

**Credits:** 4.00

In-depth examination of a selected topic in women's history, such as women and health, women in modern European political theory, comparative history of women and revolution. See "Time and Room Schedule" or department for specific topic. May be repeated for credit with permission of instructor.

### **HIST 866 - Environmental History of Northwest Atlantic Commercial Fisheries**

**Credits:** 4.00

After centuries of groundfishing humans have radically transformed the northwest Atlantic marine ecosystem, creating a tragedy for both fish and fisherman. This marine environmental history course considers the changing technology, ecology, and sociology of the commercial fishery off New England and the Canadian maritime from 1500 to the present.

### **HIST #867 - Germany from the Late Medieval Period through the Reign of Frederick the Great of Prussia**

**Credits: 4.00**

Concentrates on the political, economic, and social structure of the Holy Roman Empire, the Reformation in Germany, the Thirty-Years War, and the rise of Prussia.

**HIST #868 - Germany from 1786 to 1918****Credits: 4.00**

Concentrates on the end of the Holy Roman Empire and Napoleonic domination of much of Germany, the Prussian Reform Era, industrialization, the revolutions of 1848, national unification under Bismarck, the Second Empire, and World War I.

**HIST 869 - Germany from 1918 to Present****Credits: 4.00**

Begins with the revolution of 1918 and then explores the political, social, and intellectual character of the Weimar Republic, the rise and nature of Nazism, the Holocaust, the foundation of both the German Democratic Republic and Federal Republic and their evolution in the shadow of the Cold War, and concludes with the unification of Germany after the fall of the Berlin Wall in 1989.

**HIST #870 - Historical Thinking for Teachers****Credits: 4.00**

Examines the courses, methods, and interpretative strategies of the historian. Emphasis on texts and topics relevant to the middle- and high-school classroom. Designed for history teachers as well as individuals in the Master of Arts in Teaching (M.A.T.) program. No credit for students who have completed HIST 875.

**HIST 871 - Museum Studies****Credits: 4.00**

Introduction to theory, methods, and practice of museum studies. Examination of various museum functions, as well as historical controversies. Prereq: graduate students only.

**HIST #872 - Studies in Regional Material Culture****Credits: 4.00**

An introduction to the theory and methodology of material culture, that is, the study of history through the analysis of buildings, human-created landscapes, and artifacts made and used in the United States, particularly in New England. May be repeated for credit with the permission of the graduate director.

**HIST 873 - Early History of Ancient Greece****Credits: 4.00**

Greek history from the Minoan and Mycenaean eras through the Persian Wars of the early fifth century. Emphasis on original sources including the Homeric epics, Plutarch, Sappho, and Herodotus. Examination of the distinctive developments of political systems in Sparta, Athens, as well as issues of colonization, diplomacy, religion and culture. Through discussion of types of available evidence and their integration into historical understanding.

**HIST 874 - Historiography****Credits: 4.00**

Analysis of ancient and modern historians. (Not offered every year.)

**HIST 875 - Historical Methods****Credits: 4.00**

Introduction to contemporary historical methods. Required of all entering Ph.D. candidates; open to undergraduates with permission.

**HIST 876 - Classical and Hellenistic Greek Worlds****Credits: 4.00**

Greek History from the Persian Wars of the early fifth century through the life of Alexander the Great and the creation of the Hellenistic world. Emphasis on original sources including Herodotus, Thucydides, the Athenian playwrights, and Plato. Examination of the transformation from city-state political organization to large Hellenistic kingdoms, as well as

discussion of Greek historiography, intellectual life, and social theory. Thorough discussion of types of available evidence and their integration into historical understanding.

### **HIST 877 - Roman Republic**

**Credits:** 4.00

Covers pre-Roman Italy, the Etruscans, and the foundation of the Republic. Rome's expansion through the Punic Wars, and relations with the Hellenistic kingdoms. Disintegration and final collapse of the Republic. Includes discussion of Roman art, engineering, and political theory. Emphasis on Latin sources in philosophy, history, and literature.

### **HIST 878 - Roman Empire**

**Credits:** 4.00

Collapse of the Roman Republic and creation of the Augustan principate through the division of the empire, with discussion of the fall of Rome in the west, and the eastern empire through Justinian. Discussion of Roman art, literature, philosophy, religious developments such as the proliferation of mystery religions and the rise of Christianity.

### **HIST 879 - Workshop in History and Historical Methods**

**Credits:** 1.00 to 6.00

Workshop for teachers in History. Intensive work designed to introduce teachers to advanced current work in history. Topics vary. May be repeated with permission of the instructor or the graduate director in the history department.

### **HIST 880 - Special Topics in Museum Studies/Material Culture**

**Credits:** 4.00

Study of a selected topic related to museum studies or material culture. May be repeated for course credit with permission of the graduate director.

### **HIST 881 - Topics History of Modern China**

**Credits:** 4.00

Problems in modern Chinese history from 1800 to the present. Topics may vary. Students will read translated primary sources, analyze literary works, and write critical essays and a research paper.

### **HIST #882 - Cults and Charisma**

**Credits:** 4.00

Examines the religious sects and charismatic leaders using case studies from history and the contemporary world, as well as analytical principles from religious studies and anthropology. Explores various approaches to the question, "what makes a person powerful over others?", in connection with the formation of messianic sects, the genesis of the "cult", the traditional authority of priests and kings, sainthood, the events at Jonestown and Waco, and the popular image of the "cult". Students learn to employ a variety of tools and models to understand historical situations of charismatic leadership.

### **HIST 884 - History of Southern Africa since 1652**

**Credits:** 4.00

Struggle for political and economic control in the only region of Africa where European groups remain in power. Impact of European imperialism, European nationalism, racial conflict, economic competition and industrialization, apartheid, and assimilation with special attention to the development of European hegemony.

### **HIST #885 - Modern Middle East**

**Credits:** 4.00

Advanced study of the Middle East from 18th century to the present. Problems created by modernization and reform of the traditional society; conservative reaction to reform, impact of nationalism, and appearance of new ideologies.

### **HIST #886 - States and Societies in Precolonial West Africa**

**Credits:** 4.00

An in-depth exploration of the nature and dynamics of state formation processes in West Africa. Focuses on major states such as Ghana, Mali, Songhai, Asante, Dahomey, Oyo, Benin, Borno and the Hausa States. Through a critical

analysis of primary and secondary sources, film footage and video documentaries, the course examines the significance of such issues as oral tradition, migrations, religion, art, class, slavery, gender, trade, state, kingship, and warfare in African history.

### **HIST 887 - Quantitative Methods and Computers for Historians**

**Credits:** 4.00

The historian's use of computers and statistics; opportunities and problems in using and analyzing quantitative sources; elementary statistical techniques; practical applications involving microcomputers and application programs. No previous knowledge of computers or college mathematics is assumed or required. Prereq: admission as a graduate student in history or permission of instructor.

### **HIST 888 - African Religions**

**Credits:** 4.00

Introduction to the basic principles of African religions. Exploration of historical and recent developments in the study of religion in Africa. Taking an interdisciplinary approach, the course focuses on the place of religion in African societies. The interrelatedness of religion with issues such as myth, ritual, gender, economics, social process, illness and healing the kingship and power, will be examined. Particular attention will be paid to the experience and expressions of African religions in the Americas, as well as the history and impact of Islam and Christianity in Africa. The course is aimed at helping students to understand what is typical about religion, and special about African religion, while appreciating the role of religion in non-Western societies. Slides, films, maps and other visual aids will be used to supplement the readings and provoke further discussion.

### **HIST #892 - Seminar in the History of Science**

**Credits:** 4.00

In-depth examination of a selected topic in the history of science. Subjects vary. No special background in science required.

### **HIST 898 - Internship in Museum Studies**

**Credits:** 4.00

Supervised position with a museum, historical society, archive, or other history related site. May be repeated for a total of 16 credits. Prereq: permission. Credit/Fail.

### **HIST 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Cr/F.

### **HIST 939 - Readings in Early American History**

**Credits:** 3.00

Introduces the chief themes and issues in the secondary literature of early American history from European settlement through the Early Republic. Students write a series of short analytical papers. Expected of all graduate students preparing a field in Early America.

### **HIST 940 - Readings in Modern American History**

**Credits:** 3.00

An introduction to major historians and historiographical issues in the history of the U.S. since 1820. Intended to serve as a foundation for research in the field and as preparation for graduate examinations.

### **HIST 949 - Colloquium in United States History**

**Credits:** 3.00

Topics include 1) Early American Society; 2) Early American Culture; 3) Revolutionary Period; 4) 19th Century; 5) 20th Century. Focuses on existing historical literature on a given topic, such as American slavery. Students normally read extensively, discuss major issues and the literature in class meetings, and write essays that examine the literature critically.

### **HIST #951 - Colloquium in European History**

**Credits: 3.00**

Topics include 1) Medieval; 2) Early Modern; and 3) Modern. The course focuses on the existing historical literature on a given topic, such as the French Revolution. Students normally read extensively, discuss major issues and the literature in class meetings, and write essays that examine the literature critically. May be repeated if a different topic is selected.

**HIST 952 - Colloquium in Comparative History****Credits: 3.00**

Intensive reading in comparative studies of U.S. history. Compares the experience of the United States and that of some other area or nation. For example, comparing legal history of Britain and the U.S.; the impact of colonization on native peoples in North and South America; the nature of slavery in the U.S., the Caribbean, and Brazil; or the experience of women in Europe and America. Topics vary and may be repeated with permission.

**HIST #953 - Colloquium in African, Asian, Latin American History****Credits: 3.00**

Topics include 1) African; 2) Asian; 3) Latin American; 4) Middle Eastern. Focuses on the existing scholarly historical literature on a given topic, such as nationalism or slavery. Students normally read extensively, discuss major issues and the literature in class meetings, and write essays that examine the literature critically.

**HIST 970 - Graduate Seminar in Teaching History****Credits: 2.00**

Introduction of fundamental issues in the teaching of history at the college level. Topics include basic pedagogical issues, such as leading effective discussions, evaluating students' work, and lesson planning, and also concerns related to history teaching, e.g., developing students' historical consciousness, use of media, and so forth. Required of all entering Ph.D. students and applicable to the Cognate in College Teaching. (Also offered as GRAD 981.) Cr/F.

**HIST #988 - Historical and Descriptive Literature of Early America****Credits: 3.00**

The chief English-language writings about North America from John Smith and William Bradford to the book-length literature of the American Revolution, considered as sources, as documents of intellectual history and historiography, and as literary genres. Emphasis on development of skills of analytical and critical reading and professional-level scholarly writing.

**HIST 989 - Research Seminar in American History****Credits: 3.00**

1) Early American Society; 2) Early American Culture; 3) Revolutionary Period; 4) 19th Century; 5) 20th Century. Focuses on original research on a given topic using primary materials supplemented by secondary works. The objective is to produce a major research paper that might serve as the basis for a publishable article. May be repeated with a different topic.

**HIST 990 - Research Seminar in American History****Credits: 3.00**

See description for HIST 989.

**HIST #991 - Research Seminar in European History****Credits: 3.00**

1) Medieval; 2) Early Modern; 3) Modern. Focuses on original research on a given topic using primary materials supplemented by secondary works. The objective is to produce a major research paper that might serve as the basis for a publishable article. May be repeated with a different topic.

**HIST #992 - Research Seminar in Comparative History****Credits: 3.00**

Comparative studies of U.S. history, emphasizing primary research. Colloquium compares the experience of the United States and that of some other area or nation. For example, comparing the legal histories of Britain and the U.S.; the impact of colonization on native peoples in North and South America; the nature of slavery in the U.S., the Caribbean,

and Brazil, or the experiences of women in Europe and America. Topics vary, and the course may be repeated for credit.

**HIST #993 - Research Seminar in African, Asian, Latin American History**

**Credits:** 3.00

1) African; 2) Asian; 3) Latin American; 4) Middle East. Focuses on original research on a given topic using primary materials supplemented by secondary works. The objective is to produce a major research paper that might serve as the basis for a publishable article. May be repeated with a different topic.

**HIST #994 - Research Seminar in African, Asian, Latin American History**

**Credits:** 3.00

See description for HIST 993.

**HIST 995 - Tutorial Reading and Research**

**Credits:** 1.00 to 6.00

A) Early American History; B) American National History; C) Canada; D) Latin America; E) Medieval History; F) Early Modern Europe; G) Modern European History; H) Ancient History; I) Far East and India; J) Near East and Africa; K) European Historiography; L) American Historiography; M) Russia; N) World History; O) English History; P) New Hampshire History; Q) Historical Methodology; R) Irish History; S) History of Science; T) Maritime; U) Museum Studies. Prereq: permission.

**HIST 997 - Directed Readings in Early American History**

**Credits:** 1.00 to 6.00

Directed readings in Early American History. Supervised readings for students preparing for the Ph.D. examinations in Early American History.

**HIST 998 - Directed Readings in Modern United States History**

**Credits:** 1.00 to 6.00

Supervised readings for students preparing for Ph.D. examinations in Modern U.S. History.

**HIST 999 - Doctoral Research**

**Credits:**

Cr/F.

## Health Management & Policy

### **HMP 810 - Financial Management for Clinicians**

**Credits:** 3.00

Includes basic elements of health care financial management and cost accounting, including cost concepts and product costing, budgeting, and variance analysis with an emphasis on the departmental level of health care organizations. Contains an overview of basic principles of accounting, focusing on the balance sheet and statement of revenues and expenses to include their analysis using the tools of ratio analysis. Concludes with the basic concepts of capital project analysis and health care reimbursement. Note: This course is not part of the M.H.A. sequence. Prereq: enrollment in nursing master's program; HMP majors not allowed. Permission.

### **HMP 900 - Health Care in the United States**

**Credits:** 3.00

Identification and examination of elements that comprise the health care system in the United States. Analysis of interaction between health organizations with political, economic, and other social systems.

### **HMP #901 - Health Economics**

**Credits:** 3.00

Application of economic concepts and principles to the study of health services; emphasis on the financing and delivery of personal medical care systems.

### **HMP #903 - Health Care Planning**

**Credits:** 3.00

Theoretical and historical foundations of health planning; the relationship of health planning and regulation; application of planning methods; and use of strategic planning and its relationship to marketing. Prereq: permission.

### **HMP #907 - Managed Health Care**

**Credits:** 3.00

Discussion of the historical antecedents of managed health care; exploration of current techniques directed at controlling health care costs.

### **HMP 910 - Epidemiology**

**Credits:** 3.00

Distribution and determinants of disease, illness, and health in the community. Community health and illness measures, status, and data. Applications to health services management.

### **HMP #920 - Organization Theory in Health Care**

**Credits:** 3.00

Application of organization theory and behavior to health organizations. Motivation and leadership, work group dynamics, communications, and negotiations within the health care organization as an open system; concentrates on topics involving organizational design, change, and innovation.

### **HMP 921 - Managing Health Services**

**Credits:** 3.00

The role and function of the manager, governance, and the management of operations in health care organizations. Determinants of management strategy and action.

### **HMP #924 - Human Resources Management in Health Care**

**Credits:** 3.00

Role of human resources management in meeting goals in health care organizations, functions of human resources management, organization of personnel activities and staff, relationship of managers to personnel administration staff

and activities.

**HMP 932 - Health Care Reimbursement**

**Credits:** 3.00

Analysis and discussion of payment techniques used by third-party payers to pay for services rendered to insured or program beneficiaries by health care organizations and individual providers.

**HMP #940 - Health Law and Ethics**

**Credits:** 3.00

Legal and ethical issues confronting health services managers. Topics include corporate liability, anti-trust, contract and tort law, labor law, models of ethical decision-making, analysis of competing organizational and professional interests, values and responsibilities. Prereq: HMP 900 and HMP 910; or permission.

**HMP #960 - Advanced Topics**

**Credits:** 1.00 to 3.00

Discussion of current topics in selected areas of health management and policy.

**HMP #975 - Praxis**

**Credits:** 1.00 to 3.00

An applied experience consisting of field study and the development of management or policy case studies and supporting analysis to explore the relationship between theory and professional practice. Cr/F. IA (Continuous grading).

**HMP 995 - Independent Study**

**Credits:** 1.00 to 3.00

Directed readings and other activities to explore a specific topic related to health management and policy. May be repeated to a maximum of 12 credits. Prereq: permission.

## Justice Studies

### **JUST 867 - Students, Teachers, and the Law**

**Credits:** 4.00

Explores how the law impacts the educational lives of students and teachers. Topics include church-state relations, free speech, dress codes, and search and seizure. (Also offered as EDUC 867.)

### **JUST 897 - Culminating Project**

**Credits:** 1.00 to 4.00

Students conduct a project related to their internship under the supervision of a faculty member. Projects might include an evaluation of a community policing program, interviews with battered women in a shelter, or a survey of corporal punishment. Prereq: JUST 901, 905 or 906, 907. Cr/F.

### **JUST 899 - Masters Thesis**

**Credits:** 1.00 to 8.00

Students conduct a masters thesis under the supervision of three graduate faculty members. Thesis projects might include an intervention study to reduce delinquency, a study of immigration law in the 1920s, or a survey of hate crimes. Prereq: JUST 901, 905 or 906, 907. Cr/F.

### **JUST 901 - Proseminar: Introduction to Justice Studies**

**Credits:** 4.00

Provides students with an introduction to Justice Studies and its faculty. Interdisciplinary study of informal and formal social organization and conflict resolution. Emphasis on law in practice and how individuals operate within and against the system of law. Topics include social order, crime and punishment, security and surveillance, and sharing/assessing risk.

### **JUST 905 - Quantitative Research Methods**

**Credits:** 4.00

Introduction to the major quantitative methods used by criminologists and justice researchers. Focuses on methods which illuminate causes of crime and justice. Covers all aspects of the research process including conceptualization, design, sampling, data analysis, and dissemination of results. Does not assume prior statistical knowledge.

### **JUST 906 - Qualitative Research Methods**

**Credits:** 4.00

Introduction to qualitative research methods of data gathering and analysis in Justice Studies. An intensive workshop training in field work technique. Emphasis on collecting data and analyzing it systematically. Four dimensions: reading about qualitative work, critiquing methodologies, participant observation, analyzing/writing up field notes/interviews.

### **JUST 950 - Traditional Field Experience**

**Credits:** 4.00

Field experience internships in a variety of justice settings including courts, law enforcement and victim services. Includes weekly seminar. Prereq: JUST 901. Cr/F.

### **JUST 951 - Research Field Experience**

**Credits:** 4.00

Research experience internships in research centers on campus such as Justiceworks, Crimes Against Children, and Family Research Lab or with individual researchers on campus who conduct justice-related research. Cr/F.

### **JUST 965 - Special Topics**

**Credits:** 4.00

New or specialized courses are presented under this listing. Staff present material not normally covered by the course

offerings. Cross-listed courses. May be repeated but not duplicate content.

## Kinesiology

### **KIN 804 - Electrocardiography**

**Credits:** 4.00

This course is designed to provide students exposure regarding basic interpretation and identification of electrocardiograms (ECGs). Included in this is detailed heart anatomy, coronary circulation, cardiac conduction system, electrocardiogram development, and all aspects pertaining to normal and abnormal ECGs.

### **KIN 805 - Topics in Applied Physiology**

**Credits:** 4.00

Advanced exercise physiology course dealing with topics both current and relevant to exercise science majors. Includes: genetics, environmental influences, immune system, detraining and over-training, epidemiology, ergogenic aids and the influence of age and gender. Special fee.

### **KIN 806 - Neurology**

**Credits:** 4.00

A detailed study of the development, morphology, internal configuration, physiology, histology, function, and pathology of the human nervous system. Labs consist of clinical case studies, brain dissections, and videos/slides to enhance the understanding of material. Prereq: human anatomy and physiology. Special fee. Lab.

**Co-requisites:** KIN 807

### **KIN 807 - Neurology Lab**

**Credits:** 1.00

Basic histology, neuroanatomy and neurophysiology of the human nervous system. Use of brain specimens, videos and pathology case studies to elucidate cell structure, sensory and motor systems, and spinal cord, brainstem, and cortical organization and anatomy. Cr/F.

**Co-requisites:** KIN 806

### **KIN 824 - Metabolic Adaptations to Exercise**

**Credits:** 4.00

An overview of the metabolic processes that occur during exercise and metabolic changes that occur as a result of exercise training. Topics covered include glycogenolysis and glycolysis in muscle, cellular oxidation of pyruvate, lipid metabolism, metabolism of proteins and amino acids, neural and endocrine control of metabolism, and fatigue during muscular exercise. Prereq: physiology of exercise and general chemistry.

### **KIN #825 - Motor Control Issues in Dysfunction**

**Credits:** 4.00

An in-depth analysis of current motor control/learning theories from the fields of neurophysiology, psychology, and motor development as they relate to normal and pathological movement; discussions of important cognitive, anatomical, biomechanical, and physiological variables constraining movement organization; and, the application of basic research findings for appropriate therapeutic approaches to motor dysfunction. Prereq: neurology or motor learning or equivalent. Lab.

### **KIN 836 - Fitness and Graded Exercise Testing and Prescription**

**Credits:** 4.00

This course is designed to provide students exposure to the knowledge and practical experience necessary for establishing exercise programs in apparently healthy populations. Topics include fitness testing, test interpretation, and exercise prescription. Prereq: KIN: Exercise Science major.

### **KIN 840 - Athletic Administration**

**Credits:** 4.00

Introduces basic management components and processes used in the successful administration of school and college athletic programs. Topics include planning, organizing, and managing sports programs, personnel and policies; game scheduling; finances and facilities; equipment and event management; student services; and key legal issues. Prereq: permission.

### **KIN 841 - Social Issues in Contemporary Sports**

**Credits:** 4.00

An investigation into interrelationships among sport, culture, and society in an attempt to understand better the role and function of sport in contemporary society. Broad overview of selected socio-cultural factors that influence participation and result from participation in sports. Prereq: introduction to sociology or permission.

### **KIN #842 - Diagnostic Motor Assessment**

**Credits:** 3.00

Overview of diagnostic and prescriptive procedures used in special physical education. Psychomotor assessment instruments utilized by practitioners in the field are described, which can be applied when discerning level of performance in children with special needs. Prereq: measurement procedures in physical education. Lab.

### **KIN 843 - Sport Marketing**

**Credits:** 4.00

A survey of concepts and processes used in the successful marketing of sport programs and events. Special emphasis placed on the unique or unusual aspects of sport products, markets, and consumers. Prereq: survey of marketing and methods or permission.

### **KIN #844 - Medical and Exercise Issues of Disabling Conditions**

**Credits:** 3.00

A study of disabilities caused by anomalies found within neurological, cardio respiratory, sensory, and musculoskeletal systems. Exercise and programming techniques necessary for physical and motor development relative to present physiological and kinesiological functioning addressed. Prereq: exercise physiology or equivalent.

### **KIN #847 - Sport Broadcasting**

**Credits:** 4.00

An introduction to today's sport broadcasting business for future sport business professionals. Topics include the relationship between electronic media and the sport industry and a survey of today's media environment including radio, television, the Internet and emerging technologies. Other topics include demographics, market research, audience measurement, legal issues, production techniques and contract negotiations. Readings, lectures, discussions and opportunities for practical application. Prereq: sport studies majors.

### **KIN 850 - Theories of Motivation in Sport and Exercise**

**Credits:** 4.00

Social cognitive theories of achievement motivation as they relate to sport and exercise participation. Special consideration given to the ways coaches, exercise leaders, and physical education teachers should motivate individuals. Prereq: introduction to psychology.

### **KIN #854 - Advanced Human Motion Analysis**

**Credits:** 4.00

An in-depth analysis of human motion and the techniques of motion analysis. Focuses on the biomechanical aspects of human movement such as the kinematic variables of velocity, acceleration, and position, and on the myo-electrical components of voluntary movement. Students learn how motion analysis techniques are used in clinical and laboratory settings to quantitatively analyze both a normal and pathological movement pattern. Prereq: kinesiology or biomechanics; anatomy. Special fee. Lab.

### **KIN 870 - Psychological Skills in Performance**

**Credits:** 4.00

Provides essential elements of psychological skills training in performance. This course focuses on teaching mental skills that enhance or inhibit physical performance. Theory, direct skill acquisition, and skill application are integral to

this course. Topics include progressive relaxation, meditation, hypnosis, goal setting, and stress inoculation testing. Prereq: introduction to psychology or psychological factors in sport. Special fee.

### **KIN #875 - Sports Writing**

**Credits:** 4.00

Introduction to the basic concepts and skills of sports writing, particularly related to regular beat coverage of sports. Students learn how to write columns, advance, game and feature stories, to develop and retain sources, conduct interviews, and write well crafted stories. Students are exposed to sports journalism history and research into the dominant forms of representation of gender, race, and class in the print sports media.

### **KIN 880 - Psychological Factors in Sport**

**Credits:** 4.00

Factors of outstanding athletic achievement; psychological variables in competition; the actions and interactions of sport, spectator, and athlete. Special attention to directed to strategies for coaches, teachers, and athletic trainers to utilize sport psychology in their professional practice. Prereq: introduction to psychology.

### **KIN 881 - Inclusion in Physical Education**

**Credits:** 4.00

Overview of special physical education. Addresses modifying instruction, expectations, and learning environment to accommodate physical and motor behaviors of students with disabilities. Prereq: KIN P.E. Pedagogy majors. Lab.

### **KIN #882 - Therapeutic Applications of Adventure Programming**

**Credits:** 4.00

Examines the use of adventure activities as elements of therapeutic treatment plans. Incorporates theoretical seminars and associated practical experiences. Prereq: outdoor education philosophy and methods or theory of adventure education; permission.

### **KIN 884 - Programs in Outdoor Education**

**Credits:** 4.00

Provides an understanding of outdoor education program models currently being used, analyzing the principles underlying the curriculum development and strategies for implementing such models. Prereq: permission.

### **KIN 885 - Foundations of Adventure Education**

**Credits:** 4.00

Examination of the writings of thinkers such as Plato, Rousseau, and John Dewey and discussion of their applications to the field of adventure education. Topics include learning theory, human nature, aims of education, critical analysis and evaluation techniques. Prereq: permission.

### **KIN 886 - Organization and Administration of Outdoor Education**

**Credits:** 4.00

Study of administration of outdoor education programs using a variety of organizational models. Students develop and, through simulated exercises, manage a program. Field experience. Prereq: permission. Special fee.

### **KIN #890 - Social and Health Issues in Sport Psychology**

**Credits:** 4.00

Current trends in social and health psychology as they pertain to exercise and sport. Examines areas such as adherence motivation, bulimia and anorexia in athletes, self-theory, exercise and depression, and substance abuse in athletes. Prereq: introduction to psychology.

### **KIN 895 - Advanced Studies**

**Credits:** 2.00 to 4.00

Independent study problems. Prereq: permission of graduate adviser. May be repeated up to 8 credits.

### **KIN 896 - Advanced Research in Exercise Science**

**Credits:** 3.00 or 6.00

Students design and conduct original research that culminates in a paper of publishable quality. Completion of either this course or KIN 899 satisfies the department's research requirement for the master's degree. May be taken for 3 credits per semester in each of two semesters or 6 credits in one semester. Maximum 6 credits. Cr/F. IA (continuous grading).

**KIN 898 - Special Topics**

**Credits:** 1.00 to 4.00

New or specialized courses not normally covered in regular course offerings. Prereq: permission. May be repeated up to 8 credits.

**KIN 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Cr/F.

**KIN 900 - Applied Statistics**

**Credits:** 4.00

Designed to introduce basic statistics commonly used in the research literature of their field. Concepts such as mean, standard deviation, standard error, variance, probability, sample size, and statistical power will be presented. Specific statistical methods will be covered such as paired and unpaired t-tests, correlation, regression, multiple and step-wise regression, one and two-way ANOVA, MANOVA, canonical correlation and factorial analysis.

**KIN 901 - Analysis of Professional Literature**

**Credits:** 4.00

Critical interpretation of professional literature. This course focuses on the appropriate use of research methodologies and techniques.

**KIN 902 - Colloquium**

**Credits:** 1.00 to 2.00

Seminar format with readings, discussions, laboratory tutorials, and presentations of current research topics. A) exercise science; B) outdoor education; C) special physical education; D) sport studies. Cr/F.

**KIN #909 - Special Physical Education Practicum/Seminar**

**Credits:** 2.00

Prepares master teachers to employ teaching skills so that they can interact effectively in educational environments. Methods for a special physical education teacher to design and implement an educational program for children with disabilities that are congruent with the idiosyncrasies of the public schools. May be taken twice for credit. Cr/F.

**KIN 910 - Health Promotion and Programming in Schools**

**Credits:** 4.00

Examines health education and various health promotion programs in school settings using an ecological framework.

**KIN 931 - Advanced Exercise Science Laboratory Procedures**

**Credits:** 3.00

Designed to provide students knowledge regarding laboratory equipment, theory, experimental design, and use of statistics as well as to provide opportunities to develop technical laboratory skills. Theory, correct technique, and practice opportunities are provided routinely. Topics areas include metabolic analyses, pulmonary function, body composition assessment, phlebotomy, and various blood and urine assays. Special fee. Lab.

**KIN 950 - Internship**

**Credits:** 2.00 to 4.00

Experiential learning in a setting appropriate to the student's objectives. A 4-credit internship requires a minimum of 300 hours experience. Fewer credits require proportionally fewer hours. A) Exercise Science. Clinical work, normally in a hospital or laboratory setting, involving exercise physiology, graded exercise testing, exercise prescription, and/or cardiac rehabilitation. Must have completed all required coursework except thesis. B) Special Physical Education C) Sport Studies. Cr/F.

**KIN 985 - Change Processes in Adventure Programming****Credits:** 4.00

Current uses of adventure and other forms of experiential programming focus on working with clients who wish to change at some level (e.g. education, corporate, therapeutic) and generally to have that change last. The purpose of this course is to examine this expectation, our efforts to assist clients in achieving such an objective, and how we as facilitators of client experiences fulfill such a role.

**KIN 986 - Outdoor Education Seminar****Credits:** 4.00

Students are involved in an in-depth analysis of a particular aspect of outdoor education through a series of experiential and seminar activities. Prereq: permission.

## Liberal Studies

### **LS 800 - Core Seminar**

**Credits:** 4.00

An introductory seminar specially designed for and limited to students within the LS program. Core seminars are interdisciplinary explorations of significant issues, topics, themes, or perspectives in human life in general and the contemporary world in particular. Topics may change from semester to semester. The seminar must be taken within the first year of a student's matriculation in the program, preferably in the first semester.

### **LS 845 - Special Topics**

**Credits:** 2.00 to 4.00

New or specialized courses not normally covered in regular course offerings. Prereq: permission. May be repeated to a maximum of 8 credits.

### **LS 846 - Special Topics**

**Credits:** 2.00 to 4.00

See description for LS 845.

### **LS 895 - Independent Study**

**Credits:** 1.00 to 6.00

Independent study for graduate students in LS as part of their concentration. Prereq: permission. May be repeated to a maximum of 8 credits.

### **LS 896 - Independent Study**

**Credits:** 1.00 to 6.00

See description for LS 895.

### **LS 898 - Master's Project**

**Credits:** 1.00 to 6.00

For LS students to work out a final project consistent with concentration and interests. Prereq: LS students only; permission. Cr/F.

### **LS 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

For LS students to work out a final thesis consistent with their concentration and interests. Prereq: LS students only; permission. Cr/F.

## Life Sciences & Agriculture

### **LSA 900 - College Teaching**

**Credits:** 2.00

An overview of teaching strategies identified at the college level. The planning, execution, and evaluation of instruction for meeting the teaching needs of undergraduate students. Recommended for those who want to teach in a college setting. (Also listed as GRAD 975.)

### **LSA #901 - Introduction to Research**

**Credits:** 1.00

Orientation for beginning Graduate students. Topics include: Expectations of Graduate school, identification and design of thesis research projects, conducting research, and oral and written communication of scientific knowledge. Cr/F.

## Mathematics

### **MATH #805 - Probability, Data Analysis, and Discrete Mathematics for the Middle School**

**Credits:** 3.00

Probability, counting techniques, analysis of statistical data, elementary graph theory, and school curriculum materials for middle school teachers. Prereq: permission.

### **MATH 835 - Statistical Methods for Researchers**

**Credits:** 3.00

Emphasis is on applications of statistical methods and concepts. Topics include: Basic descriptive statistics, statistical graphs, fundamentals of statistical inference, analysis of variance (ANOVA), regression analysis, introduction to statistical design of experiments, categorical data, time-ordered data, introduction to multivariate statistical techniques. Recommended to graduate students with little or no formal training in statistical methods or to graduate students looking for a refresher course in statistics.

### **MATH 837 - Statistical Methods For Quality Improvement**

**Credits:** 3.00

Introduction to scientific data collection and analysis with an emphasis on industrial applications. Topics include statistical process control (SPC), engineering process control, failure modes and effects analysis (FMEA), Six-Sigma concepts and methods, and confidence intervals and hypothesis testing. Use of a statistical software package is an integral part of the course; graphical data analyses are emphasized. Prereq: basic introductory statistics.

### **MATH 839 - Regression Analysis**

**Credits:** 3.00

Estimation, testing, and diagnostic methods for regression models. Simple linear regression, residual analysis and model validation, multiple linear regression, model selection, multicollinearity, polynomial regression, categorical predictors, analysis of variance, analysis of covariance.

### **MATH 840 - Design of Experiments I**

**Credits:** 3.00

Quality control methods; design of experiments for quality improvement; randomization and blocking; factorial designs; nested designs; fixed-, and random- and mixed-effects models; fractional factorial designs; response surface methods. Industrial and engineering applications.

### **MATH 841 - Biostatistical Methods**

**Credits:** 3.00

Concepts and methods of nonparametric statistics, categorical data analysis and failure-time data analysis: Censored data analysis. Biostatistical techniques. Reliability and life testing. Poisson regression. (Offered alternate years.)

### **MATH 842 - Multivariate Statistics and Modern Regression Methods**

**Credits:** 3.00

Random vectors and matrices, multivariate normal distribution, Hotelling's  $T^2$ , multivariate analysis of variance (MANOVA), principal components, discriminant analysis, factor analysis, partial least squares, empirical orthogonal functions, additive and generalized additive models. (Offered in alternate years.)

### **MATH 844 - Design of Experiments II**

**Credits:** 3.00

Experimental design strategies and issues that are often encountered in practice. Topics include: Complete and incomplete blocking, partially balanced incomplete blocking (BIB), confounding intra and inter block information, split plotting and strip plotting, repeated measures, crossover design strategies, Latin squares and rectangles, Youden squares, crossed and nested treatment structures, variance components, mixed effects models, analysis of covariance,

optimizations, missing responses. Prereq: industrial statistics and design of experiments or permission.

### **MATH 845 - Foundations of Applied Mathematics**

**Credits:** 3.00

Basic concepts and techniques of applied mathematics intended for graduate students of mathematics, engineering, and the sciences. Fourier series and transforms, Laplace transforms, optimization, linear spaces, eigenvalues, Sturm-Liouville systems, numerical methods, conformal mapping, residue theory.

### **MATH 846 - Foundations of Applied Mathematics**

**Credits:** 3.00

See description for MATH 845.

### **MATH 847 - Introduction to Nonlinear Dynamics and Chaos**

**Credits:** 3.00

An introduction to the mathematics of chaos and nonlinear dynamics. Topics include: linear and nonlinear systems of ordinary differential equations; discrete maps; chaos; phase plane analysis; bifurcations; and computer simulations. Prereq: elementary differential equations; linear algebra; and multidimensional calculus. (Not offered every year.)

### **MATH 853 - Introduction to Numerical Methods**

**Credits:** 3.00

Introduction to mathematical algorithms and methods of approximation. A wide survey of approximation methods are examined including, but not limited to, polynomial interpolation, root finding, numerical integration, approximation of differential equations, and techniques used in conjunction with linear systems. Included in each case is a study of the accuracy and stability of a given technique, as well as its efficiency and complexity. It is assumed that the student is familiar and comfortable with programming a high-level computer language. (Also offered as CS 853.)

### **MATH 854 - Introduction to Scientific Computing**

**Credits:** 3.00

Introduction to the tools and methodology of scientific computing via the examination of interdisciplinary case studies from science and engineering. Emphasis on numerical approaches to solving linear systems, eigenvalue-eigenvector problems, and differential equations. Problems solved on various hardware platforms using a combination of software and data visualization packages. Prereq: linear algebra; differential equations; introduction to scientific programming; or permission. (Also offered as CS 854, PHYS 854.)

### **MATH 855 - Probability and Stochastic Processes**

**Credits:** 3.00

Introduction to the theory of probability, random variables, expectation, discrete and continuous probability distributions, correlation, Markov chains, introduction to stochastic processes, birth-death processes, moment-generating functions, limit theorems.

### **MATH 856 - Principles of Statistical Inference**

**Credits:** 3.00

Theory of statistical inference, principles of point estimation, maximum likelihood and other methods, exact and approximate methods, confidence regions, significance testing, computational methods, Bayesian inference, decision theory. Prereq: probability and stochastic processes.

### **MATH 861 - Abstract Algebra**

**Credits:** 3.00

Basic properties of groups, rings, fields, and their homomorphisms.

### **MATH 862 - Linear Algebra**

**Credits:** 3.00

Abstract vector spaces, linear transformations, and matrices. Determinants, eigenvalues, and eigenvectors. Prereq: MATH 861.

**MATH 864 - Advanced Algebra****Credits:** 3.00

Topics to be selected from among rings, modules, algebraic fields, and group theory. Prereq: MATH 861. (Not offered every year.)

**MATH 867 - One-Dimensional Real Analysis****Credits:** 3.00

Theory of limits, continuity, differentiability, integrability.

**MATH 876 - Logic****Credits:** 3.00

Induction and recursion; sentential logic; first-order logic; completeness, consistency, and decidability; recursive function. (Not offered every year.)

**MATH #883 - Set Theory****Credits:** 3.00

Axiomatic set theory, including its history, Zermelo-Fraenkel axioms, ordinal and cardinal numbers, consistency, independence, and undecidability. (Not offered every year.)

**MATH 884 - Topology****Credits:** 3.00

Open sets, closure, base, and continuous functions. Connectedness, compactness, separation axioms, and metrizable.

**MATH 888 - Complex Analysis****Credits:** 3.00

Complex functions, sequences, limits, differentiability and Cauchy-Riemann equations, elementary functions, Cauchy's theorem and formula, Taylor's and Laurent's series, residues, conformal mapping. Prereq: MATH 867.

**MATH 896 - Topics****Credits:** 3.00

New or specialized courses not covered in regular course offerings. Prereq: permission. May be repeated up to 6 credits.

**MATH 898 - Master's Project****Credits:** 1.00 to 6.00

May be repeated to a maximum of 6 credits. IA (continuous grading). Cr/F.

**MATH 899 - Master's Thesis****Credits:** 1.00 to 6.00

Cr/F.

**MATH #901 - An Introduction to Programming and the Internet for Teachers****Credits:** 3.00

An introductory course covering the basics of programming using Java applets on the internet that can be used as mathematics teaching tools. Topics include programming concepts and techniques, the definition and use of classes and basic graphical user interface components. Necessary internet topics will also be covered, such as the World Wide Web and the HTML.

**MATH 903 - Higher Algebra for Teachers****Credits:** 3.00

The integers, integral domains, and topics from number theory; equivalence relations and congruences; real numbers, complex numbers, fields, and polynomials; group theory; matrix theory; vectors and vector spaces; rings; Boolean algebra.

**MATH 904 - Higher Algebra for Teachers****Credits:** 3.00

See description for MATH 903.

**MATH 905 - Higher Geometry for Teachers****Credits:** 3.00

Systems of postulates of various geometries; geometric invariants; synthetic and analytic projective geometry; an introduction to non-Euclidean geometry and topology.

**MATH 906 - Higher Geometry for Teachers****Credits:** 3.00

See description for MATH 905.

**MATH 907 - Higher Analysis for Teachers****Credits:** 3.00

The real number system; functions and limits; elements of set theory; numerical sequences and series; continuity; the derivative and the Riemann integral; maxima and minima.

**MATH 908 - Higher Analysis for Teachers****Credits:** 3.00

See description for MATH 907.

**MATH 909 - Probability and Statistics for Teachers****Credits:** 3.00

Permutations and combinations; finite sample spaces; random variables; binomial distributions; statistical applications.

**MATH 910 - Mathematics Education****Credits:** 1.00 to 4.00

Current developments and issues in mathematics education; content, curricula, methods, and psychology of teaching mathematics.

**MATH #911 - Technology in Teaching Mathematics****Credits:** 3.00

Consideration of the role of technology in teaching mathematics; preparation of classroom materials for Macintosh and IBM; exchange of ideas and software.

**MATH #912 - Exploring Data and Planning Investigations****Credits:** 3.00

Covers basic concepts and methodologies behind exploratory statistics and design of experiments, and provides background for teaching AP statistics. Graphical displays, distributions, summary measures and their distributions, confidence intervals, hypothesis tests, factorial and fractional factorial designs, randomization, blocking, response surface methods. JMP software will be used extensively.

**MATH 914 - Topology for Teachers****Credits:** 3.00

Fundamental concepts of elementary topology; network and map problems; sets, spaces, and transformations.

**MATH #916 - Theory of Numbers for Teachers****Credits:** 3.00

Divisibility and primes; congruences; quadratic reciprocity; number theoretic functions; Diophantine equations; perfect and amicable numbers.

**MATH 917 - Mathematical Proof and Problem Solving****Credits:** 3.00

Introduction to abstract mathematics with an emphasis on problem solving and proof structure, methods and

techniques. Content includes logic, set theory and basic number theory.

**MATH #919 - Real Number System**

**Credits:** 3.00

A postulational approach to fundamentals of algebraic structure; sequences, limits, and continuity.

**MATH #920 - History of Mathematics**

**Credits:** 3.00

A problem-study approach to mathematical problems from the period of Greek mathematics until the modern era.

**MATH #921 - A Modern Approach to Geometry**

**Credits:** 3.00

The foundations and development of Euclidean geometry, with emphasis on the recent recommendations in the field of high school geometry.

**MATH 925 - Problem Solving Seminar**

**Credits:** 3.00

A study of variety of problem solving strategies and techniques in the context of solving mathematical problems. Problems will emphasize the connections between the core areas of algebra, geometry and analysis. Other mathematical topics may be included. Typically taken in conjunction with the Concluding Experience Problem Set. Cr/F.

**MATH 928 - Selected Topics in Mathematics for Teachers**

**Credits:** 1.00 to 3.00

New or specialized topics not covered in the regular course offerings. May be repeated for credit.

**MATH 929 - Directed Reading**

**Credits:** 3.00

A directed reading project on a selected topic in mathematics or mathematics education, planned in collaboration with a faculty member. May be repeated up to 6 credits.

**MATH 931 - Mathematical Physics**

**Credits:** 3.00

Complex variables, differential equations, asymptotic methods, integral transforms, special functions, linear vector spaces and matrices, Green's functions, and additional topics selected from integral equations, variational methods, numerical methods, tensor analysis, and group theory. Prereq: differential equations; linear algebra; multidimensional calculus. (Also offered as PHYS 931.)

**MATH 932 - Mathematical Physics**

**Credits:** 3.00

Complex variables, differential equations, asymptotic methods, integral transforms, special functions, linear vector spaces and matrices. Green's functions, and additional topics selected from integral equations, variational methods, numerical methods, tensor analysis, and group theory. Prereq: differential equations; linear algebra; multidimensional calculus. (Also offered as PHYS 932.)

**MATH 951 - Algebra I**

**Credits:** 3.00

Groups and their homomorphisms, products and sums, structure of groups; rings and their homomorphisms, ideals, factorization properties. Prereq: MATH 861.

**MATH 952 - Algebra II**

**Credits:** 3.00

Field extensions; Galois theory; module theory. Prereq: MATH 951.

**MATH 953 - Analysis I**

**Credits:** 3.00

Measurable spaces and functions, measures, Lebesgue integrals, convergence theorems. Prereq: MATH 867.

**MATH 954 - Analysis II**

**Credits:** 3.00

Cauchy theory and local properties of analytic functions, Riemann mapping theorem, representation theorems, harmonic functions. Prereq: MATH 888.

**MATH 955 - Topology I**

**Credits:** 3.00

Subspace, product, and quotient topologies; embedding; separation and countability axioms; connectedness; compactness and compactifications; paracompactness, metrization, and metric completions. Prereq: MATH 884.

**MATH 956 - Topology II**

**Credits:** 3.00

Chain complexes; homology of simplicial complexes, singular homology and cohomology; axiomatic homology; cup and cap products. Prereq: MATH 861 and 884.

**MATH 958 - Foundations of Math Education**

**Credits:** 3.00

Topics will include: major issues, trends, and programs in mathematics education research, the research process, theoretical perspectives to guide research, the profession and infrastructure of mathematics education, cultural and historical aspects of mathematics education, and the research-practice interface. Examples span the K-16 spectrum. Prereq: permission.

**MATH 961 - Topics in Algebra I**

**Credits:** 3.00

An introduction to topics chosen from algebra and number theory. Prereq: MATH 951-952. May be repeated.

**MATH 963 - Functional Analysis**

**Credits:** 3.00

Banach and Hilbert spaces, Hahn-Banach theorem, open mapping and closed graph theorems, dual spaces, topological vector spaces. Prereq: MATH 953.

**MATH 964 - Topics in Analysis I**

**Credits:** 3.00

An introduction to topics in analysis. Prereq: permission. May be repeated.

**MATH #965 - Topics in General Topology I**

**Credits:** 3.00

An introduction to topics in general topology. Prereq: MATH 955. May be repeated.

**MATH #966 - Topics in Algebraic Topology I**

**Credits:** 3.00

An introduction to topics in algebraic topology. Prereq: MATH 956. May be repeated.

**MATH 967 - Topics in Applied Mathematics I**

**Credits:** 3.00

An introduction to topics in applied mathematics. Prereq: permission. May be repeated.

**MATH 968 - Topics in Mathematics Education I**

**Credits:** 3.00

A) The Teaching and Learning of Mathematics; B) Curriculum and History in Mathematics Education. Topics selected from: epistemologies of knowledge applied to mathematics; theories of learning and teaching mathematics; theoretical perspectives in research; mathematics education research programs K-16; research methods for studying mathematics

teaching, learning, and curricula; theoretical frameworks for curriculum development, implementation of new curricula, and research on curricula; historical perspectives of research in mathematics education; the evolution and history of K-16 mathematics curricula both in United States and internationally. Versions A and B offered alternately. Prereq: MATH 958 or permission. May be repeated.

### **MATH 969 - Topics in Probability and Statistics I**

**Credits:** 3.00

Selected advanced topics from one or several of the following areas: probability, stochastic processes, design of experiments, biostatistics, Bayesian theory and methods, spatial and spatio-temporal statistics, time series analysis, nonparametric statistics. Prereq: permission. May be repeated.

### **MATH #971 - Topics in Algebra II**

**Credits:** 3.00

An introduction to advanced topics chosen from algebra and number theory. Prereq: MATH 951-952; permission. May be repeated.

### **MATH 973 - Topics in Operator Theory**

**Credits:** 3.00

Selected topics in operator theory. Prereq: MATH 963. May be repeated.

### **MATH 977 - Topics in Applied Mathematics II**

**Credits:** 3.00

An exploration of an area of research in applied mathematics. Prereq: permission. May be repeated.

### **MATH 978 - Topics in Mathematics Education II**

**Credits:** 3.00

An exploration of an area of research in mathematics education. Prereq: permission. May be repeated.

### **MATH 979 - Research Topics in Statistics**

**Credits:** 3.00

An exploration of the main statistical issues and computational methods associated with research problems from such areas as survival analysis, reliability, longitudinal data, categorical data, spatio-temporal data, and industrial processes. Student term projects require: literature searches, presentation, use of modern statistical software, and written reports. Prereq: permission. May be repeated.

### **MATH 998 - Reading Courses**

**Credits:** 1.00 to 6.00

A) Algebra; B) Analysis; C) Operator Theory; D) Geometry; E) General Topology; F) Algebraic Topology; G) Applied Mathematics; H) Mathematics Education; I) Probability and Statistics. Prereq: permission.

### **MATH 999 - Doctoral Research**

**Credits:**

Cr/F.

## Mechanical Engineering

### **ME #801 - Macroscopic Thermodynamics**

**Credits:** 4.00

Thermodynamic principles using an analytic, postulational approach, and Legendre transformations to obtain thermodynamic potentials. Prereq: thermodynamics or permission.

### **ME 802 - Statistical Thermodynamics**

**Credits:** 4.00

Macroscopic thermodynamic principles developed by means of microscopic analysis. Prereq: thermodynamics.

### **ME 807 - Analytical Fluid Dynamics**

**Credits:** 4.00

Kinematics of flow; constitutive relationships; development of the Navier-Stokes equations; vorticity theorems; potential flow. Prereq: fluid dynamics.

### **ME 808 - Gas Dynamics**

**Credits:** 4.00

Study of one-dimensional subsonic and supersonic flows of compressible ideal and real fluids. Wave phenomena; linear approach to two-dimensional problems; applications in propulsion systems. Prereq: fluid dynamics or permission. Special fee.

### **ME 809 - Computational Fluid Dynamics**

**Credits:** 3.00

Review of matrix methods, basics of finite differences, basics of spectral methods, stability, accuracy, Navier-Stokes solvers. Prereq: heat transfer or permission.

### **ME #811 - Coherent Optical Methods**

**Credits:** 3.00

Introduction to electro-optic experimental techniques in mechanics. Optic fundamentals including elements of scalar diffraction theory, interferometry, holography, Doppler shifts, coherence, and laser speckle. Applications include mechanical strain measurements, vibrational mode determination, fluid pressure and temperature measurements, and fluid velocity measurements. Concepts from course are demonstrated in laboratory. Prereq: permission.

### **ME 812 - Waves in Fluids**

**Credits:** 3.00

Linear and nonlinear dynamics of hyperbolic and dispersive wave systems with application to acoustic waves, surface and internal gravity waves, Rossby waves, and capillary waves. Key physical concepts include wave-generation mechanisms, wavelength and amplitude dispersion, group velocity and energy propagation, steady streaming, and mode interactions. Prereq: Fluid dynamics; or permission.

### **ME 823 - Advanced Dynamics**

**Credits:** 4.00

Classical dynamics oriented to contemporary engineering applications. Review of particle dynamics. Hamilton's principle and the Lagrange equations. Kinematics and dynamics of rigid bodies, gyroscopic effects in machinery and space structures. Prereq: mechanics III or permission.

### **ME 824 - Vibrations Theory and Applications**

**Credits:** 4.00

Discrete vibrating systems. Linear system concepts; single-degree-of-freedom systems with general excitation. Matrix theory and eigenvalue problems. Many degrees of freedom, normal mode theory for free and forced vibration.

Numerical methods; introduction to continuous systems; applications to structural and mechanical systems. Prereq: mechanics II; mechanics III or permission.

### **ME 827 - Advanced Mechanics of Solids**

**Credits:** 4.00

Stress, strain, stress-strain relations, anisotropic behavior, introduction to elasticity, plane stress/strain, bending and torsion of members with general cross-sections, introduction to thin plates and shells, energy methods. Prereq: mechanics II or permission.

### **ME 835 - Mechanics of Composite Materials**

**Credits:** 4.00

Classification of composites - Anisotropy of composite materials. Micromechanical predictions of elastic and hygrothermal properties. Strength and failure of composite materials. Analysis of laminates. Experimental methods for characterization of composites. Prereq: Mechanics II; Heat Transfer or permission.

### **ME 841 - Nonlinear Systems Modeling**

**Credits:** 4.00

Modeling of hydraulic, pneumatic, and electromechanical systems. Solution methods including linearization and computer simulation of nonlinear equations. Methods of generalizing the nonlinear models for design purposes are developed. Prereq: systems modeling, simulation, and control or permission. (Also offered as ECE 841.)

### **ME 843 - Satellite Systems, Dynamics, and Control**

**Credits:** 3.00

General satellite systems with emphasis on spacecraft dynamics and control. Course topics include general satellite information such as types of satellites, missions, and orbits, as well as satellite subsystems. Basic spacecraft dynamics and orbital mechanics topics are covered. Advanced topics will include attitude and orbit estimation, and automatic attitude control. Prereq: systems modeling or permission. Special fee.

### **ME 857 - Coastal Engineering and Processes**

**Credits:** 3.00

Introduction to small amplitude and finite amplitude wave theories. Wave forecasting by significant wave method and wave spectrum method. Coastal processes and shoreline protection. Wave forces and wave structure interaction. Introduction to mathematical and physical modeling. Prereq: fluid dynamics or permission. (Also offered as CIE 857; OE 857.)

### **ME #870 - Design with Microprocessors**

**Credits:** 4.00

Basic operation of microprocessors and microcontrollers explained, and interfacing these devices to sensors, displays and mechanical systems explored. Topics include: number systems, architecture, registers, memory mapping, interrupts and interfacing for system design. Methods of programming and interfacing with mechanical/electrical systems are covered and then implemented in lab. Prereq: introduction to electrical engineering. Special fee. Lab.

### **ME 872 - Control Systems**

**Credits:** 4.00

Development of advanced control systems design concepts such as Nyquist analysis; lead-lag compensation; state feedback; parameter sensitivity; controllability; observability; introduction to nonlinear and modern control. Includes interactive computer-aided design and real-time digital control. Prereq: permission. (Also offered as ECE 872.) Lab.

### **ME 873 - Electromechanical Analysis and Design**

**Credits:** 4.00

Analysis and design of electromechanical systems using lumped parameter models and magnetic finite element analysis (FEA). Electrostatic and magnetic field equations discussed and used to derive magnetic and electric lumped model elements. A brushless dc motor analyzed using lumped models and FEA. Various drive types discussed and the motor system analyzed to obtain torque-speed curves. Design principles given and utilized in a design project. Prereq: systems modeling, simulation, and control or permission.

**ME 876 - Product Design****Credits:** 4.00

Provides a thorough overview of the steps in the engineering design process. Topics include product planning, need identification, specification formulation, benchmarking, concept generation and selection, design for manufacture, assembly and environment. Students will develop a product as part of a team. Prereq: Computer Aided Design; Manufacturing Skills; or permission.

**ME #881 - Mathematical Methods in Engineering Science I****Credits:** 4.00

Complex variables, Fourier series and transforms, ordinary and partial differential equations, vector space theory. Prereq: differential equations with linear algebra, multidimensional calculus or permission.

**ME 883 - Geometric Modeling****Credits:** 4.00

Includes curves, surfaces, solids, analytic and relational properties, intersections, transformations, and solid modeling. Applications in computer graphics and CAD/CAM systems are emphasized. Familiarity with calculus, analytic geometry, vectors, matrix methods, and computer programming is required. Prereq: introduction to scientific programming; multidimensional calculus or permission.

**ME 885 - Solid Mechanics in Manufacturing****Credits:** 4.00

Characterization of material properties will be studied with emphasis on plastic deformation. Also, numerical approaches to solve for the forces, stresses, and strains in manufacturing processes will be covered. In particular, two prominent mass production manufacturing areas, metal forming and cutting, will be examined. Prereq: introduction to materials science, dynamics.

**ME 886 - Introduction to Finite Element Analysis****Credits:** 4.00

Topics include basic matrix theory, potential energy approach, direct stiffness method, calculus of variations, development of finite element theory, and modeling techniques. Applications in solid mechanics, heat transfer, fluids, and electromagnetic devices, via both commercially available codes and student written codes. Prereq: heat transfer or permission. Special fee. Lab.

**ME 895 - Special Topics****Credits:** 2.00 to 4.00

New or specialized courses and/or independent study. May be repeated for credit.

**ME 899 - Master's Thesis****Credits:** 1.00 to 8.00

Cr/F.

**ME 904 - Radiation Heat Transfer****Credits:** 4.00

The fundamentals of radiant heat transfer. Development and solution of the wave equation for electromagnetic radiation. Analysis of Planck's law of radiation and earlier theories. Methods of solution of radiant interchange in real systems with and without absorbing media.

**ME 906 - Convection Heat Transfer****Credits:** 4.00

An analytical study of heat transfer to laminar and turbulent boundary layers of compressible and incompressible fluids. Basic differential equations governing the heat transfer are derived and analytical solutions are obtained where possible and checked with experimental results.

**ME #908 - Theoretical Aero/Hydrodynamics**

**Credits: 4.00**

The mathematical development of the equations of frictionless fluid flow, using both tensor notation and various coordinate systems. Conformal mapping; Blasius theorem; Joukowski hypothesis; flow around airfoils. Schwarz Christoffel theorem and vortex motion.

**ME 909 - Viscous Flow****Credits: 3.00**

Exact solutions of the Navier-Stokes equations; laminar boundary layers; wakes and jets; Stoke's flow; stability of parallel flows and boundary layers; transition to turbulence. Prereq: ME 807 or permission.

**ME #910 - Turbulence****Credits: 3.00**

Modern analysis of turbulent flow: the governing equations; stationary random functions and the various averaging techniques; empirical results on turbulence; homogenous turbulence; the Kolmogorov theory for isotropic turbulence; upper bound theory; turbulence in the atmosphere and oceans; applications to problems in science and engineering. Prereq: ME 807 or permission.

**ME 911 - Theory of Hydrodynamic Stability****Credits: 3.00**

Equations of hydrodynamics in general coordinates; general instabilities caused by gravitational, surface tension, and hydromagnetic influences; instability of parallel viscous flows including the Orr-Sommerfeld equation and Tollmein-Schlichting waves; instability of free-surface waves; instability of stratified flows; instabilities in porous media. Prereq: ME 807 or permission.

**ME 922 - Continuum Mechanics****Credits: 4.00**

Conservation laws for gases, liquids, and solids in a continuum are developed starting from Liouville and Boltzmann equations. Passage from a discrete system to a continuum is discussed. Constitutive equations for viscoelastic and thermoelastic fields and nonlinear gas, liquid, and elastic fields. General discussion of rheological behavior. Causality conditions for continuum fields. Examples for solids, liquids, and gases; and biomechanics. Introduction to phenomenological Lagrangian theories.

**ME 924 - Vibrations of Continuous Media****Credits: 4.00**

Classical and numerical methods are employed to study the vibration of continuous elements and structures. Topics considered are axial and torsional vibration of rods, transverse vibration of beams and thin plates, wave propagation, and vibration of simple structures.

**ME 926 - Theory of Elasticity****Credits: 4.00**

The analysis of stress and deformation in elastic solids; conservation laws for elastic media; stress and strain relations by continuous functions; Airy stress functions; elastodynamic fields; inhomogeneous, anisotropic, wave equations; wave propagation and stress concentration problems; generalizations to thermoelasticity and viscoelastic fields. Complex variable techniques are used.

**ME 927 - Theory of Plasticity****Credits: 4.00**

Analysis of stress and deformation in inelastic solids; general development of stress invariants, variational principles, constitutive relations, and yield and loading functions. Special emphasis on ideal plasticity, strain-hardening, creep, limit analysis, and limit design.

**ME #929 - Theory of Plates and Shells****Credits: 4.00**

Theory of elasticity developed for plates and shells; conservation laws for elastic media; stress and strain relations by continuous functions; Airy stress functions; stress and strain relations in curvilinear coordinates; thin and thick plate

and shell theories; vibration of spherical, cylindrical, and conic shells and plates.

### **ME 935 - Micromechanics of Composite and Porous Materials**

**Credits:** 4.00

Classification of composites, periodic and random microstructures. Mechanics of materials approach to micromechanical modeling. Representative volume element, analytical and numerical modeling of the effective properties. Micromechanics of failure of composite and porous materials. Prereq: Mechanics II; Heat Transfer or permission.

### **ME 944 - Nonlinear Control Systems**

**Credits:** 4.00

Analysis and design of nonlinear control systems from the classical and modern viewpoints are discussed. Liapunov's stability theory; phase space methods; linearization techniques; simulation; frequency response methods; generalized describing functions; transient analysis utilizing functional analysis; and decoupling of multivariable systems. Prereq: ECE or ME 951. (Also offered as ECE 944.)

### **ME 951 - Advanced Control Systems I**

**Credits:** 3.00

State-space representation of multivariable systems; analysis using state transition matrix. Controllability and observability; pole placement using state and output feedback; Luenberger observers. Introduction to computer-controlled systems (sampling, discrete state representation, hybrid systems); nonlinear analysis (Liapunov, Popov, describing function). Prereq: ECE or ME 872. (Also offered as ECE 951.)

### **ME 952 - Advanced Control Systems II**

**Credits:** 3.00

Special topics in control theory: continuous and discrete systems: optimal control systems, including calculus of variations, maximum principle, dynamic programming, Weiner and Kalman filtering techniques, stochastic systems, adaptive control systems. Prereq: ECE or ME 951. (Also offered as ECE 952.)

### **ME 955 - Estimation and Filtering**

**Credits:** 3.00

Stochastic systems course with application to control and communications. Topics include random variables, noise in linear systems, Bayesian and minimum variance estimation theory, optimal state estimators, Weiner and Kalman filters, combined estimation and control, prediction, parameter identification, and nonlinear filtering. Prereq: ME or ECE 951; MATH 835 or equivalent. (Also offered as ECE 955.)

### **ME #982 - Mathematical Methods in Engineering Science II**

**Credits:** 4.00

Continuation of ME 881. Complex variable techniques, integral transform techniques for the solution of differential and partial differential equations, Green's functions. Weiner-Hopf techniques, variational techniques, stochastic problems with application to random vibration, statistical control theory, turbulence, heat conduction and fluctuation phenomena in solids, transport theory, gases, and liquids. Topics may vary from year to year. Prereq: ME 881.

### **ME 986 - Advanced Finite Element Analysis**

**Credits:** 4.00

Topics include introduction to dynamics, treatment of nonlinear material behavior, and plate and shell element technology. Emphasis given to problems in solid mechanics and heat transfer. Prereq: ME 886 or equivalent.

### **ME 992 - Master's Project**

**Credits:** 4.00

The student works with a faculty member during one or two semesters on a well-defined research and/or original design problem. A written report and seminar are presented. IA (continuous grading). Cr/F.

### **ME 995 - Graduate Special Topics**

**Credits:** 2.00 to 4.00

Investigations of graduate-level problems or topics in mechanical engineering.

**ME 999 - Doctoral Research**

**Credits:**

Cr/F.

## Microbiology

### **MICR 802 - Infectious Disease and Health**

**Credits:** 5.00

Principles underlying the nature of infectious agents and the diseases they cause. Pathogenic strategies employed by these microorganisms, response of the host at the animal and cellular levels, intracellular parasitism, epidemiology, role of control measures including vaccines and chemotherapy, mode of action of antimicrobial chemotherapeutic agents, pharmacokinetics, and drug metabolism. Both well-established pathogens as well as newer and emerging human and animal disease agents are covered. Prereq: pathogenic microbiology; permission. Special fee. Lab. (Not offered every year.)

### **MICR 804 - Genetics Prokaryotic Microbes**

**Credits:** 4.00

Expression and transfer of genetic elements (chromosomal and nonchromosomal) in prokaryotic and eukaryotic microorganisms; consideration of factors influencing public health, industry, the environment, and society. Students earning credit for PBIO 754/854; BCHM 754/854; GEN 754/854 may not receive credit for GEN 704/804. Prereq: general microbiology; biochemistry (Also offered as GEN 804.) Special fee. Lab.

### **MICR 805 - Immunology**

**Credits:** 5.00

Introduction to the major cellular and molecular components of the immune system; examination of their development and production, their interactions with each other and with other systems in the body, and their regulation; exploration of their role in beneficial and harmful immune responses in humans and animals. Prereq: general microbiology. Special fee. Lab.

### **MICR 806 - Virology**

**Credits:** 3.00

Principles of animal and, in selected instances, plant and bacterial virology in relation to infection and disease. Emphasis on the molecular biology of viruses, viral replication, isolation, propagation, assay, pathogenesis, diagnosis, detection, epidemiology, and control. Prereq: general microbiology.

**Co-requisites:**

### **MICR 807 - Marine Microbiology**

**Credits:** 5.00

Qualitative and quantitative evaluation of the physiological activities of microorganisms that influence the state of carbon, nitrogen, sulfur, iron, manganese, phosphorous, hydrogen, oxygen, and other elements in the sea and its sediments. Provides an understanding of the interrelationships between marine microorganisms and their surroundings by integrating microbiological phenomena with known aspects of physical, chemical, and biological oceanography. Introduces students to the primary scientific literature in marine microbiology, teaches each student how to think provocatively and concertedly, and convey those thoughts clearly and concisely in both oral and written form. Prereq: general microbiology.

### **MICR 808 - Virology Lab**

**Credits:** 2.00

Principles and practices of animal, selected plants, and bacterial virological methods for the propagation, detection, and enumeration of viruses. Prereq: general microbiology. Coreq: virology. Special fee.

**Co-requisites:** MICR 806

### **MICR 810 - Electron Microscopy and Microbial Cytology**

**Credits:** 5.00

Ultrastructure of eukaryotes, prokaryotes, and viruses. Role of bacterial appendages; cell membranes and cell walls;

cytoplasmic inclusions; cell division and sporulation and virus ultrastructure. Preparative electron microscopy techniques for biological material (and microorganisms) described in detail. Prereq: general microbiology; permission. Lab. (Not offered every year.)

### **MICR 811 - Genomics and Bioinformatics**

**Credits:** 4.00

The methods, applications, and implications of genomics--the analysis of whole genomes. Microbial, plant and animal genomics are addressed, as well as medical, ethical and legal implications. The lab provides exposure and experience of a range of bioinformatics approaches--the computer applications used in genome analysis. Prereq: Principles of Genetics. (Also offered as BCHM 811 and GEN 811.) Lab.

### **MICR 813 - Microbes and the Environment**

**Credits:** 5.00

Physiological ecology as required to understand the roles of microbes in matter and energy flow through ecosystems. Structure and function of aquatic, terrestrial and biotic habitats in which microbes are important, including life in biofilms. Consideration is given to (micro)biotic community interactions including syntrophy, consortial mixtures and stable symbioses between prokaryotes and eukaryotes. Lab provides experience with methods of evaluating composition, structure and activity of microbial communities including extraction of nucleic acids from the environment and ecological use of oligonucleotide probes. An important facet of both lab and lecture includes biochemistry of and enrichment, isolation; and enumeration methods for physiological groups of aerobic and anaerobic microbes (such as denitrifiers, sulfate reducers, metal reducers, homoacetogens, cellulolytics, nitrogen fixers, diverse extremophiles and autotrophs including nitrifiers, methanogens, and photosynthesis). Prereq: general microbiology. Special fee. Lab.

**Co-requisites:**

### **MICR 814 - Public Health and Waterborne Diseases**

**Credits:** 4.00

Course has 3 sections: 1) government, 2) disease and epidemiology, and 3) sources of anthropogenic (of human origin) microbial pollution, control and disinfection. The overall theme of the class is to understand how and why waterborne (virus, protozoal, and bacterial) and some food-borne diseases are still prevalent within our society. The class usually goes on at least two field trips, a wastewater plant and a drinking water plant, at times students may be asked to go to town meetings or public hearings concerning water and pollution. In lab, students will do experiments and then analyze their data and share it with the rest of the class by posting it on the class Web site. Prereq: general microbiology. Special fee.

### **MICR 817 - Microbial Physiology**

**Credits:** 5.00

Fundamental physiological and metabolic processes of archaea bacteria and fungi with a strong emphasis on prokaryotes. Literature-based course. Topics include regulation and coordination of microbial metabolism, bacterial cell cycle, global control of gene expression, diversity of energy metabolism, and microbial cell differentiation. Prereq: general microbiology; general biochemistry; permission. Special fee. Lab.

### **MICR 818 - Ethics and Issues in Microbiology**

**Credits:** 4.00

In conjunction with advances being made in the biological sciences is the need for scientific integrity. From guiding students in the laboratory to scientific record keeping, from authorship and peer review to potential conflicts of interest, from use of animals and humans in research to genetic technology, scientists need to understand the ethical issues that underlie their work. These and related issues will be presented and discussed in a format that encourages both an appreciation of established guidelines and an opportunity to critically examine them.

### **MICR #819 - Prokaryote Biodiversity**

**Credits:** 5.00

By what means can we evaluate the composition and diversity of the prokaryotic world? What are the molecular techniques that have provided new ways of collecting taxonomic and phylogenetic data and of evaluating the

evolutionary history of prokaryotes? How can we use molecular methodologies epidemiologically to track the distribution of particular strains of microorganisms? What characteristics distinguish each fascinating group of (known) prokaryotes? In addition to exploring these topics, students in this course will isolate new strains of microbes and will proceed to identify and characterize them by molecular and other methods. The laboratory will also enable students to learn how to examine natural habitats for the presence of particular prokaryotic groups in the absence of cultivating their representatives. Prereq: general microbiology. Special fee. Lab.

### **MICR 851 - Cell Culture**

**Credits:** 5.00

Principles and technical skills fundamental to the culture of animal and plant cells, tissues and organs. Introduction to the techniques of subculturing, establishing primary cultures, karyotyping, serum testing, cloning, growth curves, cryopreservation, hybridoma formation and monoclonal antibody production, and organ cultures. An interdisciplinary course with emphasis on the application of cell culture to contemporary research in the biological sciences. Prereq: general microbiology; permission. (Also offered as ANSC 851 and PBIO 851.) Special fee. Lab.

### **MICR 866 - Plant-Microbe Interactions**

**Credits:** 3.00

Physical, chemical, genetic and molecular methods utilized by plant pathogens (bacteria, fungi, and viruses) will be discussed, as will beneficial plant-microbe symbioses. Prereq: principles of biology, general microbiology or permission. (Also offered as PBIO 866.)

### **MICR 893 - Advanced Problems and Techniques in Microbial Cytology**

**Credits:** 1.00 to 4.00

Research in microbial ultrastructure . Advanced techniques in electron microscopy. Includes readings, organized seminars in microbial cytology, recent advances in electron microscopy, and laboratory project work. Prereq: MICR 810; permission. May be repeated to a maximum of 8 credits. (Not offered every year.)

### **MICR 895 - Special Topics**

**Credits:** 1.00 to 4.00

Advanced studies in specific areas. Prereq: permission. May be repeated to a maximum of 8 credits.

### **MICR 899 - Master's Thesis**

**Credits:** 1.00 to 10.00

Cr/F.

### **MICR #904 - Advanced Microbial Genetics**

**Credits:** 4.00

Advanced studies in expression, regulation, recombination, and transmission of genetic information in prokaryotic microorganisms. Prereq: MICR 804; permission. (Also offered as GEN 904.) Special fee. Lab. (Not offered every year.)

### **MICR 905 - Current Topics**

**Credits:** 1.00

Discussion of current developments in microbiology: A) Microbial Ecology; B) Immunology; C) Pathogenic Mechanisms; D) Microbial Genetics; E) Water-borne Diseases; F) Microbial Physiology. May be repeated. Cr/F.

### **MICR 906 - Hot Topics**

**Credits:** 1.00

Presentation and discussion of current literature in Microbiology. Required of all Microbiology graduate students. May be repeated. Cr/F.

### **MICR 907 - Instrumentation**

**Credits:** 1.00

Introduction top safety and principles of use in instrumentation in microbiology. May be repeated to a maximum of 5 credits. Cr/F.

**MICR 909 - Advanced Virology****Credits:** 4.00

Provides in-depth study of virology. Selected RNA, DNA, retroviruses, and nonretroviruses capable of causing cancer. Enables students to (1) understand genetic regulatory events occurring during virus-cell interactions, and to (2) understand the specific pathogenicity, epidemiology, prevention, and control of selected (model) viruses. Prereq: virology; permission. Special fee. Lab. (Not offered every year.)

**MICR 997 - Seminar****Credits:** 1.00

Presentation and discussion of selected topics in microbiology. Required of all graduate students in microbiology. May be repeated. Cr/F.

**MICR 999 - Doctoral Research****Credits:**

Cr/F.

## Management of Technology

### **MOT 898 - Advanced Topics**

**Credits:** 3.00

Explores several emerging technologies and studies their potential impact on the economy. Examines how the focus increasingly shifts from the specific aspects and features of the technologies to the management of such technologies as they progress from research laboratories to market.

### **MOT 931 - Accounting and Finance for Technical Managers**

**Credits:** 3.00

For technical managers who are charged with directing, planning, and controlling operations and/or major projects and making a variety of management decisions. Students learn how to extract vital information from the accounting system and how to make financial decisions within the organization. Special fee.

### **MOT 932 - Marketing Fundamentals**

**Credits:** 2.00

Provides an understanding of basic marketing concepts, tools, and techniques and their application to the marketing of new technology based products and services. The role of marketing in new product development and its role in the strategic planning of the firm are also discussed.

### **MOT 933 - Information Systems Management**

**Credits:** 2.00

Provides an understanding of the importance of information systems in today's organizations and focuses on the role of information systems as enabling technology in business operations and processes.

### **MOT 934 - Management of Technology**

**Credits:** 3.00

This introductory course provides the foundation for preparing students to manage in a turbulent, high technology environment. The course is taught from a practical, applied perspective using current readings and case studies. Special fee.

### **MOT 935 - Operations and Quantitative Decision Making**

**Credits:** 3.00

An introduction to the concepts and analytic methods useful in understanding the management of a firm's operations (both manufacturing and service). Topics include: process flows, inventory management, capacity planning, facilities location, total quality management, human resource management, and technology management and operations strategy.

### **MOT 936 - Leadership, Management and Team Skills Development**

**Credits:** 3.00

Provides students with the skills necessary for leading upwards (managing superiors) as well as laterally (e.g., in project teams) and downwards (subordinates). Students will learn how to manage and facilitate group processes in a way that evokes leadership behaviors on the part of all team members.

### **MOT 937 - Market Research for Emerging Technologies**

**Credits:** 3.00

A survey of quantitative and qualitative market research techniques and their application to product development, market opportunity assessments, and the marketing of new technology based products. Concepts and models for technological forecasting and competitive intelligence are also introduced.

### **MOT 938 - Organizational Change and Transformation**

**Credits: 3.00**

Approaches, strategies, and theories of change and transformation are examined with an emphasis on their relationship to organizational effectiveness and development. Designed to develop students' analytic, diagnostic, and management skills pertaining to both planned and unplanned change and transformation during all stages of the organizational life cycle.

**MOT 939 - Management of Enterprise Systems****Credits: 3.00**

Provides an understanding of the facilitating techniques used to integrate the functions of operations, marketing, sales, customer service, and accounting and finance into business processes. Intranet ports, data warehousing, data mining, and knowledge management also discussed.

**MOT 941 - Product Development and Commercialization****Credits: 3.00**

Provides an understanding of the concepts and principles involved in the new high-tech product development process, and an understanding of the financial and marketing strategies necessary to introduce successful new high-tech products.

**MOT 942 - Project Management****Credits: 3.00**

Focuses on both the science of project management and the art of managing projects, and provides a comprehensive, integrative understanding of the project management process.

**MOT 943 - Financial Planning for Technology Managers****Credits: 3.00**

Focuses on the timing and magnitude of financial investments required to support technical projects and formulating a convincing strategic and financial justification to obtain the necessary support and resources.

**MOT 944 - Manufacturing Technologies****Credits: 3.00**

Focuses on developing a strategic understanding of alternative manufacturing processes, their respective strengths and weaknesses, and the systems support needed to manage these processes. Selected topics in Total Quality Management (TQM), Continuous Process Improvement (CPI), and Concurrent Engineering (CCE) are introduced.

**MOT 945 - Supply Chain Management****Credits: 3.00**

Focuses on the managerial aspects of Supply Chain Management (SCM) within the context of an SCM strategy. The emphasis is on development of an understanding of concepts, methodologies, techniques and enabling technologies, which can be effectively applied to the design, analysis, and management of supply chains.

**MOT 946 - Strategic Management of Technology****Credits: 3.00**

Examines how strategic leaders transform and position their organizations to exploit technological change for competitive advantage. Provides an understanding of the issues surrounding the formulation and implementation of technology based strategies, and the framework for managing in a technology-based economy.

**MOT 947 - Intellectual Property, Ethics and Public Policy Issues****Credits: 3.00**

A three-month module course exploring several topics of importance to the management of technology. Three categories are explored: intellectual property, ethics, and public policy.

**MOT 993 - Integrated Field Project****Credits: 3.00**

In-depth industry field project carried out with a member company of the Corporate Roundtable. The project is of sufficient scope to provide students with the opportunity to demonstrate a mastery of the competencies required in the

program.

## Materials Science

### **MS 830 - Mechanical Behavior Materials**

**Credits:** 4.00

Elastic and inelastic behavior of materials in terms of micro and macromechanics. Stress, strain and constitutive relations related to recent developments in dislocation theory and other phenomena on the atomic scale and to the continuum mechanics on the macroscopic scale. Elasticity, plasticity, viscoelasticity, creep, fracture, and damping. Anisotropic and heterogeneous materials. Prereq: Mechanics II, Introduction to Materials Science; or permission. Special fee. Lab.

### **MS 831 - Fracture and Fatigue Engineering Materials**

**Credits:** 4.00

Review of fundamentals of linear elastic fracture mechanics and strain energy release rate analysis. Discusses basic methods of design for prevention of failure by fast fracture and fatigue for metals, ceramics, and polymers with attention to the effect of material properties and subsequent property modification on each design approach. Prereq: Mechanics II, Introduction to Materials Science; or permission. Special fee. Lab.

### **MS 844 - Corrosion**

**Credits:** 4.00

The course is split into three parts. The first part reviews and develops the basic concepts of electrochemistry, kinetics, and measurement methods. The second part covers the details of specific corrosion mechanisms and phenomena including passivity, galvanic corrosion, concentration cell corrosion, pitting and crevice corrosion, and environmentally induced cracking. The third part focuses on the effects of metallurgical structure on corrosion, corrosion in selected environments, corrosion prevention methods, and materials selection and design. Prereq: General Chemistry (CHEM 403-404 or 405), Introduction to Materials Science; or permission. Special fee. Lab. (Also offered as OE 844.)

### **MS 860 - Thermodynamics and Kinetics of Materials I**

**Credits:** 4.00

Introduction to thermodynamics, kinetics, and statistical mechanics as applied to various types of materials. Prereq: Introduction to Materials Science.

### **MS 861 - Diffraction and Imaging Methods in Materials Science**

**Credits:** 4.00

Introduction to x-ray diffraction and electron microscopy. Basic crystallography; reciprocal lattice; x-ray and electron diffraction, x-ray methods; transmission and scanning electron microscopy. Prereq: General Chemistry, General Physics II, or permission. Special fee. Lab.

### **MS 862 - Electronic Properties of Materials**

**Credits:** 3.00

Introduction to the electronic properties of materials and their application in electronic devices; crystallography, atomic bonding and energy band diagrams for semiconductors; intrinsic and extrinsic semiconductors; and p-n junction; diodes and transistors. Methods used in the manufacture of semi-conductor devices such as ion implementation, thermal oxidation, metallurization, and packaging. Prereq: General Chemistry, Differential Equations with Linear Algebra, General Physics I and II, or permission.

### **MS 863 - Thin Film Science and Technology**

**Credits:** 4.00

The processing, structure and properties of solid thin films. Vacuum technology, deposition methods, film formation mechanisms, characterization of thin films, and thin-film reactions. Mechanical, electrical and optical properties of thin films. Lab. Special fee. Prereq: Introduction to Materials Science, or permission.

**MS 895 - Special Topics****Credits:** 2.00 to 4.00

New or specialized courses and/or independent study. May be repeated for credit.

**MS 898 - Master's Project****Credits:** 3.00 to 4.00

The student works with a faculty member during one or two semesters on a well-defined research and/or original design problem. A written report and seminar are presented. IA (continuous grading) Cr/F.

**MS 899 - Master's Thesis****Credits:** 1.00 to 6.00

Cr/F.

**MS 900 - Seminar****Credits:** 1.00

Topics of interest to graduate students and faculty; reports of research ideas, progress, and results; lectures by outside speakers. Continuing course: instructor may assign IA (continuous grading) grade at the end of one semester.

**MS 905 - Macromolecular Synthesis****Credits:** 3.00

Fundamentals of polymerization reaction mechanisms, kinetics, and chain structures as they are developed from the different chemistries available. Detailed discussions of the chemical mechanisms of step, free radical, ionic, and ring opening polymerizations. Treatment of the reaction parameters that control the rate of polymerization, molecular weight and chemical composition of the polymer chains. Introduction to stereochemical and catalytic polymerizations. Considerations of bulk, solution, and dispersion polymerization systems. Permission of instructor required.

**MS 961 - Thermodynamics and Kinetics of Materials II****Credits:** 4.00

Introduction to diffusion and phase transformations in materials. Topics include the kinetics of diffusion, rates of phase transformations, the mechanisms of phase transformations by diffusive and displacive transformations. Applications in metals, ceramics, and polymers. Prereq: Thermodynamics and Kinetics of Materials I.

**MS 965 - Advanced Surface and Thin Film Characterization****Credits:** 4.00

Fundamentals of modern analytical techniques used to analyze the surface region of materials. Prereq: Introduction to Materials, or permission.

**MS 995 - Graduate Special Topics****Credits:** 2.00 to 4.00

Investigation of graduate-level problems or topics in Materials Science.

**MS 999 - Doctoral Research****Credits:**

Cr/F.

## Music Education

### **MUED 841 - Techniques and Methods in Choral Music**

**Credits:** 2.00

Problems in the organization and performance of high school, college, and community choruses. Techniques of choral conducting and rehearsal, repertory, and materials.

### **MUED 843 - Materials and Methods in Piano Music**

**Credits:** 2.00

Gives potential piano teachers a coherent but flexible approach to the instruction of students of different ages and levels of talent through evaluation of methods and materials and discussion of the role of the private teacher.

### **MUED 845 - Techniques and Methods in String Instruments**

**Credits:** 2.00

Class and individual instruction. Intensive training on the violin, viola, cello, and double bass. Classroom procedures, establishment of string programs, and evaluation of available methods materials. Permission required.

### **MUED 846 - Techniques and Methods in String Instruments**

**Credits:** 2.00

See description for MUED 845.

### **MUED 847 - Techniques and Methods in Woodwind Instruments**

**Credits:** 3.00

Basic course in embouchure formation, tone production, tonguing, fingering and instrument care as applied to each of the woodwinds: flute, oboe, clarinet, bassoon and saxophone. Methods, studies, solos and ensembles most useful with school players of woodwind instruments.

### **MUED 849 - Techniques and Methods in Brass Instruments**

**Credits:** 2.00

Basic course in embouchure formation, tone, tonguing, fingering, flexibility, accuracy, and range development as applied to the trumpet, French horn, trombone, euphonium, and tuba; methods, studies, solos, and ensembles most likely to be useful with school players of brass instruments. Permission required.

### **MUED 851 - Techniques and Methods in Percussion Instruments**

**Credits:** 2.00

Basic performance skills on snare drum, timpani, mallet instruments, and other percussion instruments used in bands and orchestras. Materials and methods of instruction.

### **MUED 855 - Vocal Pedagogy**

**Credits:** 2.00

A study of vocal anatomy, vocal function, and teaching methods, with an emphasis on application for singers and voice teachers.

### **MUED #863 - Jazz Music Methods**

**Credits:** 2.00

Organization and delivery of instruction in jazz. Historical development of jazz styles and the role of each instrument/voice in jazz combos and large ensembles. Reading jazz notation and teaching improvisation. Examination of appropriate literature. Prereq: piano proficiency.

### **MUED 865 - Instrumental Music Methods**

**Credits:** 2.00

Organization and delivery of instruction to groups of instrumental music students. Examination of appropriate curricula and materials, application of instrumental and conducting techniques, structure of rehearsals, assessment of student progress.

**MUED 871 - Marching Band Methods**

**Credits:** 2.00

Role of marching bands in the school music program. Design and execution of field shows and parade marching. Understanding of marching percussion and auxiliary units. Examination of appropriate music.

**MUED 890 - Teaching Elementary School Music**

**Credits:** 3.00

Experiential approach toward learning creative strategies for teaching elementary school music. Includes various curricula and methods; philosophy and psychology of music; demonstration of materials and instruments. Observation and teaching in schools. Prereq: piano proficiency.

**MUED 891 - Teaching Secondary School Music**

**Credits:** 3.00

Assembling, managing, and teaching junior/senior high school music curriculum. Academic issues of philosophy, curriculum building, application of learning theories, administration, evaluation, motivation, and classroom management combined with field experience in lesson planning and teaching/rehearsal techniques. Prereq: piano proficiency; conducting methods.

**MUED 895 - Special Studies**

**Credits:** 1.00 to 4.00

Allows upper-level students to explore individually or in groups areas related to their specific professional interests. Prereq: permission.

**MUED 983 - Instrumental Literature and Its Performance**

**Credits:** 3.00

Exploration of representative solo and ensemble music for string, wind, and percussion instruments. Typical literature from each period of music is studied. As much as possible, live performance is included; recordings are used as required. Detailed attention given to interpretation. Project required.

**MUED 995 - Special Projects**

**Credits:** 1.00 to 4.00

Independent study, investigation, or research in music education. Creative projects may be included. Prereq: permission.

**MUED 996 - Foundations and Perspectives of Music Education**

**Credits:** 4.00

Philosophical, sociological, and psychological foundations and principles of music education and the relationship of these principles to music learning and teaching.

## Music

### **MUSI #803 - Music of the Renaissance**

**Credits:** 3.00

Works of the 15th- and 16th-century composers from Dunstable to Palestrina.

### **MUSI 805 - Music of the Baroque**

**Credits:** 3.00

Music of Europe from de Rore to Bach.

### **MUSI 807 - Music of the Classical Period**

**Credits:** 3.00

Growth of musical styles and forms from early classicism through the high classicism of Haydn, Mozart, and the young Beethoven.

### **MUSI 809 - Music of the Romantic Period**

**Credits:** 3.00

A survey of Romanticism in music from Beethoven's late period to the end of the 19th century. The works of Schubert, Berlioz, Schumann, Mendelssohn, Chopin, Wagner, Verdi, Brahms, Austrian symphonists, French pre-impressionists, and national styles in European music.

### **MUSI 811 - Music of the 20th and 21st Centuries**

**Credits:** 3.00

Styles and techniques of composers from Debussy to the present. Special emphasis on tonal music before World War I; neoclassical trends; the emergence of atonality and serial techniques; electronic music.

### **MUSI 813 - Art Song**

**Credits:** 3.00

History and literature of the solo song with piano accompaniment. Survey of national styles of the 19th and 20th centuries and deeper study of the central core of the art song--the German Lied.

### **MUSI 815 - Survey of Opera**

**Credits:** 3.00

History of the genre from Monteverdi to the present.

### **MUSI 831 - Advanced Instrumental Conducting**

**Credits:** 2.00

Physical aspects, equipment of conductor, fundamental gestures and beats, baton techniques. Reading and analysis of full and condensed scores, study of transposition, psychology of rehearsal. Prereq: advanced music theory. Can be repeated for credit.

### **MUSI 832 - Advanced Choral Conducting**

**Credits:** 2.00

See description for MUSI 831. Can be repeated for credit.

### **MUSI 836 - Graduate Early Wind Instruments**

**Credits:** 1.00 to 4.00

Special fee.

### **MUSI 841 - Graduate Piano**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 845 - Graduate Voice**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 846 - Graduate Violin**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 847 - Graduate Viola**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 848 - Graduate Cello**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 849 - Graduate Bass**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 851 - Graduate Flute**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 852 - Graduate Clarinet**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 853 - Graduate Saxophone**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 854 - Graduate Oboe**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 855 - Graduate Bassoon**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 856 - Graduate French Horn**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 857 - Graduate Trumpet**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 858 - Graduate Trombone**

**Credits:** 1.00 to 4.00

Special fee.

**MUSI 859 - Graduate Euphonium**

**Credits:** 1.00 to 4.00  
Special fee.

**MUSI 860 - Graduate Tuba**

**Credits:** 1.00 to 4.00  
Special fee.

**MUSI 861 - Graduate Percussion**

**Credits:** 1.00 to 4.00  
Special fee.

**MUSI 862 - Graduate Keyboards**

**Credits:** 1.00 to 4.00  
Private instruction in jazz piano. Special fee. Permission required.

**MUSI 863 - Graduate Jazz Guitar**

**Credits:** 1.00 to 4.00  
Special fee.

**MUSI 864 - Graduate Drum Set**

**Credits:** 1.00 to 4.00  
Special fee.

**MUSI 871 - Counterpoint**

**Credits:** 3.00  
Contrapuntal techniques of tonal music. Melodic construction and dissonance treatment through work in species counterpoint and studies in harmonic elaboration and prolongation. Analysis of selected compositions emphasizes the connection between fundamental contrapuntal techniques and the voice-leading of composition. Prereq: permission.

**MUSI 875 - Composition**

**Credits:** 3.00  
Construction of phrases, periods, and short compositions following classical models. Problems of text-setting. Prereq: permission.

**MUSI 876 - Composition**

**Credits:** 3.00  
See description for MUSI 875. Prereq: MUSI 875 and permission.

**MUSI 877 - Advanced Composition**

**Credits:** 3.00  
Continuation of MUSI 876. Individual compositional projects. Prereq: MUSI 876 and permission. May be repeated for credit.

**MUSI 879 - Orchestration**

**Credits:** 3.00  
Characteristics of band and orchestral instruments both individually and in small (homogeneous) and large (mixed) groupings. Students study scores, write arrangements, and have arrangements performed if at all possible. Prereq: permission.

**MUSI 881 - Analysis: Form and Structure**

**Credits:** 3.00  
An introduction to analytical techniques through the study of representative masterworks; formal and structural elements and their interrelationships. Analysis of 18th- and 19th-century works. Prereq: permission.

**MUSI 882 - Analysis: Form and Structure**

**Credits: 3.00**

An introduction to analytical techniques through the study of representative masterworks; formal and structural elements and their interrelationships. Analysis of 20th and 21st century works. Prereq: permission.

**MUSI 885 - Electronic Sound Synthesis****Credits: 4.00**

Computers and digital synthesizers, methods of sound synthesis (e.g., fm synthesis, sampling), MIDI programming in Visual Basic and C++, control programs for synthesizers, notation using computers (e.g., Finale for PC and Macintosh.)

**MUSI 895 - Special Studies****Credits: 1.00 to 4.00**

A) J.S. Bach; B) Franz Schubert; C) Debussy and Ravel; D) the world of jazz; E) piano literature; F) 19th century French music; G) advanced analysis; H) advanced study in electronic music; I) composition through computer-generated sound; J) woodwind literature; K) brass literature; L) string literature; M) medieval performance practice; N) renaissance performance practice; O) baroque performance practice; P) classical performance practice; Q) 19th century performance practice; R) 20th century performance practice; S) woodwind repair; T) string repair; U) advanced jazz improvisation; V) advanced piano pedagogy; W) advanced accompanying; X) advanced conducting; Y) independent study. Prereq: permission. May be repeated for credit with permission.

**MUSI 955 - Introduction to Bibliography****Credits: 3.00**

An intensive survey of basic reference works, music periodicals, collected editions, series, treatises, books on musical instruments and performance practice, and the important monographs on major composers from Machaut to Schoenberg. A reading knowledge of German and French is very useful.

**MUSI 956 - Readings in Music History: Antiquity to 1600****Credits: 3.00**

An opportunity to read and study in detail a restricted number of monographs and editions.

**MUSI 957 - Readings in Music History: 1600 to 1820****Credits: 3.00**

An opportunity to read and study in detail a restricted number of monographs and editions.

**MUSI 958 - Readings in Music History: 1820 to the Present****Credits: 3.00**

An opportunity to read and study in detail a restricted number of monographs and editions.

**MUSI 991 - Research Seminar****Credits: 1.00 to 4.00**

Guidance on individual research projects. Prereq: permission.

**MUSI 994 - Theory Seminar****Credits: 3.00**

Study of representative masterworks. Score analysis. Prereq: permission.

**MUSI 995 - Independent Study in the History and Theory of Music****Credits: 1.00 to 4.00**

Opportunity for especially qualified students to investigate, with guidance, specific areas of their scholarly concern. Prereq: permission.

## Natural Resources

### **NR 800 - Critical Analysis of Water Resources Literature**

**Credits:** 2.00

Detailed consideration of current issues in water resource management in a seminar format. Emphasis on critical analysis of primary literature in environmental science relevant to water resources management. Special fee. Prereq: watershed water quality management.

### **NR 801 - Ecological Values and Ethics**

**Credits:** 4.00

Deeper more fundamental philosophical questions, including spiritual values questions, are being asked concerning the ecological/environmental challenge of our time; its causes and resolution. Aspects of this challenge--environmental education, energy, food, agriculture, and natural resources--analyzed with ethics and values approaches. Students develop ways of responding to problem identification and resolution.

### **NR 802 - Workshops**

**Credits:** 1.00 to 4.00

Short-term courses (generally a few days to two weeks) offered off campus, covering a broad variety of environmental and natural resource topics. May be repeated. Special fee required depending on topic. Prereq: permission required. Cr/F.

### **NR 803 - Watershed Water Quality Management**

**Credits:** 4.00

Principles of land use as they relate to water quality and quantity. Lectures focus on biogeochemical cycles and the watershed approach to land and water resource management. Labs and field trips focus on methods of water sampling and analysis. One year of chemistry is recommended. Prereq: freshwater resources or watershed hydrology, or permission. Special fee. Lab/field trips.

### **NR 804 - Soil Genesis and Classification**

**Credits:** 4.00

Processes involved in formation of soils, soil properties as reflectors of genetic processes. Classification systems of soils related to soil genesis and soil landscapes. Lab sessions illustrate concepts by examining soils in the field. Prereq: soils and the environment or equivalent. Special fee. Lab.

### **NR 805 - Forest Soils**

**Credits:** 4.00

An introduction to basic and applied forest soils research, with emphasis on pedogenic and ecological development, carbon and nutrient cycling, and impacts of forest management and recent changes in atmospheric chemistry. Short papers based on assigned readings and an independent research project are required. Prereq: introduction to forest science; forest ecology; or permission.

### **NR 806 - Soil Ecology**

**Credits:** 4.00

Examines the ecological relationships between soil microorganisms and their biotic and abiotic environment, with emphasis on the role of soil microorganisms in biogeochemical cycling. Specific objectives are to examine the biodiversity present in soil systems, factors controlling microbial community composition and diversity, and linkages between soil microbial communities, soil physical properties, and soil organic matter and nutrient cycling dynamics. Prereq: Introduction to principles of biology, general chemistry or equivalent, or permission. Lab. Special fee.

### **NR 809 - Fire Ecology Seminar**

**Credits:** 2.00 or 3.00

Lectures, guest lectures, and student presentations dealing with the natural role of fires in wildland communities, fire adaptations in plant and animal species. Human responses to wildland fires and prescribed fire applications. Optional set of one-half to one-day field trips for an additional 1 credit. Prereq: basic ecology course. Special fee. (Not offered every year.)

### **NR 810 - Endangered Species Seminar**

**Credits:** 2.00

This seminar provides students with an interactive class of student presentations and guest lectures by endangered-species biologists. Emphasis is placed on biological, sociological, economic, and political factors that influence endangered-species policy. Prereq: basic ecology/biology; permission. Special fee.

### **NR 811 - Wetland Ecology and Management**

**Credits:** 4.00

Analysis of the natural resources of coastal and inland wetlands and environmental problems caused by human use and misuse of these ecosystems. Groups will collect field data to summarize the structure and function of four wetland types within a management context. Special fee. Lab. Prereq: general ecology; watershed water quality management;/ or permission. Special fee. Lab/field trips.

### **NR 812 - Sampling Techniques**

**Credits:** 2.00 to 4.00

Techniques of sampling finite populations in environmental sciences; choice of sampling unit and frame, estimation of sample size, confidence limits, and comparisons of sample designs. Prereq: applied statistics or equivalent. (Not offered every year.)

### **NR 813 - Quantitative Ecology**

**Credits:** 4.00

Applied quantitative techniques: basic concepts in probability and statistics applied to ecological systems; population dynamics; spatial patterns; species abundance and diversity; classification and ordination; production; and energy and nutrient flow. Additional credit for in-depth mathematical analysis of a particular topic. Prereq: introduction courses in calculus, statistics, and ecology. (Not offered every year.)

### **NR 814 - Ecosystems of Puerto Rico**

**Credits:** 2.00

Field examination of a variety of tropical ecosystems in Puerto Rico, including cloud forest, montane rain forest, tropical dry forest, mangroves, and coral reefs. Field study supplemented by appropriate readings from the scientific literature and expert presentations. Students are responsible for round-trip airfare and personal expenses. Permission. Cr/F.

### **NR 815 - Theoretical Ecology**

**Credits:** 4.00

Study of important theoretical concepts in ecology by analysis of mathematical models. Topics include population growth, competition, coexistence of species, competitive exclusion, predator-prey dynamics, invasions, migration, and spread. Strong foundation in ecology and mathematics required. Prereq: general ecology and calculus.

### **NR 816 - Wetland Delineation**

**Credits:** 4.00

Examination of the soils, vegetation, and hydraulic functions of coastal and central New England wetlands. Students are responsible for the collection and identification of aquatic plant species, description of wetland soils, and delineation of wetland boundaries. Lectures and fieldwork. For graduate students and professionals. Special fee. Lab. (Offered summer session only.)

### **NR 818 - Law of Natural Resources and Environment**

**Credits:** 3.00

For resource managers: the legal system pertaining to resource management, protection of the environment, and possibilities for future action. Prereq: contemporary conservation issues, land-use economics, or equivalent.

### **NR 819 - Wetlands Mitigation and Restoration**

**Credits:** 3.00

Assessing the problems of wetlands loss. Asks: What steps can be taken, does restoration work, can habitat value be replaced, and what constitutes equivalent mitigation? First half of course involves field trips to visit and sample mitigation and restoration sites. Second half focuses on student projects using the scientific method to address wetlands issues. Prereq: wetland resource management or permission. Special fee. Lab/field trips. (Not offered every year.)

### **NR 820 - International Environmental Politics and Policies for the 21st Century**

**Credits:** 4.00

Examine policies for managing human activities to sustain the health of regional ecosystems and planetary life-support systems. Focus on selected problems of the international commons (e.g., oceans, marine resources, atmosphere, migratory species); global and regional carrying capacity (e.g., population, resource consumption), internationally shared ecosystems (e.g., trans-boundary watersheds and water-bodies, tropical rainforests); and the relevant international institutions and politics for policy formation, conflict resolution and implementation. Using a policy analytic framework, students develop case studies to assess international policies and institutional arrangements to achieve the objectives of Agenda 21 - The Earth Summit Strategy to Save the Planet. Prereq: permission.

### **NR 821 - Ecology of Polluted Waters**

**Credits:** 4.00

Impact of various water quality problems (e.g., excessive nutrient loading, organic matter loading, contamination by trace organic compounds) on the ecology of fresh waters, including microorganisms, aquatic invertebrates, algae, and fish. Design of impact assessment studies and data interpretation. Prereq: applied statistics, watershed water quality management, or permission. Special fee. Lab/field trips.

### **NR 822 - Advanced Silviculture**

**Credits:** 3.00

Intensive silviculture of forest stands. Regeneration (e.g., alternative regeneration methods and site preparation); stand management (e.g., thinning schedules, and fertilization). Prereq: silviculture or equivalent; permission. Special fee. (Not offered every year.)

### **NR 823 - Field Wetland Ecology**

**Credits:** 3.00

Field investigation of coastal and inland wetland types. First half of course consists of field trips to visit sample regional wetlands. Second half of course consists of methods used to analyze field samples from wetlands. Enrollment is limited. Prereq: present or past enrollment in Wetland Resource Management. Special fee. Lab/field trips.

### **NR 824 - Resolving Environmental Conflicts**

**Credits:** 3.00

Theories and practices of environmental dispute settlement. Roles of public, non-governmental organizations and government assessed. Effectiveness of public participation initiatives in influencing public policy decisions and/or resolving environmental conflicts examined. Alternative approaches to consensus (policy dialogues, joint problem solving; strategic planning; negotiation, mediation) as well as litigation examined. Specific cases critiqued and evaluated; conflict resolution skills developed. Prereq: permission.

### **NR 830 - Terrestrial Ecosystems**

**Credits:** 3.00

Processes controlling the energy, water, and nutrient dynamics of terrestrial ecosystems; concepts of study at the ecosystem level, controls on primary production, transpiration, decomposition, herbivory; links to Earth-system science, acid deposition, agriculture. Prereq: forest ecology and introduction to botany or principles of biology, or permission. Lab. (Also offered as EOS 830.)

### **NR 832 - Chemistry of Soils**

**Credits:** 4.00

Chemical composition of soil; structure of soil minerals; mineral solubility; contaminant sorption by minerals and organic matter; cation and anion exchange processes; and organic reactions in soil, their kinetics and their effects on soil properties. Prereq: general chemistry or equivalent. Special fee. Lab.

### **NR 834 - Forest Protection Seminar**

**Credits:** 3.00

The course will attempt to develop a definition of forest health, based upon the recognition that healthy and functioning ecosystems must contain dead and dying trees. The idea must be built into a forest management approach acceptable to landowners who have economic/commercial objectives, as well as a society which views forests as productive units and providers of amenities and essential natural reserves. Consideration of forest health in the context of recent evidence concerning the effects of atmospheric deposition and climate change on tree health, as well as new or introduced and currently spreading insects and diseases. Prereq: permission. (Not offered every year.)

### **NR 837 - Wildlife Population Dynamics**

**Credits:** 4.00

Mechanisms that influence the characteristics of terrestrial wildlife populations. Prereq: one course in general ecology and statistics. Lab. Special fee.

### **NR 838 - Wildlife Policy and Management**

**Credits:** 4.00

Wildlife administration and policy. Local, regional, and national wildlife management strategies. Contemporary management issues of land-use, commercialization of wildlife, and wildlife professionalism. Prereq: permission. Lab. Special fee.

### **NR 845 - Forest Management**

**Credits:** 4.00

Forest land ownership; management objectives; forest inventory regulation and policy; forest administration; professional responsibilities and opportunities. Restricted to Natural Resources majors. Lab. Special fee.

### **NR 847 - Biology Through Bugs**

**Credits:** 4.00

Insects provide an exciting and inexpensive means of delivering basic biology instruction. We will explore the utility of insects for instruction in the areas of evolution, taxonomy, form and function, behavior and ecology through lectures and labs geared toward the middle school and high school teacher. Prereq: General biology. Lab. Special fee.

### **NR 853 - Decision Sciences in Natural Resources Management**

**Credits:** 4.00

Application of decision-science methods (optimization, simulation, input-output, and statistics) to natural resources problems. Emphasis is on practical work in evaluating projects, dealing with risk and uncertainty, analyzing regional impacts, valuing non-market resources, and exploring sustainability of managed forest. Prereq: economics of forestry or intermediate microeconomics. Special fee. Lab.

### **NR 854 - Wood Products Manufacture and Marketing**

**Credits:** 4.00

Wood products from harvesting and procurement of raw materials to finished product processes, management decisions, marketing, and promotion problems. Case-study approach backed up by weekly all-day field trips to wood products manufacturing plants in the region. Prereq: Wood Science and Technology. Special fee. Lab.

### **NR 855 - Regional Silviculture and Forest Management**

**Credits:** 2.00

Extended field trip to another forest region. Prereq: forest management or permission. Limited enrollment. May be repeated. Cr/F. (Not offered every year.)

### **NR 857 - Photo Interpretation and Photogrammetry**

**Credits:** 4.00

Practical and conceptual presentations of techniques for using remote sensing, specifically aerial photographs, in natural resources. Includes photo measures of scale, area, parallax and object heights; flight planning; photo geometry; an introduction to the electromagnetic spectrum; and photo interpretation and mapping. Concludes with an introduction to digital remote sensing including multi-spectral scanners, radar, and thermal imagery and a brief discussion of geographic information systems (GIS). Applications to forestry, wildlife, land-use planning, earth sciences, soils, hydrology, and engineering. Prereq: algebra. Special fee. Lab.

### **NR 859 - Digital Image Processing for Natural Resources**

**Credits:** 4.00

Introduction to digital remote sensing including multi-spectral scanners (Landsat and SPOT) radar and thermal imagery. Hands-on image processing including filtering, image display, ratios, classification, registration, and accuracy assessment. GIS as it applies to image-processing. Discussion of practical application. Use of ERDAS image processing software. Knowledge of PCs and DOS required. Prereq: Photo Interpretation and Photogrammetry or equivalent and permission.

### **NR 860 - Geographic Information Systems in Natural Resources**

**Credits:** 4.00

Theory, concepts, and applications of geographic information systems (GIS) for use in natural resources and related fields. Discussion of database structures, sources of data, spatial data manipulation/analysis/modeling, data quality standards and assessment, and data display/map production including many examples and practical applications. Hands-on lab exercises using ArcGIS 8.x software. Permission. Lab.

### **NR 864 - Vegetation Sampling and Analysis**

**Credits:** 4.00

Methods for sampling plant populations and communities, especially estimation of abundance. Analysis of pattern, measurement of species diversity, and relation of abundance to environmental factors. Ordination and classification of communities. Modeling of succession. Prereq: statistics; and general ecology or equivalent. Lab. Special fee.

### **NR 865 - Community Ecology**

**Credits:** 4.00

Properties of biotic communities, especially biodiversity. Effects of physical stress, disturbance, competition, predation, positive interactions, and dispersal on community properties. Community dynamics, including succession and stability. Prereq: applied biostatistics and general ecology. Special fee. Lab.

### **NR 872 - Wildlife Energetics**

**Credits:** 2.00

Energy requirements of wildlife species and the manner in which these needs are met in their natural environment. Thermodynamics in ecological systems, factors influencing metabolic rate, food habits, food-use efficiency, food availability. Prereq: permission. Special fee.

### **NR 880 - Earth as a System for Educators**

**Credits:** 4.00

Exploration of the Earth as a system. Topics include ecosystems, habitats, biomes, biodiversity, weather, climate, water and air (environmental) quality, watersheds, remote sensing, the flow of matter and energy through the universe, water and nutrient cycles, wildlife identification and monitoring, wetlands, seasons, interdependence, and changes over time. Course focuses on content being taught through Project WILD, WET, Learning Tree and Project HOME activities. The GLOBE protocols are an integral part of all lab exercises, and provide an opportunity to learn science methods and content through the use of classroom friendly techniques used to integrate into units for elementary and middle school students. For elementary and middle school teachers. Permission.

### **NR 883 - Forest Communities of New Hampshire**

**Credits:** 4.00

A hands-on, field course designed to introduce students to the diverse forest community types of New Hampshire. Topics include: 1) field identification of forest types using different classification systems and keys, 2) identification

of characteristic plant and animal species, 3) the roles of climate, geology, soils, natural disturbance, forest management, and biotic factors in determining forest community type, 4) primary and secondary succession, including old-growth. Prereq: 1 course in ecology or environmental biology or permission. Special fee.

### **NR 884 - Sustainable Living**

**Credits:** 3.00

Concepts of living within ecosystem limits explored in a learning-community format. The importance of human communication, sense of place and time, and the health and longevity of our human species and natural systems emphasized. Examination of governance, education, economic, agricultural, and ethical systems while asking, "What makes one system more or less sustainable than another?" to lead to directions for sustainable society. Field trips and small research projects conducted. Special fee.

### **NR 885 - Systems Thinking for Sustainable Living**

**Credits:** 3.00

Introduction to systems thinking from a sustainable living perspective. The course is a collaborative inquiry using a problem-solving approach. After study of different types of systems and learning a variety of tools useful in systems analysis, we ask "In what ways can systems thinking be employed to understand and begin to resolve the complex problems that face us as we move toward living within limits of natural systems?" Prereq: sustainable living or permission.

### **NR 896 - Summer Institute in Environmental Education**

**Credits:** 8.00

The Summer Institute is an intensive (8 credit), team-taught educational experience that immerses students in a process of inquiry explicitly designed to connect and integrate work in the focus areas of: Pedagogy, Environmental Science, and Human Patterns and Environmental Transformations. Classroom and field-based activities help students experience the interdisciplinary nature of environmental education firsthand, while beginning to construct a plan for deepening their understanding through an individually designed program of graduate study. Prereq: Bachelor's degree, permission. (Also offered as EDUC 896.)

### **NR 897 - Special Topics**

**Credits:** 1.00 to 4.00

Course is designed as an "Experimental Course", for the purpose of introducing a new course or teaching a special topic for a semester in Environmental Conservation, Forestry, Soil Science, Water Resources, and Wildlife Management. Permission required. Special fee on some sections.

### **NR 899 - Master's Thesis**

**Credits:** 1.00 to 10.00

Usually 6 credits, but up to 10 credits when the problem warrants. Cr/F.

### **NR 902 - Ecological Ethics and Values**

**Credits:** 4.00

Increasingly fundamental philosophical questions, including spiritual values questions, are posited concerning the ecological/environmental challenge of our time, its causes, and its resolution. Examination of these questions, put forth with ethics and values approaches. Students work to develop responses to both problem identification and resolution. Lab.

### **NR 903 - Approach to Research**

**Credits:** 3.00

The meaning of science and the application of logic in the scientific method. Principles and techniques of scientific research. Survey of experimental design procedures. Organization of investigative work, problem analyses, working plans, and scientific writing. Prereq: permission.

### **NR 905 - Contaminant Fate and Transport in the Subsurface**

**Credits:** 4.00

Processes controlling contaminants in soils and groundwater; sorption and desorption of inorganic and organic

contaminants; leaching of inorganic contaminants and pesticides; runoff of agricultural chemicals; biological factors affecting contaminants; soil flooding effects on water quality; groundwater contamination; bacteria and virus transport in groundwater. Prereq: groundwater hydrology and soil chemistry or equivalent/or permission. Special fee.

### **NR 910 - Forest Stand Dynamics**

**Credits:** 4.00

Discussion and presentation on forest dynamics to include soil-site quality evaluation, individual tree growth, stand growth and yield, stand and forest management, and related resource politics. (Not offered every year.)

### **NR 918 - Advanced Forest Biology**

**Credits:** 3.00

Topical orientation following a workshop-type format. Presentations by faculty, students, and outside speakers. Emphasis is placed on management impacts on biological systems. Sessions on theory and current literature are followed by data analysis and practical sessions, as appropriate. Subject areas include conservation biology, conservation genetics, climate change, old-growth forests, and the impact of management on natural forest ecosystems. Prereq: permission. (Not offered every year.)

### **NR 930 - Modeling of Forest Ecosystems**

**Credits:** 3.00

Computer modeling of energy, water, and nutrient dynamics of forest ecosystems; review of existing ecosystem models, modification of an existing model. Original programming of new model required as course project. Prereq: Terrestrial Ecosystems or permission. (Also offered as EOS 930.)

### **NR 947 - Current Issues in Ecosystem Ecology**

**Credits:** 1.00 to 4.00

Examines current issues in ecosystem ecology and biogeochemistry by weekly discussion of primary research articles. Topics covered include elemental interactions in biogeochemical processes, mechanisms regulating nitrogen losses from terrestrial ecosystems, and hydrologic-chemical interactions in streams and groundwater. Special fee. Cr/F.

### **NR 993 - Natural and Environmental Resources Seminar**

**Credits:** 1.00

Presentation and discussion of recent research, literature, and policy problems in the natural and social sciences influencing resource use. Cr/F.

### **NR 995 - Investigations**

**Credits:** 1.00 to 4.00

Investigations in Natural Resources may include topics in environmental conservation, forestry, soil science, water resources, and wildlife management. Permission required.

### **NR 996 - Natural Resource Education**

**Credits:** 1.00

Responsibilities include set-up, teaching, and grading of one lab section per week or equivalent lecture experience. Required of all M.S. degree students in the department. Cr/F.

### **NR 997 - Special Topics**

**Credits:** 1.00 to 4.00

Course is designed as an "Experimental Course", for the purpose of introducing a new course or teaching a special topic for a semester in Environmental Conservation, Forestry, Soil Science, Water Resources, and Wildlife Management. Permission required.

### **NR 998 - Directed Research**

**Credits:** 4.00

Student designs and conducts original research that culminates in a paper of publishable quality. Alternative to NR 899 for those choosing non-thesis degree option. Cr/F. IA (continuous grading).

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**NRES 995 - Independent Study**

**Credits:** 1.00 to 4.00

**NRES 999 - Doctoral Research**

**Credits:**

Cr/F.

## Nursing

### **NURS 801 - Introduction to Nursing**

**Credits:** 2.00

Examines the values and philosophy of the Department of Nursing. Explores the four domain concepts of nursing: health and how it is defined, the diverse clients served by nursing, nursing as a profession, and the complex environment within which nursing is practiced. The nature of nurse-client encounters is explored with an emphasis on teaching students the skills to interact in a caring, facilitative manner.

### **NURS 802 - Concepts in Pathophysiology/Pharmacology**

**Credits:** 4.00

Focuses on concepts of pathophysiology/pharmacology relevant to nursing practice. The physiologic response and manifestations of alterations on normal body functioning are analyzed and the effects of pharmacological agents on these alterations are examined. Prereq: NURS 801.

**Co-requisites:** NURS 808, NURS 814

### **NURS 808 - Foundations of Nursing Judgment**

**Credits:** 4.00

Focuses on the knowledge and analytical skills required to adequately assess the health status of individuals. Students learn how to collect data using an assessment framework, to analyze the data, and to identify client resources and problems. Emphasizes the implications of the individual's development status, culture, and biologic variations at all points in the assessment process. Prereq: NURS 801.

**Co-requisites:** NURS 802, NURS 814

### **NURS 810 - Families in Health and Illness**

**Credits:** 3.00

Seminar focusing on the family environment as a context for the experience of health and illness. Current middle-range theories and research from nursing and other disciplines analyzed for their application to family health. Public policy initiatives related to family health will be explored.

### **NURS 814 - Techniques of Clinical Nursing**

**Credits:** 4.00

Focuses on the acquisition of psychomotor and assessment skills required for the delivery of safe nursing care. Students begin by learning clinical skills in the simulation setting and then using those skills with supervision in the clinical setting. An additional focus of this course is understanding fundamental nursing concepts as they pertain to providing safe, effective care. Prereq: NURS 801, Lab. Special fee.

**Co-requisites:** NURS 802, NURS 808

### **NURS 815 - Care of the Adult**

**Credits:** 8.00

Addresses the professional nursing practice, decision making processes, strategies and interventions as they relate to the care of adults who are experiencing chronic illnesses, acute illnesses, or impending death. The perspective adopted emphasizes the functional issues of daily living that these illnesses impose and the meanings these illnesses have for adults and their families within cultural, socioeconomic, sociopolitical, physical, and personal contexts. Prereq: NURS 801, 802, 808, 814. Special fee.

**Co-requisites:** NURS 819

### **NURS 818 - Caring for People with Alterations in Mental Health**

**Credits:** 4.00

Provides an understanding of the concepts of mental health and major factors affecting human behavior and interaction. Uses specific theoretical concepts and psychosocial theories as a vehicle for supporting the person's and

family's optimum state of well-being. Also emphasizes the practice of psychiatric nursing as being grounded on certain empirical, aesthetic, personal, and ethical knowledge. Through a variety of clinical experiences, the student applies mental health concepts, principles of therapeutic communication, and the nursing process in caring for individuals and families with alterations in mental health. Prereq: NURS 801, 802, 808, 814, 815, 819. Special fee.

**Co-requisites:**

**NURS 819 - Clinical Decision Making I**

**Credits:** 4.00

To practice effectively nurses must be able to gather data, interpret its meaning, take actions based on an understanding of the data, and evaluate outcomes. They also must be aware of the processes used to reach conclusions and be prepared to revise, adapt, or reject them. The course focuses on teaching learning theory, ethical decision making, and helping clients and families deal with situational and maturational crises, using a critical thinking framework. Prereq: NURS 801, 802, 808, 814.

**Co-requisites:** NURS 815

**NURS 820 - Caring for the Childbearing and the Childbearing Family**

**Credits:** 8.00

This course has family as the focus for nursing practice, introducing the student to the care of young families throughout pregnancy, birth, and child-rearing periods. Healthy transitions and physical alterations occurring from conception through adolescence are examined. The health needs of the young family are discussed in terms of major morbidity/mortality and contemporary issues. Experience in various clinical settings will provide opportunities for the development of professional practice roles. Prereq: NURS 801, 802, 808, 814, 815, 818, 819, 823, 845. Special fee.

**Co-requisites:** NURS 822

**NURS 822 - Clinical Decision Making II**

**Credits:** 4.00

Emphasizes the clinical decision making process in the nursing care of individuals, families, and communities across the lifespan and from diverse backgrounds. Builds upon the theoretical foundation developed in 819, Clinical Decision Making I. Students strengthen expertise in developing clinical judgements, interventions, and outcome evaluations. Skills predicted upon attending to and processing relevant information from clinical situations. Students apply knowledge from clinical nursing courses in a variety of ways. Prereq: NURS 801, 802, 808, 814, 815, 818, 819, 823, 845.

**Co-requisites:** NURS 820

**NURS 823 - Nursing Leadership/Management and the Organizational Context**

**Credits:** 4.00

Focuses on understanding ways in which the nurse can affect the organizations in which practice occurs and ways in which the organizations affect the individual's practice. Emphasizes issues of leadership; management; power; change; motivation; and interfacing of autonomous, dependent, and interdependent nursing functions in current and future health care delivery systems. Prereq: NURS 801, 802, 808, 814, 815, 819.

**Co-requisites:**

**NURS 824 - Community Health Nursing**

**Credits:** 4.00

Explores the role of community health nursing in health promotion, disease prevention, and long-term care. Analyzes contemporary community health problems with implications for community health nursing. Explores a variety of clinical and population-focused roles in primary, secondary, and tertiary prevention of health problems. Prereq: NURS 801, 802, 808, 814, 815, 818, 819. Special fee.

**Co-requisites:** NURS 845

**NURS 845 - Nursing Research**

**Credits:** 2.00 to 4.00

Focuses on enhancing the student's ability to evaluate, read, comprehend, participate in, and apply research to the practice of nursing. Prereq: NURS 801, 802, 808, 814, 815, 818, 819.

**Co-requisites:** NURS 824

### **NURS 850 - Clinical Decision Making III**

**Credits:** 4.00

Provides opportunity for students to refine and integrate theory and practice from previous coursework into professional practice through cooperatively designed learning experience. Prereq: NURS 801, 802, 808, 814, 815, 818, 819, 820, 822, 845. Special fee.

**Co-requisites:** NURS 850C

### **NURS 850C - Transition to Professional Nursing**

**Credits:** 6.00

Provides opportunity for students to refine and integrate theory and practice from previous coursework into professional practice through cooperatively designed learning experience. Prereq: NURS 801, 802, 808, 814, 815, 818, 819, 820, 822, 823, 845. Special fee.

**Co-requisites:** NURS 850

### **NURS 894 - Special Topics**

**Credits:** 1.00 to 4.00

Formal course given on selected topics or special interest subjects. Several topics may be taught in one year or semester. Prereq: permission. May be repeated.

### **NURS 898 - Master's Research Project**

**Credits:** 3.00

Opportunity to develop, implement, and evaluate a project relevant to the practice setting. Prereq: permission. IA (continuous grading). Cr/F.

### **NURS 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Prereq: permission. Cr/F.

### **NURS 900 - Discipline of Nursing**

**Credits:** 3.00

Nursing as a discipline with a focus on paradigms for nursing science, patterns of knowing, concept analysis, and nursing theory. Emphasis on concepts fundamental to nursing practice, including advocacy, caring, power, and collaboration; analysis of nursing theories in relation to practice and research. Prereq: permission.

### **NURS 901 - Nursing and Change in Health Services**

**Credits:** 3.00

Emphasizes identification of emerging issues that have an impact on the health care system and determination of nursing in providing leadership to address these issues. Students analyze problems and process solutions from a nursing perspective with reasoned approach to their resolution. Prereq: permission.

### **NURS 905 - Research**

**Credits:** 3.00

Provides overview of current state-of-the-art research in nursing. Emphasis on critique of research findings and application of research to clinical practice. Prepares student to work collaboratively with expert researchers in either academic or clinical settings. Discusses types of research designs and qualitative and quantitative methods. Critique process focuses on individual components of research study, including the theory, purpose, sample, data collection procedures, and analysis. Includes ethical issues of scientific fraud and misconduct and issues of human subjects. Prereq: permission.

### **NURS 907 - Pharmacology**

**Credits:** 3.00

Principles of pharmacodynamics and pharmacokinetics relevant to primary care practice. Focuses on major classes of drugs with an emphasis on knowledge necessary for prescriptive authority. Prereq: permission.

### **NURS 908 - Clinical Application of Human Physiology**

**Credits:** 3.00

Examines human physiologic function and interaction of selected body systems in maintaining health. Clinical correlation strategies used to examine implications of recent advances in selected areas of human physiology to better understand the human body and its functioning in health and illness. Stresses application of course materials to advanced nursing practice in a variety of settings. Prereq: permission.

### **NURS 909 - Health and Illness Appraisal**

**Credits:** 3.00

Advanced health assessment including communication strategies, functional health pattern assessment, advanced physical assessment, screening diagnostic tests, developmental evaluation, and clinical decision making. Lab and clinical component. Pre- or Coreq: NURS 900; 905; 907; 908. Special fee.

### **NURS 920 - Administrative Theories in Nursing**

**Credits:** 3.00

Application of administrative theories and organizational behavior concepts to the practice of nursing administration in current and emerging health care settings. Examines organizational structure, motivation, leadership/management, decision making, creativity, and change. Prereq: permission.

### **NURS #921 - Administrative Context for Quality Nursing Care Delivery**

**Credits:** 3.00

Identification of strategies to create an organizational context to enhance effective and efficient quality nursing practice in a variety of health care settings. Intra- and interdepartmental effectiveness, care delivery models, governance models, patient/client focused redesign, operations improvement programs, and human resource management are studied within an open systems focus.

### **NURS #922 - Resource and Financial Management in Nursing**

**Credits:** 3.00

Strategies for the effective use of human and financial resources in health care systems. Explores budget development and control, business plan development, skill mix, costing of nursing services, computer uses, classification of systems and acuity determination of staffing/skill mix, and marketing of nursing service strategies in relation to fiscal responsibilities of the nurse and administrator.

### **NURS #929 - Practicum and Seminar in Nursing Administration**

**Credits:** 6.00

Individualized practicum experience arranged to assist student in applying theoretical knowledge in the practice setting and to achieve personal goals related to development as a nurse administrator. Seminar topics selected to reflect issues arising from practicum experiences but will include ethical administrative considerations and nursing administration in future health care delivery systems. Prereq: permission. Special fee.

### **NURS 935 - Primary Care of the Adult**

**Credits:** 3.00

Lecture/discussion course covering the primary care management of healthy adults through the lifespan with a focus on health maintenance and disease prevention. Focuses on evaluation and management of common acute and chronic adult health care problems. Major causes of adult morbidity are covered. Prereq: NURS 909. Special fee.

### **NURS 936 - Practicum in the Primary Care of Adults**

**Credits:** 3.00

Supervised clinical experience in the primary care management of adults through the lifespan, including assessment and management of common acute and chronic clinical problems. Focuses on the clinical application of knowledge of health maintenance, disease prevention, and the evaluation and management of major causes of adult morbidity and mortality. Prereq: NURS 908; 909. Pre- or Coreq: NURS 907; 935. Special fee.

### **NURS 937 - Primary Care of Children**

**Credits: 3.00**

Lecture/discussion course covering the primary care management of children across the health-illness continuum, including assessment and management of common acute and chronic clinical problems. A developmental perspective is taken to examine child-health evaluation and maintenance from infancy through adolescence. Prereq: NURS 909. Special fee.

**NURS 938 - Practicum in the Primary Care of Children****Credits: 3.00**

Supervised clinical experience in the primary care management of the child and adolescent, including assessment and management of common acute and chronic clinical problems. A family-centered developmental perspective is taken to provide child-health services from infancy through adolescence. Nursing care, family, and rehabilitation issues related to various health problems are investigated in practice. Prereq: NURS 908; 909. Pre- or Coreq: NURS 907; 937. Special fee.

**NURS 939 - Seminar and Practicum in the Primary Care of Families****Credits: 6.00**

Final integrative clinical course that allows for intensive application of primary care knowledge and skills in practice. Seminar allows for in-depth analysis of various clinical problems and role issues. Students are actively involved in a primary care setting appropriate to their area of study. Extensive clinical experience under the guidance of a preceptor. Prereq: NURS 935; 936; 937; 938. Special fee.

**NURS 941 - Population Focused Practicum****Credits: 3.00**

In this practicum students acquire the specialty knowledge and skills that are required in the care of a particular population. Students propose clinical performance competencies, learning activities, settings, and resource persons for the supervised practicum and complete a minimum of 112 perceptible clinical hours. May be repeated to a maximum of 6 credits. Prereq: NURS 935; 936. Special fee.

**Co-requisites:****NURS 945 - Clinical Decision Making in Health Care****Credits: 3.00**

Clinical decision making is analyzed and applied with a focus on integrating the humanistic, functional and medical frameworks of health care. An approach to identifying and analyzing ethical conflicts is developed, and culture-appropriate care is examined. Students consider the range management modalities that might benefit their populations of interest, and are assisted in expanding their repertoire of interventions. Pre- or Coreq: NURS 935; 936.

**NURS 946 - Practicum in Adult Health Care****Credits: 6.00**

Students design the precepted clinical experience to refine, expand, and/or re-focus existing clinical competencies with the objective of developing the ability to assess and manage complex client cases, and/or manage cases across clinical settings. Seminars involve presentation-discussions of case management situations, and discussion of role issues relevant to advanced practice roles. Pre- or Coreq: NURS 945. Special fee.

**NURS 950 - Reading and Research in Advanced Nursing****Credits: 2.00 to 8.00**

Through a process of selective review and critical evaluation, students examine the current literature and explore the issues and trends in their topic area. Students prepared by education and experience to do independent work under the guidance of a professor may register for one or more of these sections. Topics include: oncology, women's health, community nursing, case management, geriatric nursing, nursing care of children and families, nursing those with disabilities, quality improvement, special topics. Hours and credits to be arranged. Pre- or Coreq: NURS 900, 901, 905.

**NURS 955 - Practicum in Advanced Nursing Practice****Credits: 3.00 to 6.00**

Students acquire the specialty knowledge and skills required in the area of their master's study. Students work with their faculty mentor to propose performance competencies, learning activities, settings, and resource persons for this supervised practicum. Practicum must include a minimum of 112 hours of supervised practice. May be repeated. Pre- or Coreq: NURS 950. Special fee.

**NURS #994 - Special Topics**

**Credits:** 1.00 to 3.00

Formal course given on selected topics or special interest subjects. Several topics may be taught in one year or semester. Prereq: permission. May be repeated.

**NURS 996 - Independent Study**

**Credits:** 1.00 to 3.00

Opportunity for study and/or practice in an area of choice. Objectives are developed by students and must be approved by faculty. May be repeated. Prereq: permission.

## Nutritional Sciences

### **NUTR 809 - Nutritional Epidemiology**

**Credits:** 4.00

This course will provide an introduction to the principals and applications of nutritional epidemiology. The major methods of nutritional assessment will be reviewed in relation to nutritional epidemiology and the evidence of diet-disease relationships will be examined. Course activities will include lecture, discussion participation, presentations, and group work. Prereq: NUTR 400, introduction to statistics. Permission required.

### **NUTR 820 - Community Nutrition**

**Credits:** 4.00

Solutions to the complex public health problems require cost-effective, community-based interventions that address their multiple causes. The community nutritionist is a key player in diagnosis and treatment of the public. This course provides the skills and tools needed to assess, design, implement, and evaluate community interventions. Prereq: Prereq: Nutrition Health and Well Being.

### **NUTR 825 - Metabolic Adaptations to Exercise II**

**Credits:** 4.00

This course examines the regulation of cellular metabolism in muscle, liver, adipose and other tissues of the body by enzymes, effectors, and hormones in response to exercise. It focuses on the exercise-induced mechanisms for controlling metabolic pathway flow, techniques for studying metabolism, and up-to-date molecular and cellular exercise physiology research. Prereq: BCHM 658 or KIN 724.

### **NUTR 840 - Nutrition for Children with Special Needs**

**Credits:** 2.00

Nutritional assessment and care of children with special needs resulting in feeding difficulties requiring medical nutrition therapy. Prereq: basic nutrition course.

### **NUTR 850 - Nutritional Biochemistry**

**Credits:** 4.00

Study of digestion, absorption, transport, and utilization of food nutrients from a biochemical perspective. Emphasis on the role of macro- and micronutrients as substrates and catalysts for metabolic pathways, and the role of these pathways in maintaining human health at the cellular, organ, and whole body levels. Prereq: general biochemistry. (Also offered as ANSC 850.)

### **NUTR 856 - Treatment of Adult Obesity**

**Credits:** 2.00

Overview of the risk factors associated with obesity; evidence-based recommendations for assessment and treatment of obesity. Counseling skills important to successful weight management and non-diet approaches are also explored.

### **NUTR 860 - Geriatric Nutrition**

**Credits:** 2.00

Emphasis on the nutritional requirements of the elderly in view of psychological and physiological changes in aging. Approaches for nutrition intervention and support are addressed. Prereq: basic nutrition course.

### **NUTR 873 - Clinical Nutrition**

**Credits:** 4.00

Principles of normal nutrition and physiology applied to clinical problems; altered nutrient requirements in human disease. Prereq: basic nutrition and biochemistry or permission. (Fall semester only.)

**Co-requisites:**

### **NUTR 875 - Practical Applications in Medical Nutrition Therapy**

**Credits:** 3.00

Supervised practical experience in therapeutic dietetics in one of several cooperating New Hampshire hospitals. Emphasis on nutritional counseling, assessment, and instruction of patients with nutrition-related disorders.

**Co-requisites:** NUTR 873

### **NUTR 880 - Critical Issues in Nutrition**

**Credits:** 4.00

Critical review and analysis of controversial topics in nutrition; emphasis on developing oral and written communications skills and analytical reasoning skills. Prereq: permission. (Spring semester only.)

### **NUTR 898 - Master's Project**

**Credits:** 1.00 to 4.00

Students develop a project of interest and identify a mentor within the department to advise them throughout the project. Students prepare a project proposal for review. Final paper and presentation. Cr/F.

### **NUTR 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Graduate students must enroll for a total of 6 credits for this course. Students may enroll in 1-6 credits per semester. Permission required. Cr/F.

### **NUTR 900 - Contemporary Topics in Animal, Nutritional, and Biomedical Sciences**

**Credits:** 1.00

An informal forum for graduate students to gain experiences in evaluating the current literature of a contemporary topic. (Also offered as ANSC 900.) May be repeated for a maximum of 2 credits. Offered both fall and spring semesters. Cr/F.

### **NUTR 910 - Mineral Nutrition**

**Credits:** 2.00

Detailed analysis of the digestion, absorption, transport and intermediary metabolism of minerals as essential nutrients. The chemical and biochemical characteristics of minerals are examined to account for their physiological functions. Prereq: nutritional biochemistry or permission. (Offered in alternate years in spring semester only.)

### **NUTR 911 - Lipids**

**Credits:** 4.00

Structure, metabolism, and function of lipids of importance to animals. Prereq: biochemistry (Offered in alternate years.)

### **NUTR 912 - Vitamin Nutrition**

**Credits:** 2.00

Detailed analysis of the digestion, absorption, transport and intermediary metabolism of vitamins as essential nutrients. The chemical and biochemical characteristics of vitamins are examined to account for their physiological functions. Prereq: nutritional biochemistry or permission. (Offered in alternate years in spring semester only.)

### **NUTR 929 - Principles of Dietetics**

**Credits:**  
Principles of Dietetics will provide an orientation to those graduate students enrolled in the dietetic internship program that encompasses community, food service and clinical nutrition topics. Concepts to be explored include, but are not limited to, an orientation to the profession, ethical standards of the American Dietetic Association, counseling theory, evidence-based medicine, food safety, research, and emotional intelligence. Using the diabetes camp experience, students will have the opportunity to apply nutrition theory and education via a multi-day placement. Required for all dietetic intern students. Special fee.

### **NUTR 930 - Dietetics Practicum I: Foodservice Systems Management and Community Nutrition**

**Credits:** 4.00

Dietetics Practicum I provides dietetic interns with seminars and practice related experiences in the area of foodservice systems management and community nutrition to prepare for careers as Registered Dietitians.

**NUTR 931 - Dietetics Practicum II: Medical Nutrition Therapy**

**Credits:** 4.00

Dietetics Practicum II combines weekly seminars with clinical nutrition experiences in area hospitals to prepare interns for careers as Registered Dietitians.

**NUTR 955 - Disorders in Energy Balance**

**Credits:** 4.00

Etiology, pathophysiology, and treatments of obesity, anorexia nervosa, and bulimia are reviewed. Role of heredity, neurological, metabolic, and environmental mechanisms are discussed. Particular emphasis on obesity. Prereq: permission of instructor.

**NUTR 995 - Non-thesis Investigations**

**Credits:** 1.00 to 4.00

Advanced investigations in a research project, exclusive of thesis project. Elective only after consultation with the instructor. May be repeated for a maximum of 4 credits. (Offered both fall and spring semesters.)

## Ocean Engineering

### **OE 810 - Ocean Measurements Laboratory**

**Credits:** 4.00

Measurements of fundamental ocean processes and parameters. Emphasis on understanding typical offshore measurements, their applications, and the use of the acquired data. The latter is in terms of the effects on structures and processes in the ocean.

### **OE 844 - Corrosion**

**Credits:** 4.00

The course is split into three parts: (1) reviews and develops basic concepts of electrochemistry, kinetics, and measurement methods; (2) covers the details of specific corrosion mechanisms and phenomena including passivity, galvanic corrosion, concentration cell corrosion, pitting and crevice corrosion, and environmentally induced cracking; and (3) focuses on the effects of metallurgical structure on corrosion, corrosion in selected environments, corrosion prevention methods, and materials selection and design. Prereq: general chemistry, introduction to materials science or permission. (Also offered as MS 844.) Special fee. Lab.

### **OE #853 - Ocean Hydrodynamics**

**Credits:** 3.00

Fundamental concepts of fluid mechanics as applied to the ocean; continuity; Euler and Navier-Stokes equations; Bernoulli equation; stream function, potential function; momentum theorem; turbulence and boundary layers are developed with ocean applications. Prereq: permission.

### **OE 854 - Ocean Waves and Tides**

**Credits:** 4.00

Introduction to waves: small-amplitude, linear wave theory, standing and propagating waves, transformation in shallow water, energy and forces on structures, generation by wind and specification of a random sea, long waves with rotation, and internal waves. Introduction to tides: description of tides in ocean tidal generation forces, equilibrium tide, and tidal analysis. Lab/project: field and lab measurements with computer analysis. Prereq: general physics; differential equations;/ or permission. Lab.

### **OE 856 - Principles of Naval Architecture and Model Testing**

**Credits:** 4.00

Fundamentals of naval architecture presented including hydrostatics, basics of resistance and propulsion, sea keeping and scaling. Concepts applied in experiments utilizing the tow/wave tank and associated instrumentation. Prereq: fluid dynamics, mechanics III, or equivalent. Lab.

### **OE 857 - Coastal Engineering and Processes**

**Credits:** 3.00

Introduction to small-amplitude and finite-amplitude wave theories. Wave forecasting by significant wave method and wave spectrum method. Coastal processes and shoreline protection. Wave forces and wave structure interaction. Introduction to mathematical and physical modeling. Prereq: fluid dynamics or permission. (Also offered as CIE 857 and ME 857.)

### **OE 867 - Interactive Data Visualization**

**Credits:** 3.00

Detailed discussion of how an understanding of human perception can help us design better interactive displays of data. Topics include: color, space perception, object perception and interactive techniques. Students write interactive programs, give presentations and undertake a project designing and evaluating a novel display technique. Prereq: Introductory level C or C++ programming course. (Also listed as CS 867.)

### **OE 870 - Introduction to Ocean Mapping**

**Credits:** 4.00

An introduction to the principles and practices of hydrography and ocean mapping. Methods for the measurement and definition of the configuration of the bottoms and adjacent land areas of oceans, lakes, rivers, estuaries, harbors and other water areas, and the tides or water levels and currents that occur in those bodies of water. Prereq: college physics. (Also listed as ESCI 870.) Lab.

### **OE 871 - Geodesy and Positioning for Ocean Mapping**

**Credits:** 3.00

The science and technology of acquiring, managing, and displaying geographically referenced information; the size and shape of the earth, datums and projections; determination of precise positioning of points on the earth and the sea, including classical terrestrial-based methods and satellite-based methods; shoreline mapping, nautical charting and electronic charts. Prereq: one year of calculus and one year of college physics. (Also listed as ESCI 871.)

### **OE #881 - Physical Instrumentation**

**Credits:** 4.00

Analysis and design of instrumentation systems. Sensors, circuits, and devices for measurement and control. Elements of probability and statistics as applied to instrument design and data analysis. Transmission, display, storage, and processing of information. The design, implementation, testing, and evaluation of an instrument system is an integral part of the course. Prereq: permission. (Also offered as ECE 881.)

### **OE 885 - Underwater Acoustics**

**Credits:** 4.00

Vibrations; propagation; reflection; scattering; reverberation; attenuation; sonar equations; ray and mode theory; radiation of sound; transducers; and small- and large-signal considerations. Prereq: permission. (Also offered as ECE 885.)

### **OE 895 - Special Topics**

**Credits:** 2.00 to 4.00

New or specialized courses and/or independent study. May be repeated for credit.

### **OE 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Cr/F.

### **OE #937 - Advanced Hydrodynamics**

**Credits:** 4.00

Continuation approach to the analysis of ocean circulation problems. Shallow and deep water modeling to include temperature, salinity, and species distributions in time and space. Air-sea interaction, energy transport phenomena, internal currents, and the effect of coastal geometry on wave reflection and resonant phenomena. Fundamental data acquisition and analysis techniques. Prereq: permission.

### **OE 954 - Ocean Waves and Tides II**

**Credits:** 4.00

Continuation of ocean waves and tides. Topics include nonlinear wave theory, long wave (tidal) equations with Coriolis acceleration and friction, turbulence, Reynold's stress, and estuarine fronts. Random seas studied with consideration of wave spectra, generation of random seas for numerical and physical modeling, and the response of marine vehicles and structures to wave loading. Prereq: OE 854.

### **OE 956 - Dynamics of Moored Systems**

**Credits:** 4.00

Dynamic response to floating and submerged moored systems to currents and wave spectra studied. Examples include buoys, moored platforms, and ocean net pens. Prereq: OE 856 or permission.

### **OE 972 - Hydrographic Field Course**

**Credits: 4.00**

A lecture, lab, and field course on the methods and procedures for the acquisition and processing of hydrographic and ocean mapping data. Practical experience in planning and conducting hydrographic surveys. Includes significant time underway (day trips and possible multi-day cruises) aboard survey vessel(s). Prereq: Introduction to Ocean Mapping, Geodesy and Positioning for Ocean Mapping; or permission. Special fee. (Also listed as ESCI 972.)

**OE 973 - Seafloor Characterization****Credits: 3.00**

Remote characterization of seafloor properties using acoustic (echo sounders, sub-bottom profilers, side-scan, multibeam and interferometric sonars) and optical (video and laser linescanner) methods. Models of sound interaction with the seafloor will be explored as well as a range of possible geologic, geotechnical, morphologic, acoustic, and biologic descriptors. Prereq: permission. (Also listed as ESCI 973.)

**OE 990 - Ocean Seminars I****Credits: 1.00**

Various topics, including marine systems design, marine vehicle operation, data collecting and processing, and marine law. Cr/F.

**OE 991 - Ocean Seminars II****Credits: 1.00**

See description for OE 990. Cr/F.

**OE 995 - Graduate Special Topics****Credits: 2.00 to 4.00**

Investigation of graduate-level problems or topics in ocean engineering. May be repeated for a maximum of 16 credits.

**OE 998 - Independent Study****Credits: 1.00 to 4.00**

Independent theoretical and/or experimental investigation of an ocean engineering problem under the guidance of a faculty member.

**OE 999 - Doctoral Research****Credits:**

Cr/F.

## Occupational Therapy

### **OT 822 - Assistive Technology**

**Credits:** 4.00

This hands on course will provide participants with an overview of the application of assistive technology in all life settings for individuals affected by physical, sensory, or cognitive limitations. Methods, materials, and resources for obtaining and providing assistive technology services will also be discussed. Special fee.

### **OT 824 - Assistive Technology and Physical Disabilities**

**Credits:** 4.00

An advanced course that focuses on the specialized assistive technology needs of persons with physical impairments. Topics include: seating and positioning needs; prosthetic devices; manual and powered mobility devices; ergonomics and computer access. Special fee.

### **OT 826 - Assistive Technology and Sensory, Communicative, and Cognitive Disabilities**

**Credits:** 4.00

Explores the application of various technologies for individuals with visual, auditory, cognitive and communication impairments. Included are: Blind and low vision aides, assistive listening devices, alternative and augmentative communication devices, memory aides, and prompting aides. Special fee.

### **OT 841 - Human Occupation**

**Credits:** 4.00

Students will have three hours of classroom contact and regular contact with a mentor who is a master of a particular occupational activity. Students learn the activity with support of the mentor and other relevant experiences. Assignments include a presentation and two papers. Honors in the major course.

### **OT 842 - Human Occupation II**

**Credits:** 4.00

Expanding on the work from Human Occupation I, this course facilitates students' understanding of occupation as described and utilized in occupational therapy. The course has a four-fold purpose, (1) consider the historical and philosophical base of occupation, (2) examine the frames of reference that define and delineate occupation as a therapeutic medium, (3) explore the importance and meaning of belonging to a group, and (4) engage in ethnographic research.

### **OT 851 - Mind Body Systems/Neurologically-based Function and Dysfunction**

**Credits:** 4.00

Students will study neurologically related disorders commonly seen by occupational therapists. A problem based learning method will be used to examine the perceptual, cognitive, biopsychosocial basis of these disorders. A basic overview of human body-mind systems will be provided with an emphasis on pathology, the recognition of symptoms, their causes and the occupational implications of the disorders. Selected theoretical frames of reference for assessment and intervention will be discussed in terms of general, holistic methods of practice. This course is a prerequisite for courses in specific occupational therapy assessment and intervention.

### **OT 852 - Human Movement in Occupation**

**Credits:** 4.00

This course will integrate the student's prerequisite knowledge of occupation. The course will develop skills required for interpretation of biomechanical analysis for creating successful occupational performance for individuals with varied musculoskeletal, cardiac, and respiratory dysfunction. Integration of the occupational therapy clinical reasoning process and the use of occupations as a therapeutic mechanism for change will be emphasized. The analysis of environment as it relates to human movement and participation in desired occupations will be explored. Special fee.

## **OT 861 - Occupational Therapy: Professional Roles and Principles of Practice**

**Credits:** 3.00

This course introduces students to foundation knowledge, values and philosophy of OT practice. Students learn and apply professional behavior skills required for competent and ethical OT practice. Topics included in the course are: historical roots of occupational therapy, organization and structure of the profession, professional roles, theoretical frameworks, the occupational therapy process, clinical reasoning, and professional code of ethics. Course assignments introduce students to the profession's scholarly literature.

## **OT 862 - Occupational Therapy Evaluation and Intervention I**

**Credits:** 4.00

The main goal of this course is to introduce students to the OT evaluation process. Students will apply the clinical reasoning process to OT evaluation across age levels, and types of medical conditions. Students will learn about common assessment tools available to occupational therapists, where, when, and how to apply them, and how to evaluate assessment tools. Students will develop technical skills in administering selected evaluation tools, in integrating assessment data, and demonstrate emergent clinical decisions about intervention planning. Finally, they will gain an appreciation of the importance of measurement in various facets of OT practice. Special fee.

**Co-requisites:** OT 863

## **OT 863 - Occupational Therapy and Intervention II**

**Credits:** 4.00

This course extends upon knowledge gained and skills developed in Evaluation and Intervention I. Students will further develop skills in selecting evaluation tools and in demonstrating coherent clinical decisions about intervention planning based on data gathered. Selected cases will be used for application of knowledge, and the course will emphasize the application and demonstration of common intervention strategies used by occupational therapists. Special fee.

**Co-requisites:** OT 862

## **OT 865 - Occupational Therapy Practice and Professional Reasoning**

**Credits:** 3.00

This course extends upon knowledge gained and skills developed in Evaluation and Intervention courses I and II. However, selected case studies will be at the population or program level, and will be used to apply OT theory, and practical knowledge, to develop, implement and evaluate OT services and programs in various community, and medically-based settings. Students will be expected to consider research knowledge.

## **OT 871 - Enabling Participation in Community Groups**

**Credits:** 4.00

In this class students will work in an organization, learn about the people served by this organization, conduct an assessment for occupation-based program or wellness program needs within the organization, and develop a proposal for this program to be implemented during the semester. Special fee.

## **OT 872 - Occupation, Health, and Community Programming**

**Credits:** 4.00

This is the second course in the Community Occupational Therapy Sequence. Students will continue to work with their first semester seminar group in the same organization. They will begin the semester by adapting their plan based on the feedback from the organization. They will use the rest of the semester to implement their program and evaluate its effectiveness. Special fee.

## **OT 875 - Leadership in Occupational Therapy Systems of Practice**

**Credits:** 3.00

This course integrates concepts, principles, and strategies that are fundamental to the provision of occupational therapy services in the changing U.S. health care system. This course links system management, reimbursement mechanisms, and public policy found in occupational therapy practice settings to the populations served. Knowledge of leadership, management, ethics and marketing principles that are necessary for success in today's industry are emphasized.

### **OT 883 - Introduction to Research**

**Credits:** 3.00

This course assists students to be effective consumers of research, introduces them to the concepts and importance of evidence-based practice, and familiarizes students with the many research methods used to conduct scientific inquiry. Course content includes: reading and critiquing research, developing research questions; developing a small research proposal including a literature review; introduction to qualitative and quantitative research methods, evaluation and selection of research designs; data analysis; and research ethics.

### **OT 885 - Research Methods and Application to Practice**

**Credits:** 3.00

This course is designed to engage students actively in the research process. Students will complete a research project either individually or in small groups. Students will be encouraged to develop their research questions from a limited number of research topics and projects currently being addressed by OT faculty or community occupational therapists. Students with a strong interest area, and clear research question related to that interest area, may complete a small research project related to that topic at the discretion of the instructor.

### **OT 892 - Level I Fieldwork**

**Credits:** 1.00

This course provides occupational therapy students an opportunity to experience occupational therapy in a clinical setting. Students attend a seminar prior to beginning their placement. Level I placement is scheduled between the fall and spring semesters of the senior year. During fieldwork, students observe an occupational therapist as well as participate in the planning and implementing of the occupational therapy assessment or intervention process for a client. Cr/F.

### **OT 893 - Special Topics**

**Credits:** 2.00 to 4.00

Formal courses given on selected topics or special interest subjects. Work may be directed in one of the following areas: A) Administration; B) Clinical Education; C) Pediatrics; D) Physical Disabilities; E) Mental Health; F) Gerontology/Geriatrics; G) School-based Practice, and others. Prereq: permission. May be repeated to a maximum of 12 credits. Special fee on some topics.

### **OT 894 - Level II Fieldwork I**

**Credits:** 9.00

This course is a 12-week, full-time internship that takes place the fall semester of the second graduate year. Level II fieldwork provides students with opportunities to: experience in-depth delivery of occupational therapy services to clients; focus on the application of purposeful and meaningful occupation and/or research, administration and management of occupational therapy services. Level II fieldwork is designed to promote clinical reasoning and reflective practice, to transmit values and beliefs that promote ethical practice and to develop professionalism and competence as career responsibilities. Cr/F.

### **OT 895 - Readings and Research in Occupational Therapy**

**Credits:** 1.00 to 6.00

Independent work under the guidance of an instructor. Work may be directed in one of the following areas: A) Administration; B) Clinical Education; C) Pediatrics; D) Physical Disabilities; E) Mental Health; F) Gerontology/Geriatrics; G) School-based Practice, and others. Prereq: permission. May be repeated to a maximum of 8 credits.

### **OT 896 - Level II Fieldwork II**

**Credits:** 9.00

This course is the second 12-week, full-time internship. It takes place the summer after the second graduate year. OT 896 provides students with opportunities to evaluate, develop and implement in-depth delivery of occupational therapy services in population-based practice and to focus on research and/or administration and management of occupational therapy services. Cr/F.

**OT 897 - Graduate Project****Credits:** 1.00 to 6.00

Application of graduate education addressing an issue related to occupational therapy and a change in occupational therapy practice, education, or administration. The project includes a literature review, a plan for change based on the literature, a plan of implementation, and a plan for evaluation. Prereq: permission. IA (continuous grading). May be repeated up to a maximum of 6 credits. Cr/F.

**OT 898 - Capstone****Credits:** 2.00

Designed as a seminar in which students integrate previous course work and readings with a framework of professional goals, challenges, and strategies that advance students' progress as occupational therapy practitioners, researchers, educators, and leaders. Cr/F.

**OT 899 - Master's Thesis****Credits:** 1.00 to 6.00

Prereq: permission. Cr/F.

**OT 901 - Theoretical Practice of Occupational Therapy****Credits:** 4.00

The therapist's patterns of daily clinical practice reflect underlying theoretical assumptions that can be made self-evident through an informed process of practice-inventory. Students increase their knowledge of the contributions and constraints of theoretical developments in occupational therapy which enhance daily clinical/administrative practice and support research. Open only to students in the master's OT program.

**OT 902 - Advanced Statistics for Health Care Research****Credits:** 4.00

Exploration and application of non-parametric, parametric, descriptive, inferential and multi-variant statistical procedures commonly used in health care research and program evaluation. Basic competencies using SPSS, statistical computer software will be developed. Prereq: Introduction to statistics course.

**OT 903 - Research Methods for Occupational Therapists****Credits:** 4.00

Exploration of the components of health-related research. Students guided through the research proposal process. Issues addressed include developing and implementing research questions, literature review, appropriate research design, qualitative and quantitative methods, data analysis, publication collaboration, peer review, and research ethics. Class meetings structured to help students choose a research topic and develop a grant proposal. Open only to students in the master's OT program. Prereq: OT 902.

**OT 904 - Health Care Trends and Occupational Therapy****Credits:** 4.00

Students examine the dynamics of health policy formulation, the political economy of health care, and the roles and potential for occupational therapy within the changing system. Open only to students in the master's OT program.

**OT #911 - Clinical Reasoning****Credits:** 4.00

Clinical reasoning in health care and occupational therapy, phenomenology and interpretative sociology, and qualitative research analyzed as applied to the practice of occupational therapy. Students function as a research team which explicates the clinical reasoning used by team members. Narratives, journals, and video-taped treatment sessions used as part of this exploration. Open to students in the master's OT program. Prereq: OT 901 or permission.

## Plant Biology

### **PBIO 801 - Plant Physiology**

**Credits:** 3.00

Structure-function relationship of plants, internal and external factors regulating plant growth and development, plant hormones, plant metabolism, water relations, and mineral nutrition. Prereq: introductory botany or concepts of plant growth; one year of college chemistry (e.g., general chemistry); organic chemistry or basic chemistry; or permission.

### **PBIO 802 - Plant Physiology Laboratory**

**Credits:** 2.00

Analytical techniques for plant physiology, effects of growth regulators on plant growth and development, cell and tissue culture, enzyme kinetics, and plant water relations. Pre- or Coreq: plant physiology. Special fee.

### **PBIO 809 - Plant Stress Physiology**

**Credits:** 3.00

Examines the physiological and biochemical mechanisms of plant response to abiotic stresses including drought, salt, high and low temperature, visible and ultraviolet radiation, heavy metals, and air pollutants. Discusses current hypotheses, agricultural and ecological implications. Prereq: plant physiology; biochemistry; or permission.

### **PBIO 813 - Biochemistry of Photosynthesis**

**Credits:** 4.00

The physiology and biochemistry of photosynthesis in higher plants and microorganisms: light reactions, electron transport, membrane structure and function, carbon assimilation pathways, energy conservation, and metabolic regulation. Agronomic and ecological aspects of photosynthesis are examined. Prereq: plant physiology or biochemistry. (Not offered every year.)

### **PBIO 814 - Electron Microscopy**

**Credits:** 2.00

Theory and principles involved in preparing plant and animal tissue for observation with the transmission (TEM) and scanning (SEM) electron microscopes; x-ray analysis (EDAX); freeze-fracture, including shadow casting and photographic techniques; and presentation of micrographs for publication. Prereq: permission.

**Co-requisites:**

### **PBIO 815 - Electron Microscopy Lab**

**Credits:** 3.00

Practical application of theoretical principles and practices utilized in preparing and observing plant and animal tissues with the transmission and scanning electron microscopes. Student project assigned. Prereq: permission. Special fee.

**Co-requisites:** PBIO 814

### **PBIO 817 - General Limnology**

**Credits:** 4.00

Introduction to the ecology of freshwater systems with emphasis on lakes. Origins of lakes and the effects of watersheds on lake chemistry and nutrient cycling are explored. Other topics include the impact of human disturbances on productivity and aquatic food webs and methods used for the management and restoration of lakes. Comparisons are made of the structure and functions of lake ecosystems found in temperate, tropical and arctic regions. Prereq: general ecology or equivalent. (Also offered as ZOOL 817.)

### **PBIO 819 - Field Studies in Lake Biology**

**Credits:** 4.00

Ecology of lakes and other freshwater habitats examined through field studies. Emphasizes modern methods for studying lakes, analysis and interpretation of data, and writing of scientific papers. Seminars on research papers and

student presentations of class studies. Field trips to a variety of lakes, from the coastal plain to White Mountains; investigate problems, such as eutrophication, acidification, biodiversity and biotoxins. Capstone experiences include interaction with state agencies, lake stakeholders and the submission of written manuscripts for publication. Prereq: introductory biology. (Also offered as ZOOL 819.) Special fee. Lab.

### **PBIO 820 - Plant Nutrition**

**Credits:** 4.00

Mineral nutrition of higher plants, behavior of nutrients in the soil and in plants, environmental and genetic factors that influence nutrient absorption and translocation, and visual diagnosis and remediation of plant nutrient deficiencies and toxicities. Special fee.

### **PBIO 821 - Microscopic Algae**

**Credits:** 4.00

Survey of phytoplankton and periphyton in local marine and freshwater habitats. Identification, systematics, and evolution. Class and individual collection trips. Prereq: principles of biology II, or introductory botany, or evolution of plants. Lab. (Not offered every year.) Special fee.

### **PBIO 822 - Marine Phycology**

**Credits:** 4.00

Identification, classification, ecology, and life histories of the major groups of marine algae, particularly the benthonic marine algae of New England. Periodic field trips. Prereq: principles of biology or elementary botany or survey of the plant kingdom. Lab. (Not offered every year.)

### **PBIO 824 - Freshwater Algal Ecology**

**Credits:** 4.00

Survey of freshwater algal habitats; physiological explanation of population models. Individual experimental projects. Prereq: general limnology or permission. Special fee.

### **PBIO 825 - Marine Ecology**

**Credits:** 4.00

Marine environment and its biota, emphasizing intertidal and estuarine habitats. Includes field, laboratory, and independent research project. Prereq: general ecology; permission. Marine invertebrate zoology, oceanography, and statistics are desirable. (Also offered as ZOOL 825.) Special fee. (Not offered every year.)

### **PBIO 826 - Integrated Pest Management**

**Credits:** 4.00

Integration of pest management techniques involving biological, culture, and chemical control with principles of insect ecology into management approach for insect pests. Prereq: permission.

### **PBIO 827 - Algal Physiology**

**Credits:** 3.00

Survey of major topics in the physiology and biochemistry of marine and freshwater algae including nutrition, metabolic pathways, reproductive physiology, storage and extracellular products, cell inclusion, growth, and development. Prereq: introduction to biochemistry or permission. (Not offered every year.)

**Co-requisites:** PBIO 829

### **PBIO #829 - Algal Physiology Laboratory**

**Credits:** 2.00

Laboratory techniques useful in studying the physiology of freshwater and marine algae. Experiments in nutrition, metabolism, and pigment and enzyme analysis. Small research project required. Prereq: permission. (Not offered every year.)

**Co-requisites:** PBIO 827

### **PBIO #830 - Plant Growth Research and Modeling**

**Credits:** 4.00

Case study approach taken to learn the theory, practice and application of computer modeling of plant growth. Process of applied research covered, including problem definition, experimental design, data collection, analysis, report writing, and presentation. Prereq: applied biostatistics I or permission. Lab.

### **PBIO 832 - Lake Management: A Multidisciplinary Approach**

**Credits:** 4.00

Lectures and seminars on interpreting lake water quality, developing a natural history inventory for lakes, the process of creating a lake management plan, and resolution of conflicting uses of lakes. Students develop lake management plans in cooperation with governmental agencies and lake associations. Guest speakers from State agencies and non-governmental organizations. Introduction to and use of GIS (Geographic Information Systems) methods for the analysis of lakes and watersheds. Presents lake management issues from scientific and social science points of view. Open to students from all disciplines. (Also offered as ZOOL 832.) Special fee. Lab.

### **PBIO 840 - Ecological Agriculture**

**Credits:** 4.00

Application of ecological concepts and principles to the design of agricultural ecosystems. Processes in natural ecosystems will be used as models for sustainable agricultural management. The course will emphasize self-directed, project-based learning during which students will individually and in groups apply their knowledge in the analysis of real world agroecosystems. Prereq: Plants, Soils, and Environment or equivalent; permission.

### **PBIO 847 - Aquatic Higher Plants**

**Credits:** 4.00

Flowering plants and fern relatives found in and about bodies of water in the northeastern United States; extensive field and herbarium work, preparation techniques, and collections. Prereq: plant taxonomy or permission. Lab. (Not offered every year.)

### **PBIO 851 - Cell Culture**

**Credits:** 5.00

Principles and technical skills fundamental to the culture of animal and plant cells, tissues and organs. Introduction to the techniques of subculturing, establishing primary cultures, karyotyping, serum testing, cloning, growth curves, cryopreservation, hybridoma formation and monoclonal antibody production, and organ cultures. An interdisciplinary course with emphasis on the application of cell culture to contemporary research in the biological sciences. Prereq: general microbiology; permission. (Also offered as ANSC 851 and MICR 851.) Special fee. Lab.

### **PBIO 852 - Mycology**

**Credits:** 4.00

Classification, identification, culturing, life histories, and ecology of fungi, from slime molds to hallucinogenic mushrooms; the significance of fungi in human history, from their contribution to the art of bread making and alcoholic fermentation to their destructiveness as agents of deadly diseases of plants and animals. Prereq: principles of biology I, II or introduction to botany, or equivalent. Special fee. Lab.

### **PBIO 853 - Cytogenetics**

**Credits:** 4.00

Chromosome structure, function, and evolution. Eukaryotic genome organization. Theory of, and laboratory techniques for, cytogenetic analysis in plants and animals. Prereq: principles of genetics. (Also offered as GEN 853.) Special fee. Lab. (Not offered every year.)

### **PBIO 854 - Laboratory in Biochemistry and Molecular Biology of Nucleic Acids**

**Credits:** 5.00

Application of modern techniques to the analysis of biomolecules, with an emphasis on nucleic acids; includes DNA isolation and analysis, cloning, sequencing, and analysis of gene products. No credit if credit has been received for MICR 704. Prereq: BCHM 658/659; 751, or permission. (Also offered as BCHM 854 and GEN 854.) Special fee. (Not offered every year.)

### **PBIO 858 - Plant Anatomy**

**Credits: 5.00**

Anatomy of vascular plants from a functional/developmental point of view with emphasis on Angiosperms. Basic cell and tissue structure of plant organs will be covered as well as the importance of chaos, fractals, scaling, mechanical stress and environmental factors in determining the role anatomy plays in the biology of plants. Prereq: principles of biology or introductory botany. Lab. (Not offered every year.)

**PBIO 861 - Biodiversity: Phytogeographic Perspective****Credits: 4.00**

Global view of biodiversity, floras and vegetation types, from a phytogeographical perspective. Major factors such as climatic, edaphic, biotic, geologic, glaciation on distributions. Four Saturday field trips: Mt. Washington, northern bogs, old-growth forest, coastal dunes. Prereq: Systematic Botany or permission. (Not offered every year.) Special fee.

**PBIO 866 - Plant-Microbe Interactions****Credits: 3.00**

Physical, chemical, genetic and molecular methods utilized by plant pathogens in interactions with plants, as well as plant defense mechanisms. Major groups of plant pathogens (bacteria, fungi and viruses) will be discussed, as will beneficial plant-microbe symbioses. Prereq: principles of biology I and II, general microbiology;/or permission. (Also offered as MICR 866.)

**PBIO 872 - Evolutionary Genetics of Plants****Credits: 4.00**

Mechanisms of genetic change in plant evolution, domestication, breeding, genetic engineering. Topics include Darwinian theory; speciation and hybridization; origins and co-evolution of nuclear and organelle genomes; gene and genome evolution; transposable elements, chromosome rearrangements, polyploidy. Lab: DNA techniques, sequence analysis programs, phylgenetic trees. Special fee. Prereq: principles of genetics or equivalent; introductory botany or principles of biology I and II or equivalent. (Also offered as GEN 872.)

**PBIO 874 - Plant Biotechnology and Genetic Engineering****Credits: 3.00**

Plant transformation and regeneration, gene isolation and identification, structure and regulation of plant genes, current applications of plant genetic engineering, environmental and social implications. Prereq: BIOL 604 or permission. (Also offered as GEN 874.)

**Co-requisites: PBIO 875****PBIO 875 - Plant Biotechnology and Genetic Engineering Lab****Credits: 2.00**

Techniques for genetic transformation and selection of plants, analysis of foreign gene expression, and plant cell and tissue culture. Coreq: PBIO or GEN 874. (Also offered as GEN 875.) Special fee. (Not offered every year.)

**Co-requisites: PBIO 874****PBIO 899 - Master's Thesis****Credits: 1.00 to 10.00**

Cr/F.

**PBIO 985 - Advanced Topics****Credits: 1.00 to 6.00**

Discussions of current topics in selected areas of plant biology. A) Systematic Botany; B) Physiology; C) Pathology; D) Anatomy; E) Morphology; F) Ecology; G) Mycology; H) Phycology; I) Cell Biology; J) Genetics; K) Evolution; L) Plant Utilization; M) Cell Physiology; N) Developmental Plant Biology; O) Cell and Tissue Culture; P) Physiological Ecology; Q) Plant Disease Control; R) Plant Hormones. Prereq: permission.

**PBIO 995 - Investigations****Credits: 1.00 to 6.00**

Supervised projects in selected areas of plant biology. A) Systematic Botany; B) Physiology; C) Pathology; D) Anatomy; E) Morphology; F) Ecology; G) Phycology; H) Mycology; I) Cell Biology; J) Cell Physiology; K) Microtechnique; L) Cell and Tissue Culture; M) Genetics; N) Crop Management; O) Developmental Plant Biology; P) Scientific Writing; Q) History of Botany; R) Teaching in Plant Biology; S) Plant Growth Research and Modeling. Prereq: permission.

**PBIO 997 - Graduate Seminar**

**Credits:** 1.00

Tips and techniques for effective communication in science. Discussions and practice in oral and written communication, including presentations at scientific meetings, seminars, grant proposals, abstracts, dissertations, and research papers. Cr/F.

**PBIO 999 - Doctoral Research**

**Credits:**

Cr/F.

## Public Health

### **PHP 900 - Public Health Care Systems**

**Credits:** 3.00

The focus of this course is on the pattern of services in the United States and on the structure and function of their component parts. It examines the impact on the system of a wide range of external factors including social, political, economic, professional, legal, and technological forces.

### **PHP 901 - Epidemiology**

**Credits:** 3.00

Exploration of factors underlying the distribution and determinants of states of health in various human populations. Emphasis is placed on investigative techniques, epidemiologic methodology, and disease prevention.

### **PHP 902 - Environmental Health**

**Credits:** 3.00

This course offers a general introduction to the ecological basis of health and disease. It applies the principles and framework of ecosystems to human health problems associated with environmental hazards, including toxic and infectious agents that contaminate our air, water, food, the work place and other special environments. Links between environmental and occupational health effects will be explored within the public health model. Policy required for regulation and alternative strategies for prevention will be discussed.

### **PHP 903 - Biostatistics**

**Credits:** 3.00

This course introduces students to the principles of biostatistics. Students will learn through classroom instruction, lab instruction and exercises, a variety of statistical methods in public health. Students will review measures of central tendency, rates, and standardization, probability, sampling, hypothesis testing, comparisons, and simple, multiple and logistic regression techniques.

### **PHP 904 - Social and Behavioral Health**

**Credits:** 3.00

A graduate level course which provides fundamental concepts of the behavioral sciences as they illuminate public health. Since public health practice is the application of physical, biological and behavioral knowledge to living societies, a firm understanding of human social organization and behavior is essential. Individual and community responses to prevention, identification of symptoms, diagnoses, treatments, chronic ailments and rehabilitation are discussed. In each of these areas, the course explores the interaction between community, family, patient, and health care provider.

### **PHP 905 - Public Health Administration**

**Credits:** 3.00

This course on public health managers, organizational culture, management process, management functions & roles, leadership, motivation, communication, and human resource management.

### **PHP 906 - Public Health Finance and Budgeting**

**Credits:** 3.00

This course reviews the manner in which public health services are financed in the United States, including sources and uses of such funds. In addition students will be introduced to the vocabulary and tools of financial management and budgeting, including financial statements, basic accounting conventions, and the process of developing and managing a programmatic budget.

### **PHP 907 - Public Health Policy**

**Credits:** 3.00

An analysis of the public policy process, the development of public health policy in the United States, and a discussion of specific public health policy issues with international comparisons. This course begins with an analytical framework for analyzing the American political system and process. It is followed by a general introduction to health policy in the United States with examples of specific policies and programs. Students will be asked to examine in depth selected specific public health policy.

### **PHP 908 - Public Health Ethics**

**Credits:** 3.00

This course examines selected ethical issues arising in public health policy and practice and ethical dilemmas faced by public health professionals, practitioners, and researchers. Students analyze competing personal, organizational and professional, and societal interests, values, and responsibilities. Case studies apply different models of ethical decision making and provide MPH students with an added opportunity to explore and clarify their values and those of their colleagues.

### **PHP 912 - Public Health Law**

**Credits:** 3.00

This course seeks to provide the legal basis for public health that is needed to effectively practice public health, especially with respect to understanding and enforcing compliance with public health regulations, and managing public health programs and organizations. The course introduces the core elements of law, legal practice and reasoning, and illustrates their application and use in public health.

### **PHP 914 - Public Health Policy Analysis**

**Credits:** 3.00

Analysis of the public policy outputs from the perspectives of effectiveness, efficiency, and equity by applying analytical tools to public health policies in the United States. This course begins by examining the major methods used to examine health policy outputs. The perspectives of effectiveness, efficiency and equity are used as a framework for the course. Students read and critique articles from health services research literature that use previously learned methodologies.

### **PHP 916 - Survey Research in Public Health**

**Credits:** 3.00

Introduction to the principles in design and use of health surveys through classroom instruction, exercises and projects. Topics include: survey types, question formation, validity of measures, sampling, response rates, confidentiality, data weighting, hypothesis testing, and other topics.

### **PHP 920 - Social Marketing**

**Credits:** 3.00

This course offers and introduces students to the vocabulary and tools of marketing public health programs and services. Expanding upon traditional principles of marketing and consumer behavior the student will be exposed to the theory, practice and challenges of marketing social change. The course also explores the current and emerging issues related to public health marketing.

### **PHP 922 - Public Health Economics**

**Credits:** 3.00

This course gives each student a hands-on opportunity to become familiar with a broad range of health economics issues and analyses. The objective is to help its graduates successfully compete for advancement in careers requiring knowledge of health policy analysis.

### **PHP 924 - Policy and Practice of Community Health Assessment**

**Credits:** 3.00

This course explores the process of community health assessment as a tool for bridging the gap between public health and the personal health care system. It provides an historical perspective of using population based measurements as a framework for health improvement initiatives. It examines several community health assessment methodologies including IOM, CIAP, PATCH, APEXAH, and VHA approaches and explores the complexity of developing a

community-based health assessment.

### **PHP 926 - Evaluation in Public Health**

**Credits:** 3.00

An introduction to program evaluation as it relates to public health practice and research, primarily in the United States. Public health-specific examples are presented throughout the course. Includes discussion of striking a balance between scientific rigor and the practicalities often faced by program evaluators.

### **PHP 930 - Climate Change and Health**

**Credits:** 3.00

An overview of the climate system including its physical and chemical compounds, the greenhouse effect, forcing agents and dynamics at global, regional and local scales. Human dimensions of climate change will be considered in light of data and models. An environmental epidemiology framework for analyzing the direct and indirect impacts of climate variability to public health as well as appropriate public policies, such as monitoring the greenhouse gas emission reductions will be developed.

### **PHP 932 - Disease Ecology**

**Credits:** 3.00

Students will have an understanding of the basic structure and dynamics of: climate system, ecological systems, social systems. Also gained will be the understanding of epidemiological significance of co evolutionary processes linking climate system with ecological and social systems that influence the interaction between human beings and disease agents and the understanding of the relational significance of assessment frameworks including ecosystem health, ecosystem services, environmental epidemiology, epidemiological environment.

### **PHP 934 - Work Environment Policy and the Health of Workers**

**Credits:** 3.00

Overview of occupational safety and health policy in the U.S. Focus on the legal context, especially on OSHA, and provides an analytical framework for examining the role of social, economic, and political factors in the recognition and control of occupational hazards. Some attention to the more technical aspects of this field (e.g., industrial hygiene, ergonomics, general health and safety); emphasis on understanding current occupational health and safety policies and controversies.

### **PHP 940 - Public Health Nursing I**

**Credits:** 3.00

In the context of history, standards, and research in the field of public health and the roles to be played by public health nursing in their situation. The framework is based on the first three stages used in the scope of practice: community assessment, diagnosis, and outcomes identification.

### **PHP 942 - Public Health Nursing II**

**Credits:** 3.00

Role and leadership: the remaining three stages of the scope of practice is used as the framework of this course: program planning, assurance, and evaluation. The function of policy development and leadership roles such as project management, case management, teaching and research are developed as means for operationalizing this practice. International implications for practice will be considered.

### **PHP 950 - Seminar in Epidemiologic Study Design**

**Credits:** 3.00

Seminar engages in in-depth exploration of key papers in epidemiologic methodology. Topics include linking causal theory with study design and prevention efforts, precision of exposure and disease management and effects estimation, internal and external validity, confounding, and methodological issues in cohort and case studies. Prereq: PHP 901, 903 or instructor permission.

### **PHP 985A - Special Topics in Policy and Management**

**Credits:** 1.00 to 3.00

Study of a special topic in Public Health Policy and Management. Prereq: permission.

**PHP 985B - Special Topics in Public Health Ecology**

**Credits:** 1.00 to 3.00

Study of a special topic in Public Health Ecology. Prereq: permission.

**PHP 985C - Special Topics in Public Health Nursing**

**Credits:** 1.00 to 3.00

Study of a special topic in Public Health Nursing. Prereq: permission.

**PHP 990 - Field Study**

**Credits:** 3.00

This course provides a semester long opportunity to apply core and concentration knowledge and skills to a particular area of public health under the direction of a faculty member and a community public health mentor. Permission required.

**PHP 995 - Independent Study**

**Credits:** 1.00 to 3.00

Directed readings and other activities to explore a specific topic related to public health. Permission required.

**PHP 998 - Integrating Seminar**

**Credits:** 3.00

This course provides the opportunity for students from various concentrations in public health to focus on a common public health problem from their individual and joint perspectives. This incorporates substantive, analytical, administrative, and policy perspectives. Students make a formal presentation of recommendations.

## Physics

### **PHYS 805 - Experimental Physics**

**Credits:** 4.00

Experiments in nuclear, solid-state, and surface physics. Includes discussion of laboratory techniques, data analysis, and data presentation. Special projects assigned to individual students.

### **PHYS 810 - Introduction to Astrophysics**

**Credits:** 4.00

Review of the sun, stars, Milky Way, external galaxies, and expansion of the universe. Recent discoveries of radio galaxies, quasi-stellar objects, cosmic black-body radiation, x rays, and gamma rays precede a discussion of Newtonian and general relativistic cosmological models, steady-state/big-bang theories, and matter-antimatter models. (Also offered as EOS 810.) (Alternate years only.)

### **PHYS 811 - Topics in Modern Physics**

**Credits:** 1.00 to 4.00

Discussions, lectures, and laboratory work on topics of current interest in physics. An introductory course for secondary school teachers and others with some science background.

### **PHYS 812 - Physics of the Ionosphere**

**Credits:** 4.00

Introduces basic plasma physics using a case study of the Earth's ionosphere and its connection both to the upper atmosphere and to the Earth's magnetosphere. Topics include single-particle motion, fluid and kinetic descriptions of ionospheric plasma, wave propagation, and instabilities. Prereq: electricity and magnetism I or equivalent; calculus II. (Also offered as EOS 812.)

### **PHYS 818 - Introduction to Solid-State Physics**

**Credits:** 4.00

Crystal structure, diffraction, lattice vibrations, electronic and optical properties of metals and semiconductors; selected topics in modern condensed matter physics. Prereq: introduction to quantum mechanics I, electricity and magnetism I or equivalent. (Normally offered every other year.)

### **PHYS 820 - Nuclear Physics**

**Credits:** 4.00

Nuclear phenomenology, reactions, models, radiation, interaction of radiation with matter; accelerators; properties and interactions of elementary particles; symmetries and symmetry breaking standard model. Prereq: introduction to quantum mechanics I and II; electricity and magnetism I and II; or permission of instructor.

### **PHYS 854 - Introduction to Scientific Computing**

**Credits:** 3.00

Introduction to the tools and methodology of scientific computing via the examination of interdisciplinary case studies from science and engineering. Emphasis on numerical approaches to solving linear systems, eigenvalue-eigenvector problems, and differential equations. Problems are solved on various hardware platforms using a combination of software and data visualization packages. Prereq: linear algebra; differential equations; introduction to programming;/ or permission. (Also offered as MATH 854; CS 854.) Lab.

### **PHYS 895 - Independent Study**

**Credits:** 1.00 to 8.00

Individual project under direction of a faculty adviser.

### **PHYS 899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Cr/F.

### **PHYS 901 - Physics Teaching Seminar**

**Credits:** 1.00

Course for new graduate students providing an introduction to their role as teaching assistants. Designed to raise awareness of professional responsibilities, to provide instruction on theory-based teaching and learning, and to provide opportunities for reflective practice. Cr/F.

### **PHYS 902 - Issues in Teaching and Learning Physics**

**Credits:** 1.00 to 3.00

Issues in teaching and learning physics including cognitive models of learning; assessment tools; meta-cognitive issues; role of mathematics; effectiveness of labs; issues in problem solving; misconceptions studies. Extensive reading, writing, discussion and reflection is required. May be repeated for a maximum of 3 credits.

### **PHYS 931 - Mathematical Physics**

**Credits:** 3.00

Complex variables, differential equations, asymptotic methods, integral transforms, special functions, linear vector spaces and matrices, Green's functions, and additional topics selected from integral equations, variational methods, numerical methods, tensor analysis, and group theory. (Also offered as MATH 931.)

### **PHYS 932 - Mathematical Physics**

**Credits:** 3.00

Complex variables, differential equations, asymptotic methods, integral transforms, special functions, linear vector spaces and matrices, Green's functions, and additional topics selected from integral equations, variational methods, numerical methods, tensor analysis, and group theory. (Also offered as MATH 932.)

### **PHYS 935 - Statistical Physics**

**Credits:** 3.00

Review of thermodynamics and kinetic theory, followed by an introduction to classical and quantum statistical mechanics. Microcanonical, canonical, and grand canonical ensembles; ideal Fermi and Bose gases and applications of statistical mechanics to selected physical problems. Prereq: PHYS 931; 939; 943.

### **PHYS 939 - Theoretical Mechanics I**

**Credits:** 3.00

Newtonian, Lagrangian, and Hamiltonian formulation of the classical mechanics of particles and rigid bodies; continuum mechanics. Topics that serve as background for the study of modern physical theories are emphasized.

### **PHYS 940 - Theoretical Mechanics II**

**Credits:** 3.00

See description for PHYS 939.

### **PHYS 941 - Electromagnetic Theory**

**Credits:** 3.00

The formulation and detailed application of electromagnetic theory to physical problems. The material covered is at the level of the text by J.D. Jackson, "Classical Electrodynamics".

### **PHYS 942 - Electromagnetic Theory**

**Credits:** 3.00

See description for PHYS 941.

### **PHYS 943 - Quantum Mechanics**

**Credits:** 3.00

Introduces nonrelativistic quantum theory, covering wave mechanics, Dirac notation, angular momentum, the use of perturbation theory to calculate atomic energy levels, the interaction of atoms with radiation, and various approaches to

calculating the differential scattering cross-section.

### **PHYS 944 - Quantum Mechanics**

**Credits:** 3.00

See description for PHYS 943.

### **PHYS 951 - Plasma Physics I**

**Credits:** 3.00

Kinetic theory of plasmas; plasma waves, instabilities, turbulence, diffusion, adiabatic motion of charged particles, nonlinear plasma phenomena. Prereq: PHYS 935; 941; 941. (Normally offered every other year.)

### **PHYS 952 - Plasma Physics II**

**Credits:** 3.00

See description for PHYS 951.

### **PHYS 953 - Solar Magnetohydrodynamics**

**Credits:** 3.00

Introduction to solar physics, with emphasis on gas dynamics and magnetic fields. Interior structure, the theory of convection, wave motions in the presence of magnetism and gravity, coronal heating theories, steady and nonsteady flows, dynamo theory, and the theory of solar flares and other transient phenomena. Salient observational data are reviewed. (Normally offered every other year.)

### **PHYS 954 - Solar Wind and Cosmic Rays**

**Credits:** 3.00

The solar wind and its effects on cosmic rays. The basic equations of the solar wind: mass, momentum, angular momentum, and energy balance. Transport processes. Waves, shocks, and instabilities in the solar wind. The basic equations of energetic particle transport. Solar modulation of solar and galactic cosmic rays. Interaction of energetic particles with shock waves. Salient data are reviewed. (Normally offered every other year.) Also offered as EOS 954.

### **PHYS 955 - Geophysical and Astrophysical Fluid Dynamics**

**Credits:** 3.00

Applies principles of fluid dynamics and magnetohydrodynamics to the Earth's atmosphere and oceans and to space plasmas. Emphasizes common problems and techniques. Topics include mass, momentum, energy conservation; static equilibriums; quasigeostrophic flow; waves (acoustic-gravity, planetary, magnetoacoustic); surface waves in the ocean and in space; instabilities (convection, baroclinic Rayleigh-Taylor, Kelvin Helmholtz); boundary layer problems (Ekman layers, Stewartson layers, tearing modes; resonance absorption); supersonic flows (the solar wind, shock waves). Prereq: MATH 845 and 846, or PHYS 931. (Also offered as EOS 955.) (Normally offered every other year.)

### **PHYS 961 - Advanced Quantum Mechanics**

**Credits:** 3.00

Relativistic wave equations, propagator theory and Feynman diagrams, quantum theory of radiation, second quantization, introduction to quantum field theory and related topics. Prereq: PHYS 939; 944. (Normally offered every other year.)

### **PHYS 962 - Advanced Quantum Mechanics II**

**Credits:** 3.00

See description for PHYS 961.

### **PHYS #963 - Nuclear Physics**

**Credits:** 3.00

Introduction to nuclear processes including nuclear forces, nuclear structure and models, static properties, beta and gamma emission, and nuclear reactions. Selected topics in experimental methods. Prereq: PHYS 944. (Normally offered every other year.)

### **PHYS #964 - Nuclear Physics**

**Credits:** 3.00

See description for PHYS 963.

**PHYS 965 - Advanced Solid-State Physics**

**Credits:** 3.00

Theory of crystalline metals, semiconductors, and insulators. Selected topics from the following: surfaces, films, quantum dots, clusters, solid-state devices. Prereq: PHYS 935; 941; 943. (Normally offered every other year.)

**PHYS #969 - Nuclear Physics Seminar**

**Credits:** 1.00 to 3.00

Lectures and discussions of current topics in nuclear and particle physics. (Not offered every year.)

**PHYS #978 - Condensed Matter Physics Seminar**

**Credits:** 1.00 to 3.00

Lectures and discussions of current topics in condensed matter physics. May be repeated.

**PHYS 987 - Magnetospheres**

**Credits:** 3.00

Introduces plasma of physics of the interaction of solar and stellar winds with planets having internal magnetic fields, most predominately, the Earth. Both MHD and kinetic descriptions of internal and boundary processes of magnetospheres as well as treatment of the interaction with collisional ionospheres. Flow of mass, momentum, and energy, through such systems. Prereq: PHYS 951; 952;/or permission. (Also offered as EOS 987.) (Normally offered every other year.)

**PHYS 988 - High Energy Astrophysics**

**Credits:** 3.00

One-semester course on the physical principles underpinning the field of high energy astrophysics. Subjects covered include production, detection, and transport processes of neutral and charged high energy particles and photons. Emphasizes the applications of these processes to the detection and measurement problem and theory of telescope design. Uses astrophysical examples to illustrate the subject matter. First part serves as a basis for discussing the astrophysics of the heliosphere, including solar flares, galactic and solar cosmic rays, and the influence of the Earth's magnetic field on the cosmic rays. Prereq: PHYS 941; 942; 944. (Also offered as EOS 988.) (Normally offered every other year.)

**PHYS #989 - Space Physics Seminar**

**Credits:** 1.00 to 3.00

Lectures and discussions of current research in the physics of fields and particles in space. May be repeated to 6 credits. (Not offered every year.)

**PHYS 995 - Special Topics**

**Credits:** 1.00 to 3.00

Any special fields of study not covered by the above courses may be included. Topic choices in previous years: astrophysics; elementary particles; lasers/masers; many-body theory; general relativity and cosmology; group theory; atomic physics; quantum theory of light; nonlinear equations, and chaos. May be taken more than once. (Not offered every year.)

**PHYS 999 - Doctoral Research**

**Credits:**

Cr/F.

## Political Science

### **POLT 801 - Courts and Public Policy**

**Credits:** 4.00

Impact of judicial decisions on public policy and influences on judicial decision making at the federal, state, and local levels.

### **POLT 802 - Public Planning and Budgeting**

**Credits:** 4.00

Analysis, goal setting, and strategic planning in a governmental setting, with particular emphasis on budgetary processes as a means for controlling policy effectiveness.

### **POLT 803 - Urban and Metropolitan Politics**

**Credits:** 4.00

An eclectic approach to the study of urban and metropolitan politics. Topics include: urban politics, forms of local government; migrations, urban development, intergovernmental relations; community power structure, urban policy making, urban service delivery, crime and law enforcement, urban bureaucracy, urban decay, and revitalization.

### **POLT 804 - Policy and Program Evaluation**

**Credits:** 4.00

Policy and program evaluation of federal, state, and local governmental enterprise; focuses on the politics, practices, and methods of evaluative investigation. Evaluation as a technique for providing rational information for budgetary and policy-making decisions.

### **POLT 805 - American Public Policy**

**Credits:** 4.00

Examination of public policy formation, agenda-setting, decision-making, implementation. Focuses on theories, models, concepts, actors, and case study examples.

### **POLT 807 - Criminal Justice Administration**

**Credits:** 4.00

Examines the administration and politics of police organizations, the courts, and correctional institutions.

### **POLT 808 - Administrative Law**

**Credits:** 4.00

Examines the legal rules governing regulatory agencies, in the U.S. Topics include regulatory adjudication and rulemaking, legislative and executive control over administrative agencies, judicial review and public participation. Course examines federal and state levels of government.

### **POLT 810 - Public Human Resource Management**

**Credits:** 4.00

Examination of the administration, politics, and strategies of effective public human resource management.

### **POLT 821 - Feminist Political Theory**

**Credits:** 4.00

Exploration of various strands of feminist political theory; taking a specifically political view of the challenges of feminist activism and philosophy. Issues of public space, power, social transformation and democracy addressed.

### **POLT 843 - Comparative Political Economy**

**Credits:** 4.00

Exploration of the origins, development, and functions of the modern state in the West, its links with markets and

capitalism, and its role in contemporary political economy. Examples from various advanced industrial societies.

**POLT 860 - Theories of International Relations**

**Credits:** 4.00

Theoretical approaches of international politics, international organization, and international political economy with particular emphasis on systems theories, domestic determinants of foreign policy, and theories of decision making.

**POLT 862 - International Political Economy**

**Credits:** 4.00

Evolution of international economic regimes (monetary, trade, development). Particular emphasis on theoretical approaches to explain current economic problems: systematic theories (interdependence, hegemonic stability); domestic determinants (bureaucratic, interest group); and decision making theories (rational choice).

**POLT 878 - International Organization**

**Credits:** 4.00

Various forms of cooperation among nations on security, economic, environmental and social issues through international organizations such as the United Nations, NATO, the World Trade Organization and other global and regional bodies. Includes examination of the role and influence of non-governmental international organizations.

**POLT 880 - International Environmental Politics, Policy and Law**

**Credits:** 4.00

Explores international/global environmental politics and policymaking, multilateral negotiations, the role of science and technology in policymaking, state capacity, the making of international law, implementation, and compliance. Other issues include climate control, marine pollution, long-range air pollution, United States leadership in the global political arena, North-South divisions in global politics, environmental justice, sustainable development, and the role of the United Nations and other international organizations.

**POLT 897B - Seminar in American Politics**

**Credits:** 4.00

Advanced analysis and individual research.

**POLT 897C - Seminar in Comparative Politics**

**Credits:** 4.00

Advanced analysis focusing on government and politics in foreign nations or regions. Areas of interest may include: constitutional structures, political parties and interest groups, legislatures, bureaucracy and public policy. Topics address such concerns as: religion and politics, patterns of economic development, ethnic strife, political leadership.

**POLT 897E - Seminar in International Politics**

**Credits:** 4.00

Advanced analysis focusing on problems of theory and contemporary issues in international politics. Areas of interest may include: democratic norms in international relations; NATO expansion and European security; the peace process in the Middle East, etc. See department listings for semester offerings.

**POLT 897F - Seminar in Public Administration**

**Credits:** 4.00

Advanced analysis and individual research, including opportunities for direct observation of governmental administration.

**POLT 897I - Seminar in Political Thought**

**Credits:** 4.00

Advanced treatment and individual research.

**POLT 898B - Seminar in American Politics**

**Credits:** 4.00

Advanced analysis and individual research.

**POLT 898C - Seminar in Comparative Politics**

**Credits:** 4.00

See description for POLT 897C.

**POLT #898E - Seminar in International Politics**

**Credits:** 4.00

See description for POLT 897E.

**POLT 898F - Seminar in Public Administration**

**Credits:** 4.00

Advanced analysis and individual research, including opportunities for direct observation of governmental administration.

**POLT 898I - Seminar in Political Thought**

**Credits:** 4.00

Advanced treatment and individual research.

**POLT 899 - Master's Thesis**

**Credits:** 4.00 or 8.00

Each student carries out original research that culminates in a master's thesis. Must be taken 4 credits per semester in each of two semesters or 8 credits in one semester. Required. Cr/F.

**POLT 905 - Methods of Policy Analysis**

**Credits:** 4.00

Research design, survey methods, experimental techniques, and aggregate data analysis applied to public policy settings.

**POLT 906 - Theories and Processes of Public Administration**

**Credits:** 4.00

Theories of organization and bureaucracy, the implications of bureaucratization, and the major processes of public administration including budgeting, personnel, policy making, as well as attention to contemporary policy issues including collective bargaining, affirmative action, citizen participation.

**POLT 907 - Cases in Public Management**

**Credits:** 4.00

Policy case studies emphasizing politics, organizational structure, and inter-organizational behavior; management case studies emphasizing behavior, human relations, personality, and intraorganizational dynamics; and simulation and role-playing exercises.

**POLT 970 - Administrative Internship**

**Credits:** 4.00

Practical administrative experience in an area of professional interest. Prereq: M.P.A. candidate.

**POLT 995 - Reading and Research**

**Credits:** 1.00 to 4.00

A) American Politics; B) Comparative Politics; C) International Politics; D) Political Thought; E) Public Administration; F) Public Policy. The graduate student engages in independent study under the direction of one of the members of the department. Requires approval of the graduate committee. MPA candidates who have been exempted from the administrative internship are required to complete a 4 credit independent research project in lieu of POLT 970.

**POLT 996 - Reading and Research**

**Credits:** 1.00 to 4.00

See description for POLT 995.



## Psychology

### **PSYC 894 - Advanced Research**

**Credits:** 4.00 or 8.00

Student designs and conducts original research that culminates in a paper of publishable quality. Completion of either this course or PSYC 899 satisfies the department's research requirement for the master's degree. May be taken for 4 credits per semester in each of two semesters or 8 credits in one semester. Maximum of 8 credits. Cr/F.

### **PSYC 899 - Master's Thesis**

**Credits:** 4.00 or 8.00

four credits per semester in each of two semesters or 8 credits in one semester. Maximum of 8 credits. Cr/F.

### **PSYC 901 - Graduate Proseminar**

**Credits:**  
Students and graduate faculty in psychology meet periodically for a mutual exchange on current issues in psychology. Cr/F.

### **PSYC 902 - Graduate Proseminar**

**Credits:**  
See description for PSYC 901. Cr/F.

### **PSYC 905 - Research Methodology and Statistics I**

**Credits:** 4.00

A consideration of research techniques and problems of methodology in psychology. The first semester stresses the principles of statistical inference, correlational approaches, and their interrelatedness in design. Topics considered include probability theory, linear regression, function-free prediction, the theory underlying statistical inference, parametric and nonparametric tests of significance, and principles of analysis of variance. The second semester extends correlational approach to the techniques and methodology of multiple regression and considers the appropriate use and theoretical bases of complex designs. Prereq: undergraduate statistics and experimental psychology.

### **PSYC 906 - Research Methodology and Statistics II**

**Credits:** 4.00

See description for PSYC 905.

### **PSYC 907 - Research Methods and Statistics III**

**Credits:** 4.00

The application of multivariate methods of data analysis in psychological research: multiple regression, analysis of covariance, Hotelling's T<sup>2</sup> multivariate analysis of variance, path analysis, discriminant functions, canonical correlation, factor analysis.

### **PSYC #909 - Advanced Seminar in Quantitative and Analytic Methods**

**Credits:** 4.00

Advanced treatment of methodological topics of current interest. Content varies: representative topics include field research, surveys, time series, causal analyses, log-linear models, formal and mathematical models, and computer simulation. May be repeated for credit.

### **PSYC 914 - Advanced Seminar in Cognition**

**Credits:** 4.00

An in-depth examination of one or more specific topics in cognition including issues in memory, attention, the use and development of language, and cognitive science. May be repeated for credit.

**PSYC 917 - Advanced Seminar in Sensory and Perceptual Processes**

**Credits:** 4.00

Comprehensive examination of a specific topic in sensory and perceptual processes. May be repeated for credit.

**PSYC 933 - Advanced Seminar in Physiological Psychology**

**Credits:** 4.00

In-depth examination of a specific topic in the neurosciences. Topics vary depending on interests of instructor and students. May be repeated for credit.

**PSYC 945 - Advanced Seminar in Behavioral Analysis**

**Credits:** 4.00

Current empirical and theoretical issues in the analysis of behavior. May be repeated for credit.

**PSYC 954 - Advanced Seminar in Social Psychology**

**Credits:** 4.00

Intensive coverage of the experimental and theoretical literature in a selected area of basic or applied social psychology. Students participate directly in the conduct of the seminar by means of individual topical discussions, development and/or execution of research designs, and critical assessment of the current state of the topic area under discussion. Illustrative topics: political behavior, paralinguistics and non-verbal communication, ethnic and racial prejudice, and environmental psychology. May be repeated for credit.

**PSYC 974 - Advanced Seminar in the History and Theory of Psychology**

**Credits:** 4.00

In-depth examination of a specific topic in the history and/or theory of psychology. Topics vary each time the seminar is offered. May be repeated for credit.

**PSYC 982 - Advanced Seminar in Developmental Psychology**

**Credits:** 4.00

In-depth analysis of one or several specific topics or issues in developmental psychology. May be repeated for credit.

**PSYC 991 - Practicum and Seminar in the Teaching of Psychology**

**Credits:** 6.00

Practicum offers the student an opportunity to teach introductory psychology under close supervision from the staff. The seminar is coordinated with this experience and focuses on both practical and theoretical issues of significance in the teaching/learning process at the college level.

**PSYC 992 - Practicum and Seminar in the Teaching of Psychology**

**Credits:** 6.00

See description for PSYC 991.

**PSYC 995 - Reading and Research**

**Credits:** 1.00 to 4.00

A) Cognition/Psycholinguistics; B) Developmental Psychology; C) History and Theory of Psychology; D) Learning and Behavior Analysis; E) Personality/Psychopathology; F) Physiological Psychology; G) Sensation/Perception; H) Social Psychology; I) Statistics/Methodology. As part of the development as an independent scholar, the student is encouraged to plan (1) broad reading in an area; (2) intensive investigation of a special problem; or (3) experimental testing of a particular question. Requires approval of both adviser and faculty member directing project. May be repeated for credit.

**PSYC 998 - Problems and Issues**

**Credits:** 4.00

Seminar on a problem that has been the subject of specialized research and study by a member of the faculty. Topic and instructor vary. May be repeated for credit.

**PSYC 999 - Doctoral Research**

**Credits:**  
Cr/F.

## Resource Administration & Mgt

### **RAM 805 - Ecotourism: Managing for the Environment**

**Credits:** 4.00

Ecotourism by definition embraces both the environment and economics. A comprehensive framework for planning and managing ecotourism in order to both maximize the potential benefits and minimize the potential costs for people and the environment. Conducted in a seminar format, case studies used to assess the role of ecotourism in the sustainable development of natural resources. Prereq: introduction to tourism. (Also offered as TOUR 705.)

### **RAM 841 - Critical Issues in Solid Waste Management**

**Credits:** 2.00

Overview of the basic issues in managing society's waste, focusing on municipal solid waste and sewage sludge or "biosolids". Issues such as recycling, source reduction, composting, incineration, land spreading, and land filling examined in detail from the perspectives of different disciplines. Five basic modules: agronomy, economics, engineering and hydrology, planning and policy, and social/cultural/ethical issues. Guest speakers from state government and legislature, private sector firms, and nonprofit and environmental groups. Field trips to waste management sites, e.g., landfills, recycling centers, and composting operations. Prereq: environmental and resource economics perspectives or equivalent, principles of biology I or equivalent or permission. (Also offered as CD 741.)

### **RAM 867 - Social Impact Assessment**

**Credits:** 4.00

A cross-disciplinary perspective on the issues, problems, and methods of Social Impact Assessment (SIA). The analytic approach and theoretical framework provided applied to the assessment of very diverse events--changes in the natural environment, local economy, or dominant technology. SIA is required of most U.S. and Canadian federal and state sponsored projects that come under the National Environmental Protection Act, to include tourism, park and recreation development, highways, reservoirs, timber production, hazardous waste disposal, as well as policy issues. SIA is also required for all projects funded by international donor agencies such as USIA, the World Bank, and private international development agencies.

### **RAM 877 - Topics in Community Planning**

**Credits:** 4.00

Advanced treatment of the concepts and tools required for effective local and regional planning to guide land use, capital investment in infrastructure, and organization for service delivery. Prereq: CD 614 or permission. (Also offered as CD 777.) (Offered every other year.)

### **RAM 896 - Investigations**

**Credits:** 2.00 to 4.00

A) Resource Administration; B) Resource Management; C) Resource Policy; D) Public Laws and Resources. Prereq: permission. May be repeated.

### **RAM 898 - Directed Research**

**Credits:** 4.00 to 6.00

Hours and credits to be arranged. Not available if credit obtained for RAM 899. A year-long course; an IA grade (continuous course) given at the end of the first semester. Prereq: permission. Cr/F.

### **RAM 899 - Master's Thesis**

**Credits:** 1.00 to 10.00

Cr/F.

### **RAM 900 - Resource Administration and Management Internship**

**Credits:** 4.00

Practical administrative and management experience in an area of professional interest. Open only to graduate students in the RAM program. Cr/F.

**RAM #903 - Approach to Research**

**Credits:** 2.00

The meaning of science and the application of logic in the scientific method. Principles and techniques of scientific research. Survey of environmental design procedures. Organization of investigative work, problem analyses, working plans, and scientific writing. Prereq: permission. (Also offered as RECO 903.)

**RAM 911 - Natural and Environmental Resource Management**

**Credits:** 4.00

Fundamental economic, aesthetic, and ethical principles involved in the management of natural resources. Ways to apply these principles in the formulation and evaluation of resource management policies, including the management of specific renewable resources, soils, water, forests, and wildlife. Prereq: permission. (Also offered as RECO 911.) (Offered every other year.)

**RAM #912 - Administrative Principles and Practices for Resource Systems**

**Credits:** 4.00

An overview of the traditional concepts of administrative philosophy and theory, including emerging concepts in chaos theory and other administrative approaches. Demonstrates how administrators in resource agencies can apply these concepts to create a new vision of organizational change. Traditional and innovative management techniques are presented relative to shaping organizational cultures, flattening hierarchies, and reengineering work and evaluates their capacity to allow organizational systems to respond to change in agencies responsible for natural resource policy implementation. Prereq: permission.

**RAM 993 - Natural and Environmental Resources Seminar**

**Credits:** 1.00

Presentation and discussion of recent research, literature, and policy problems in the natural and social sciences influencing resource use. (Also offered as RECO 993.) Cr/F.

## Resource Economics

### **RECO 800 - Marketing Communications Research: Methodological Foundations**

**Credits:** 4.00

Concepts, tools, and techniques to facilitate accurate product, service, and idea marketing communications. Specific applications to tourism and economic/community development initiatives are included. Prereq: Basic statistics course; or permission.

### **RECO 808 - Environmental Economics**

**Credits:** 4.00

Environmental pollution, the market economy, and optimal resource allocation; alternative control procedures; levels of environmental protection and public policy; property right issues. Prereq: intermediate microeconomic theory; permission.

### **RECO 815 - Linear Programming and Quantitative Models**

**Credits:** 4.00

Solving applied economic problems using linear and nonlinear techniques with emphasis on problem specification and interpretation of model results. The unit of analysis includes individuals, firms, or communities as they address contemporary problems in resource allocation, product distribution, and whole-firm organization. Computer applications on both mainframe and personal computers used for managerial decision making. Prereq: permission.

### **RECO 856 - Rural and Regional Economic Development**

**Credits:** 4.00

Concepts and methods of delineating regional economies, methods of measuring activity, regional development, and public policies. Emphasis on empirical research studies. Prereq: intermediate economy theory or permission. (Offered every other year.)

### **RECO 895 - Investigations**

**Credits:** 2.00 to 4.00

A) Agricultural Marketing; B) Agricultural Production and Farm Management; C) Community Development; D) Economics of Human Resources; E) Economics of Population and Food; F) Land Economics; G) Marine Economics; H) Rural Economic Development; I) Regional Economics; J) Water Economics. Special assignments in readings, investigations, or field problems. Prereq: permission. May be repeated.

### **RECO 898 - Directed Research**

**Credits:** 4.00 to 6.00

Hours and credits to be arranged. Not available if credit obtained for RECO 899. A year-long course; an IA grade (continuous grading) given at the end of the first semester. Prereq: permission. Cr/F.

### **RECO 899 - Master's Thesis**

**Credits:** 1.00 to 10.00

Cr/F.

### **RECO #903 - Approach to Research**

**Credits:** 2.00

The meaning of science and the application of logic in the scientific method. Principles and techniques of scientific research. Survey of experimental design procedures. Organization of investigative work, problem analyses, working plans, and scientific writing. Prereq: permission. (Also offered as RAM 903.)

### **RECO 911 - Natural and Environmental Resource Management**

**Credits:** 4.00

Fundamental economic, aesthetic, and ethical principles involved in the management of natural resources and ways to apply these principles in the formulation and evaluation of resource-management policies including the management of specific renewable resources, soils, water, forests, and wildlife. (Also offered as RAM 911.) Prereq: permission. (Offered every other year.)

**RECO 993 - Natural and Environmental Resources Seminar**

**Credits:** 1.00

Presentation and discussion of recent research, literature, and policy problems in the natural and social sciences influencing resource use. (Also offered as RAM 993.) Cr/F.

## Recreation Management & Policy

### **RMP 800 - Concepts of Recreation and Leisure**

**Credits:** 3.00

An overview of historical and philosophical perspectives of the play, recreation, therapeutic recreation, and park and natural resource conservation movements. Students examine recreation leisure and recreation resources in contemporary society, particularly in the context of the development of social capital. Includes leisure values and ideals, the emergence and evolution of "free time" diversity, and public policy implications. Prereq: permission.

### **RMP 805 - Management and Policy in Therapeutic Recreation**

**Credits:** 3.00

Students acquire knowledge of current principles and procedures for assuming an administrative role in the therapeutic recreation profession. Includes issues and practices related to supervision, reimbursement, quality improvement programs, consultation, marketing, and more. Prereq: permission.

### **RMP 806 - Recreation Administration and Organizational Behavior**

**Credits:** 3.00

The organization and administration of public, private, and not-for-profit recreation agencies. The primary unit of analysis in this class is the recreation organization and the environment in which it operates. Emphasis is placed on organization, management, marketing, and financing applications, theories, and research. Prereq: RMP 800, permission.

### **RMP 811 - Recreation Resource Management**

**Credits:** 3.00

An examination of the supply and demand of natural resources for outdoor recreation uses, with emphasis on relationships between public and private roles and responsibilities. Historical, social, and environmental impacts of outdoor recreation use are discussed. Current principles and techniques of recreation resource planning and management are outlined. Prereq: permission.

### **RMP 830 - Camp Administration and Leadership**

**Credits:** 3.00

Provides students with an understanding of administrative and organizational practices in structured camp settings. The theory, practice, and challenges of program planning for youth and adult development within the recreation context of camping. Explores current sociological, environmental, economical and legislative trends influencing contemporary camp management. Prereq: permission.

### **RMP 860 - Community Sport Organizations: Administration and Development**

**Credits:** 3.00

The administration and development of participant-based community sport organizations and resources. Emphasizes the administrative and programming competencies necessary to effectively manage these resources. A focus on problems and the development of research-oriented solutions related to the management of community sport organizations is emphasized. Prereq: RMP 800, 805 or 806 or permission.

### **RMP 870 - Management and Design of Recreation and Park Facilities**

**Credits:** 3.00

Provides students with an orientation to the theories, design, operation, and functions of recreational facilities. Topics include facility development, operational considerations, and auxiliary functions that impact the manager's role. Students gain insight into key areas of facility management through visitations to actual facilities. Prereq: RMP 800, 805 or 806; permission. Special fee.

### **RMP 872 - Law and Public Policy in Leisure Services**

**Credits: 3.00**

Topics including an overview of the nature of law and U.S. legal systems; the law of torts, contracts, civil liberties and rights; risk management and legal research are addressed in the context of recreation services and resources. Public policy and professional advocacy implications are examined as related to legislative and decisional systems. Prereq: RMP 800 and permission.

**RMP 897 - Master's Project****Credits: 3.00**

Prereq: RMP 800, 805 or 806. Permission required.

**RMP 899 - Master's Thesis****Credits: 3.00**

Prereq: RMP 800, 805 or 806, A graduate level statistics and graduate level methods course. Permission required. Cr/F.

**RMP 910 - Conceptual Issues and Trends in Therapeutic Recreation****Credits: 3.00**

An analysis and exploration of contemporary professional issues in the field of therapeutic recreation, including: philosophical foundations, credentialing, legislation, professional development, reimbursement, performance improvement, and documentation. Historical and cultural contexts of each issue are discussed and translated into practical applications for therapeutic recreation professionals. Prereq: RMP 800, permission.

**RMP 912 - Non-Profit Administration and Leadership****Credits: 3.00**

An overview of the creation, management, and administration of non-profit organizations and businesses. Examines legal requirements for charter and incorporation by state law and Federal guidelines from the Internal Revenue Service. Current trends and issues in non-profit sector business are explored and a survey of the wide diversity of non-profit sector organizations is included. Since a high percentage of recreation agencies are incorporated as non-profit organizations, specific applications are made to the field of leisure and recreation. Prereq: RMP 800, 805 or 806 or permission.

**RMP 924 - Grantwriting and Fund Development****Credits: 3.00**

Students develop an understanding of the meaning of philanthropy, its importance in society, and its integral relationship to the fund development process. The social context for philanthropy, development, and fund raising and the changing practices for non-profit leadership are addressed. Presents and evaluates strategies and communication tools used to support fund development goals. Students develop abilities in grantwriting, requesting major donor support, structuring annual giving campaigns, and establishing special events. Prereq: RMP 800 or permission.

**RMP 964 - Graduate Internship****Credits: 3.00**

Supervised, professional administrative work experience in an approved recreation, park, tourism, or health care agency. Students participate in a 14-week 560-hour internship experience after receiving approval from their academic adviser and the internship coordinator. Prereq: RMP 800, 805 or 806, permission. Cr/F.

**RMP 970 - Teaching Practicum****Credits: 3.00**

Students work with a faculty mentor to investigate, observe, and practice teaching methods and learning theory. Includes the various instructional technologies as tools to enhance the teaching/learning process. The Teaching Practicum is designed for students who wish to assume part-time or adjunct University teaching positions upon completion of the Master's degree or who see themselves pursuing a future doctoral degree with higher education as a career goal. Prereq: RMP 800 and permission. Cr/F.

**RMP 980 - Independent Study****Credits: 3.00**

Prereq: RMP 800 and 805 or 806, permission.

**RMP 995 - Colloquium Seminar**

**Credits:** 3.00

As a capstone course for the M.S. Degree in Recreation Management and Policy, this course is designed to invite students to bring content and ideas formed in previous coursework and experience to the consideration of opportunities and challenges in future professional practice. Central themes include ethical problem solving and issues and trends within the profession. Approaches to ethical inquiry, analysis of evidence and advocacy methodologies are addressed in the context of forming and articulating professional positions. The course is conducted as a colloquium with all participants contributing to the learning process. Prereq: RMP 800, 805 or 806, and permission.

## Sociology

### **SOC 815 - Criminological Theory**

**Credits:** 4.00

Introduces graduate students and advanced undergraduates to the major theoretical literature in crime and delinquency. Covers both classical and contemporary theory, with empirical assessments of theories, including macro- and micro-level control, strain, and learning theories as well as recent developments in biosocial, deterrence, labeling, and critical/feminist theories.

### **SOC 820 - Sociology of Drug Use**

**Credits:** 4.00

Examines licit and illicit drug use from a sociological perspective. Draws primarily from the sociology of mental health and criminology to explore a variety of drug-related topics including: historical and current U.S. drug trends, dominant theoretical approaches about the initiation into, and continued use of drugs, drug-related crime, therapeutic use of drugs, prevention and treatment of drug problems, and drug-related policies.

### **SOC #835 - Complex Organizations**

**Credits:** 4.00

Comparative study of the structure and dynamics of complex, formal organizations (business, military, political and governmental, educational, medical). Power and social control in formal systems; organizational processes, performances, and effectiveness; effect of complex, formal organizations on persons and societies.

### **SOC 840 - Sociology of Mental Health**

**Credits:** 4.00

Introduces students to different sociological approaches for studying and understanding mental health and illness. Students examine the social distribution of mental illness in the United State and the social-structural factors that help to explain mental health variations. Also addresses issues surrounding mental health treatment, systems, and policies for the mentally ill.

### **SOC 845 - Race, Ethnicity, and Inequality**

**Credits:** 4.00

Sociological perspectives on race and ethnic relations for graduate and advanced undergraduate students. Topics include the creation of racial and ethnic identities; the nature and extent of segregation; education, employment, and wealth inequalities; and the effects of state policy. Course emphasizes both theoretical and empirical assessments.

### **SOC 860 - Aging and Late Life Family**

**Credits:** 4.00

Using a life-course perspective, this course focuses on family relationships and social role transitions in later life. Addresses impact of the empty nest stage, grandparenthood, retirement, care giving, and widowhood on the well-being and relationships of older people.

### **SOC 873 - Sociology of Childhood**

**Credits:** 4.00

This course will expose students to a variety of sociological perspectives on childhood in American society. Focus will be on the analysis of how social institutions, like the modern American family, school, economic system, justice system and communications media affect children. Assumes a prior understanding of important sociological concepts, critical thinking skills and social science writing ability.

### **SOC 880 - Social Conflict**

**Credits:** 4.00

Analysis of the social conditions associated with the major forms of conflict management in human societies:

discipline, rebellion, vengeance, negotiation, mediation, law, therapy, supernaturalism, and avoidance.

### **SOC #890 - Applied Sociology**

**Credits:** 4.00

(1) Current level of use of sociological knowledge; (2) the advocate, consultant, and researcher roles in applied settings; (3) techniques of applied research; (4) implications of applied sociology, including ethical problems. Each student focuses on a social problem and writes a paper covering the above issues. Applied projects where possible. Prereq: methods of social research.

### **SOC #892 - Research Internship**

**Credits:** 4.00

For students who want practical experience applying social research methods in a program or policy setting. Placements, arranged jointly by student and faculty and faculty member, include community development agencies, social service agencies, non-profits, research centers, and companies. Students meet bi-weekly to discuss their internship experiences. A major report on the research undertaken is required. Prereq: Sociological Methods I: Intermediate Social Statistics, Sociological Methods II: Research Design and permission.

### **SOC 894 - Evaluation of Social Programs**

**Credits:** 4.00

Evaluation research defined: purposes of evaluation; design of evaluation studies; setting of programs; utilization of evaluation results. Examination of case studies of evaluations of social programs. Students are responsible for designing an evaluation study in their chosen substantive area. Prereq: methods of social research.

### **SOC 897 - Special Topics**

**Credits:** 4.00

Occasional or experimental offerings. May be repeated for different topics.

### **SOC 899 - Master's Thesis**

**Credits:** 1.00 to 10.00

Usually 6 credits but up to 10 credits when the problem warrants. Cr/F.

### **SOC 900 - Proseminar**

**Credits:** 2.00

An introduction to the discipline of sociology and to the graduate program. Topics include writing for professional audiences, publishing, applying for support, TA workshop, writing a thesis or dissertation. Meetings with faculty members throughout the semester. Cr/F.

### **SOC 901 - Sociological Methods I: Intermediate Social Statistics**

**Credits:** 4.00

Application of statistical methods to the analysis of social data, with particular emphasis on multiple regression and related topics.

### **SOC 902 - Sociological Methods II: Research Design**

**Credits:** 4.00

Systematic investigation of each step in the design and implementation of sociological research. Selected techniques of data collection and analyses are pursued. Prereq: methods of social research; social statistics;/or their equivalents or permission.

### **SOC 903 - Sociological Methods III: Advanced Social Statistics**

**Credits:** 4.00

Multivariate statistical methods for the analysis of social data. Topics include problem-solving with multiple regression, categorical-variable models, dynamic models, and others.

### **SOC 904 - Sociological Methods IV: Qualitative and Historical Research Methods**

**Credits:** 4.00

An introduction to qualitative and historical methods of data gathering and analysis in the social sciences. The seminar is intended as an intensive workshop training in such techniques as participant observation, in-depth interviewing, content analysis, and archival exploration. Students conduct qualitative and/or historical research and are responsible for designing an individual project, collecting and analyzing appropriate data, and writing a research paper.

### **SOC 911 - Sociological Theory I**

**Credits:** 4.00

The content, presuppositions, and implications of the body of sociological theory, exemplifying the full range of sociological inquiry.

### **SOC 912 - Sociological Theory II**

**Credits:** 4.00

The content, presuppositions, and implications of contemporary sociological theory. Students engage in theory construction and analysis and in this endeavor are encouraged to develop their particular interests in substantive areas. Prereq: SOC 911.

### **SOC 921 - Crime and Conflict**

**Credits:** 4.00

Serves as the core course for the Crime and Conflict concentration. Theories and patterns of crime; the social origins of violent and nonviolent conflict; the role of social factors in the justice system; alternative forms of crime control and conflict management.

### **SOC #942 - Sociology and Social Policy**

**Credits:** 4.00

Social policy and public policy defined: description of the policy making process. The political sociology of the policy-making process; who makes policy and who influences policy, under what conditions, and with what effect. Definition of social policy research and the various roles social scientist can adopt for policy-relevant work. Students are responsible for critiquing the readings and for preparing a substantial research paper.

### **SOC #954 - Sociology of Religion**

**Credits:** 4.00

The reciprocal relationship of religion and culture; the function of religion in society; the contributions of sociological research; the relationship between religion and other social institutions; religion and social change; the problem of church and state.

### **SOC #970 - Social Stress and Health**

**Credits:** 4.00

Focuses on social stress processes and their relation to physical and mental health. Sources, moderators, and outcomes of stress are examined within various social-structural contexts. Specific topics include the measurement and conceptualization of stress, social support and coping practices, self concept, and the role of gender, race, and social class in the stress process.

### **SOC 975 - Sociology of the Family**

**Credits:** 4.00

Major approaches in the sociological study of families. Individuals in families, family relationships, and families as groups and the interrelationships among these levels. Interactional and systemic properties of marriage, parent-child relations, and extended family relations.

### **SOC 976 - Violence in the Family**

**Credits:** 4.00

Analysis of abusive relationships within the family, especially physical and sexual abuse of children and spouses. The primary focus is on the design of research to test theories purporting to explain intrafamily violence, consequences of violence for family members and society, and research on prevention.

### **SOC 980 - Social Stratification**

**Credits:** 4.00

Introduces students to the core of theoretical, methodological, and substantive issues in social stratification. Readings include classical and contemporary theories of stratification and work exploring the sources and consequences of stratification. Inequalities based on class, race, and gender examined.

**SOC #988 - Medical Sociology: Health, Healing, and Society**

**Credits:** 4.00

Social context of wellness, illness, and healing; stratification and health; mortality and morbidity in relation to class, race, ethnicity, religion, gender, and age; social control functions of medicine: medicalization and de-medicalization; interaction of physicians and patients; medical occupations; mental health and mental illness; stress and illness; medical care systems in various countries.

**SOC 990 - Teaching Sociology Seminar**

**Credits:** 4.00

Helps graduate students explore teaching techniques and improve their teaching skills. Topics include: setting course goals, designing lectures, evaluating student course work, leading discussion, and experimenting with innovative teaching techniques. (Also offered as GRAD 974.)

**SOC 995 - Reading and Research**

**Credits:** 2.00 to 8.00

A student prepared by training and experience to do the independent work under the guidance of an instructor may register. Prereq: 16 graduate hours of sociology and permission. Hours and credit to be arranged. May be repeated for different topics.

**SOC 996 - Reading and Research**

**Credits:** 2.00 to 8.00

See description for SOC 995.

**SOC 997 - Advanced Special Topics**

**Credits:** 2.00 or 4.00

Occasional or experimental offerings. Cr/F.

**SOC 999 - Doctoral Research**

**Credits:**

Cr/F.

## Spanish

### **SPAN 833 - History of the Spanish Language**

**Credits:** 3.00

The evolution of the Spanish language from the period of origins to the present. Special fee. (Not offered every year)

### **SPAN #852 - Drama and Poetry of the Siglo de Oro**

**Credits:** 3.00

Social and historical background of baroque period. Representative plays of Lope de Vega, Tirso de Molina, Calderon; lyric poetry of Lope, Gongora, and Quevedo; prose developments. Special fee. (Not offered every year.)

### **SPAN #854 - Age of Cervantes**

**Credits:** 3.00

Study of the major works of Cervantes and his contemporaries in the context of the historical, literary, and social currents of the time. Special fee. (Not offered every year.)

### **SPAN #855 - Literature of 19th Century**

**Credits:** 3.00

Larra, Espronceda, Becquer, Perez Galdos, and Blasco Ibanez. Romanticism, realism, and naturalism. Special fee. (Not offered every year.)

### **SPAN #856 - Modern Spanish Poetry**

**Credits:** 3.00

Study of selected Spanish poets of the 18th, 19th, and 20th centuries in the context of the historical, literary, and social currents of the times. Special fee. (Not offered every year.)

### **SPAN #857 - Spanish Drama of the 20th Century**

**Credits:** 3.00

Study of selected Spanish dramatic works of the 20th century in the context of the historical, literary, and social currents of the times. Special fee. (Not offered every year.)

### **SPAN #858 - Spanish Prose of the 20th Century**

**Credits:** 3.00

Novels, short stories, and essays. Unamuno, Baroja, Menendez Pidal, Ortega y Gasset, Julian Marais, Aranguren, Perez de Ayala, Gironella, and Cela; survey of contemporary prose. Special fee. (Not offered every year.)

### **SPAN #871 - Latin American Drama**

**Credits:** 3.00

From pre-Hispanic origins to the present; modern playwrights of Mexico and Puerto Rico. Special fee. (Not offered every year.)

### **SPAN #872 - Latin American Novel**

**Credits:** 3.00

Development from Romanticism to the present; contemporary trends and techniques. Special fee. (Not offered every year.)

### **SPAN 873 - Latin American Short Story**

**Credits:** 3.00

Representative authors; stress on the 20th century. Principles of interpretation. Special fee. (Not offered every year.)

### **SPAN #874 - Major Latin American Authors**

**Credits:** 3.00

Special fee. (Not offered every year.)

### **SPAN 882 - Summer Seminar for Teachers**

**Credits:** 3.00

Special two-week program designed for K-12 foreign language teachers who want to enhance their teaching and Spanish skills. The program is cosponsored by the Department of Languages, Literatures, and Cultures and the University of Las Americas en Puebla, Mexico. Provides teachers with a unique opportunity to gain Spanish language proficiency and to learn about Mexican culture through the interaction with native speakers. Current foreign language methods and practices will be examined through readings, videos, interviews, and field trips. Students design classroom activities using authentic materials collected in the community and compile a teaching portfolio based on the five C's of Foreign Language National Standards--communication, cultures, connections, comparisons, and communities. Each participant takes home a collection of already-made lessons which can be implemented immediately in their own teaching contexts. Special fee.

### **SPAN 890 - Grammatical Structure of Spanish**

**Credits:** 3.00

An overview of the grammatical structure of Spanish through an in-depth analysis of both morphology and syntax, with emphasis given to the meaningful contrasts that exist within the Spanish language and to grammatical contrasts between Spanish and English. Special fee.

### **SPAN 891 - Methods of Foreign Language Teaching Spanish**

**Credits:** 3.00

Interdepartmental course. Objectives, methods, and techniques in teaching Spanish, French, German, and Latin from elementary grades through college. Discussion, demonstration, preparation of instructional materials, microteaching of the language skills. Prereq: permission. Special fee.

### **SPAN 897 - Special Studies in Spanish Language and Literature**

**Credits:** 3.00

A) The History of the Spanish Language; B) Medieval Spanish Literature; C) Spanish Literature of the Renaissance; D) Spanish Literature of the Golden Age; E) Spanish Literature of the 18th and 19th Centuries; F) Spanish Literature of the 20th Century; G) Contemporary Spanish Literature; H) Latin American Literature of the 16th and 17th Centuries; I) Latin American Literature of the 18th and 19th Centuries; J) Latin American Literature of the 20th Century; K) Contemporary Latin American Literature; L) Structural and Applied Linguistics; M) Spanish Literary Criticism; N) Latin American Essay; O) Latin America; P) Spanish Theatre; Q) Spanish Poetry; R) Latin American Poetry; S) Galdos; T) Archetype Latin American Literature; U) Special Teaching Problems; V) Spanish Civilization and Culture; W) Latin American Civilization and Culture. Specialized courses covering topics not normally presented in regular course offerings. Prereq: permission of major supervisor. Special fee.

### **SPAN 898 - Special Studies in Spanish Language and Literature**

**Credits:** 3.00

A) Hispanic Minorities of the United States; B) Portuguese; C) Hispanic Film; D) Introduction to Hispanic Linguistics; F) Other. Specialized courses covering topics not normally presented in regular course offerings. Barring duplication of content, Topic F may be repeated for credit. Prereq: permission of major supervisor. Special fee.

### **SPAN #899 - Master's Thesis**

**Credits:** 1.00 to 6.00

Cr/F.

### **SPAN 901 - Bibliography and Methods of Research**

**Credits:** 1.00

Required of all graduate students in their first year of study. An introduction to standard bibliographical techniques and to form and style in the preparation and writing of research findings. Preparation of a research paper.

### **SPAN 903 - Applied Linguistics**

**Credits: 1.00**

Required of all graduate assistants teaching in the departmental program, but open to all graduate students in Spanish. Discussion of current methodology and linguistic approaches to the teaching of Spanish. Instruction in the use of audio-visual aids including language laboratories. Readings, discussion, class observation. May be repeated for a total of 3 credits.

**SPAN 995 - Independent Study****Credits: 1.00 to 3.00**

Guided individual study with training in bibliography and organization of materials. Topics selected by instructor and student in conference. Barring duplication of content, may be repeated for credit. Prereq: permission of major supervisor.

**SPAN 997 - Graduate Seminar****Credits: 3.00**

Presents and discusses selected topics in Spanish language and literature. See SPAN 897 for list of topics. Prereq: permission of major supervisor. Special fee.

**SPAN #998 - Graduate Seminar****Credits: 3.00**

Presents and discusses selected topics in Spanish language and literature. See SPAN 898 for list of topics. Barring duplication of content, Topic F may be repeated for credit. Prereq: permission of major supervisor. Special fee.

## Social Work

### **SW 801 - Women and Aging**

**Credits:** 3.00

An overview of women as they age in the American culture, with a brief international overview. Ethnic and cross-cultural perspectives explored. Areas to be studied include biological aging, focusing on menopause; economics and women, including retirement issues; women in the media; lesbian relationships; and late marriages.

### **SW 805 - Child Welfare: Policies, Programs, and Practice**

**Credits:** 3.00

Major social work policy and program questions in the field of child welfare introduced. The relationship between child welfare and the rest of the social work profession analyzed. Various types of child welfare services, some aspects of social and child welfare policy studied, as well as current research and practice issues in child welfare services.

### **SW #810 - Computer Utilization in Social Work**

**Credits:** 3.00

Provides students with a basic understanding of computerization and its application in social work. Computer literacy is seen as a requirement for effective practice of social work in the 21st century.

### **SW 811 - Social Work and Mental Illness**

**Credits:** 3.00

An overview of the public mental health system focusing on people affected by severe and persistent mental illness. Reviews the current service system and its history; major mental illness, psychosocial rehabilitation, and treatment; and community support systems.

### **SW 812 - Social Work and Developmental Disabilities**

**Credits:** 3.00

Analysis of the complex social contexts of people with developmental disabilities. Explores and questions traditional approaches and the current service system. Examines family and community services and resources. Special fee.

### **SW 814 - Introduction to Addiction: Assessment and Intervention**

**Credits:** 3.00

Information and skills necessary to address issues of substance abuse with individuals, families and communities. Overview of the dynamics of addiction; the treatment and recovery process; and the role of social work professionals in the identification and treatment of addiction. Special populations (women, adolescents, elderly, gay/lesbian/bisexual/transgendered, ethnic/racial groups) discussed. Treatment approaches explored.

### **SW 815 - Practice with Gay, Lesbian, and Bisexual Clients**

**Credits:** 3.00

Sexual minorities constitute the minority group a counselor most consistently encounters wherever he or she works. Addresses the task of counseling gay, lesbian, and bisexual people on both personal and professional levels for the counselor. Readings include theoretical, experimental, clinical, counseling, and personal perspectives, as well as providing an introduction to the gay/lesbian/bisexual subculture. Students explore and examine their own attitudes and assumptions regarding gays, lesbians, and bisexuals.

### **SW 820 - Social Welfare Policy I**

**Credits:** 3.00

The history and development of social welfare systems in the United States. Origins and development of significant policies, values, attitudes, and other issues related to the social welfare system and the delivery of service. Basic social welfare concepts studied and economic inequality in the U.S. examined along with policy responses to this social issue.

**SW 830 - Social Work Practice I****Credits:** 3.00

Basic concepts, theories, and skills of social work practice. Lectures and discussions, readings and written exercises, and laboratory and practice sessions. Students use the experiential parts of the course (laboratory and interview simulations) to apply the conceptual and theoretical knowledge.

**SW 831 - Social Work Practice II: Practice in Small Groups and Community Organizations****Credits:** 3.00

Continuation of Social Work Practice I with the further aim of introducing students to social work with groups and communities as models of social work practice.

**SW 840 - Implications of Race, Culture, and Oppression for Social Work Practice****Credits:** 3.00

Concepts of race and oppression. Examines and explores the social, psychological, and social-structural implications of racism, culture, and oppression as a dynamic force influencing social work practice. Analyzes and evaluates the social, cultural, political, economic and interpersonal contexts of racism that bear on our current policies and institutions. Describes and analyzes the life experiences of culturally different populations and sensitizes students to the issue of racism and oppression on both cognitive and affective levels.

**SW 850 - Human Behavior and the Social Environment I****Credits:** 3.00

Human growth and development through the life span using systems theory and person-in-environment as a conceptual framework. Theoretical perspectives from biology, sociology, and social systems theory explored as influences on developmental processes.

**SW 851 - Human Behavior and the Social Environment II****Credits:** 3.00

Continuation of the exploration of human growth and development begun in SW 850. The key organizing concept of this sequence of courses is the bio-psycho-social and interactive processes evidenced by social work's focus on person-in-environment. Information about small and large systems including families, ethnic and cultural groups, social groups, organizations, and communities. Prereq: (SW 850) Human Behavior and the Social Environment I.

**SW 860 - Research Methods in Social Work****Credits:** 3.00

Designed to acquaint first-year master's degree students with the concepts and skills necessary to carry out research in social work practice. Particular emphasis placed on methodological issues related to research in a variety of practice contexts. Although the skills necessary to review research critically are examined, the primary emphasis is on preparing the student to carry out research related to practice.

**SW 873 - Intervention with Groups****Credits:** 3.00

Principles in social work practice with groups. Focus on helping the individual within the framework of a group setting. The purpose and usefulness of group work as a preventative method and as an intervention tool outlined. History, underlying theory, techniques of group facilitation and typology of treatment and task groups examined. Students actively participate in a group simulation.

**SW 880 - Field Internship I****Credits:** 3.00

This two-semester requirement provides supervised learning and practice within social work programs in a wide range of program settings. Students spend 16 hours per week in the field. Individual field placements arranged with each student by the field coordinator. In order to receive credit, students must satisfactorily complete both SW 880 and SW 881. A concurrent integrative seminar is required. In this weekly seminar attention is given to the development of basic social work skills and techniques, legal and ethical issues, and the development of appropriate professional relationships. A primary goal is to integrate classroom learning with the field experience. Special fee. Cr/F.

### **SW 881 - Field Internship II**

**Credits:** 3.00

SW 881 is a continuation of SW 880, Field Internship I. Students must satisfactorily complete both field experience semesters to receive credit. Prereq: SW 880 (Field Internship I). Cr/F.

### **SW 885 - Comparative Social Welfare Systems**

**Credits:** 3.00

Students in this course examine the historical development of social welfare in another country including an analysis of the underlying values and attitudes that dictate practice and policy decisions. The course includes agency site visits, lectures, themed readings and visits to important cultural sites. Only open to first and second year MSW students. Special fee. Cr/F.

### **SW 897 - Special Topics in Social Work and Social Welfare**

**Credits:** 3.00

Seminar for graduate students. Topics may include: A) Alcohol and Alcoholism; B) Drugs and Chemical Dependency; C) Income Maintenance; D) Health Care; E) Child Welfare; F) Aging; G) Mental Health; H) Developmental Disabilities. May be repeated for different topics.

### **SW 900 - Advanced Standing Practice and Field Seminar**

**Credits:** 3.00

Weekly seminar held concurrently with field placement designed to orient and adequately prepare advanced standing students for advanced practice and field courses. Bridges the undergraduate and graduate curriculum and reviews foundation year concepts, theories, and skills of social work practice and field. Exploration of social work identity and professional relationships with supervisors, colleagues, and agencies. Primary focus on social work values and ethics and the development of ethical decision-making skills including the importance of culturally competent practice. Only offered to advanced standing MSW students. Special fee. Cr/F.

### **SW 926 - Social Welfare Policy II**

**Credits:** 3.00

A continuation of the exploration of social policy issues begun in SW 820. Students review various methods of social policy analysis and apply these to issues of concern at the state, local, and agency levels. The course's key organizing concept is the integration of social policy concerns with social work practice and the promotion of client well-being. Prereq: SW 820.

### **SW 932 - Direct Practice III: Clinical Assessment and Intervention**

**Credits:** 3.00

Builds on the academic and direct practice foundations from Practice I and II and the first-year field placement. Deepens the process of differential assessment and intervention with individuals, dyads, and families. Students learn to assess clients' functioning using a variety of theoretical frameworks and constructs which explore the person/environment fit. Prereq: SW 831.

### **SW 933 - Direct Practice IV: Advanced Clinical Assessment and Intervention**

**Credits:** 3.00

The major objective of the direct practice curriculum is to educate practitioners to work toward restoration and enhancement of functioning and prevention of maladaptive functioning. Direct clinical practice reflects the mutuality and reciprocity between individuals and systems and links present, past, and future. Advanced assessment using cognitive, psychodynamic, and systemic frameworks are presented. Course emphasizes conscious, purposeful, and differential use of self as a therapeutic or change agent. Prereq: SW 932.

### **SW 936 - Community and Administrative Practice III: Community Organization and Political Strategies**

**Credits:** 3.00

Provides students with the knowledge base and skills necessary to engage in community planning and organizing activities. Students learn to use political strategies to mobilize support for human service endeavors that enhance the well-being of underserved constituent groups. Course is required of students in the community and administrative

practice concentration, but is also open as an elective to any M.S.W. student who has completed first-year practice courses.

### **SW 937 - Community and Administrative Practice IV: Management of Human Service Organizations**

**Credits:** 3.00

Continuation of the exploration of macro practice issues begun in SW 936. Preparation of students for informed participation in public and private human service settings. Focuses on the concepts, principles, values, and strategies that inform administrative practice, including policy formulation and program planning. Emphasis on the integration of knowledge of organizational dynamics and managerial roles. Course is required of students in the community and administrative practice concentration (Prereq: SW 936), but is also open as an elective to any direct practice M.S.W. student who has completed first-year practice courses.

### **SW 952 - HB/SE III: Adaptive and Maladaptive Functioning**

**Credits:** 3.00

Designed to acquaint master's degree students with the epidemiology, classification, etiology, and treatment of the major forms of mental illness. A primary objective is to develop the student's diagnostic skills in the field of psychopathology and to apply the competence acquired in direct practice settings. At course conclusion, students have an effective working knowledge of: the biological and psychosocial bases of the major mental disorders; the behavioral symptomology that characterizes them; the major modalities of treatment currently available for each of them; and their classification according to the DSM IV system of classification. Prereq: Social Work Practice II: Practice in Small Groups and Community Organizations (SW 831) and Human Behavior and the Social Environment II (SW 851).

### **SW 957 - Program and Resource Development in the Social Service Arena**

**Credits:** 3.00

This course is designed to introduce students to various approaches to fundraising in the health and human services. Students are provided with an overview of the history of philanthropy in the United States, important theories and concepts, the relevance of organizational context, stages in the donor development process, trends in giving and volunteering. Students receive step-by-step instruction in the techniques of grant writing. In addition, the use of emerging technologies such as the Internet for health and human service fundraising are explored. Ethical issues specific to the health and human service fundraising are examined.

### **SW 962 - Research II Statistics**

**Credits:** 3.00

Social science statistics is a set of methods used to organize and analyze data for the purpose of either answering research questions or testing social science theories with data. Course provides practical, data-oriented introduction to the methods of modern statistical analysis with a focus on understanding and interpretation rather than the details of calculation. Students with extensive experience may test out.

### **SW 965 - Research III: Program and Practice Evaluation**

**Credits:** 3.00

A one semester course, basic introduction to evaluation methods in the context of social work practice and social welfare. Students develop and conduct evaluations of practice, programs, and policies. Course provides skills required for practice and program evaluation. Prereq: SW 860; 962.

### **SW 974 - Social Work Supervision**

**Credits:** 3.00

Prepares students for a supervisory role in social agency or field of social work practice. Basic principles and techniques of supervision reviewed and related to the student's own experiences in supervision or as a supervisor.

### **SW 975 - Theory and Practice of Family Therapy**

**Credits:** 3.00

Designed to provide an advanced specialist overview of evolving viewpoints, perspectives, values, intervention techniques, and goals of family therapy. Views the family as a unit of attention and target of intervention. Emphasis on

the development and enhancement of knowledge, skills, theories, and values specific to family therapy and social work practice.

### **SW #977 - Ego Psychology I**

**Credits:** 3.00

Development of ego psychology from Freud's early writings to contemporary theorists. Examines the historical changes since Freud. Differences between early ego psychology and current psychology views examined by focusing on ego functions. Emphasis on the relationship between theory and its application to practice with many clinical examples given demonstrate the impact of changing theory has on clinical practice. Prereq: SW 851.

### **SW #978 - Brief Treatment in Social Work**

**Credits:** 3.00

Examination of the theory and practice of short-term treatment approaches used in social work practice with individuals, families and small groups. Particular attention is given to the principles and techniques of assessment as the basis for treatment design critical to effective practice and differential use of modes and techniques of brief service. Prereq: graduate students in M.S.W. program or permission.

### **SW 979 - Social Work and the Law**

**Credits:** 3.00

Social work practitioners routinely encounter and interact with the legal system in their work. The course provides knowledge of, and learning about, the differences between the legal and social service networks, the realities of work involving the law, and legal issues, as well as an understanding of those aspects of the legal system most likely to impact clients and their families.

### **SW 982 - Field Internship III**

**Credits:** 4.00

This two semester requirement provides advanced practice experience in a wide range of social work settings. Students spend 24 hours per week in the field. Individual field placements are arranged with each student by the field coordinator. In order to receive course credit, students must satisfactorily complete both semesters(SW 982 and SW 983). A concurrent integrative seminar is also required. The goal of the weekly seminar is to assist students in conceptualizing and integrating the multiple theoretical issues and practice concepts of course work and the practicum. Students are expected to take major responsibility for the semester, using the instructor as a resource. Special fee. Cr/F.

### **SW 983 - Field Internship IV**

**Credits:** 4.00

This two semester requirement provides advanced practice experience in a wide range of social work settings. Students spend 24 hours per week in the field. Individual field placements are arranged with each student by the field coordinator. In order to receive course credit, students must satisfactorily complete both semesters. A concurrent integrative seminar is also required. The goal of the weekly seminar is to assist students in conceptualizing and integrating the multiple theoretical issues and practice concepts of course work and the practicum. Students are expected to take major responsibility for the semester, using the instructor as a resource. Cr/F.

### **SW #985 - Object Relations: Theory and Practice**

**Credits:** 3.00

Builds on content from Ego Psychology I. Explores concepts of object relations theory and practice. Emphasis placed on the centrality of relationships in developmental theory and on the relationship between theory and clinical practice. Prereq: SW 977; second-year M.S.W. students;/or permission.

### **SW 992 - Special Projects and Independent Study**

**Credits:** 1.00 to 3.00

Projects, research and reading programs in areas of concentration. Sixty days advance approval of the student's plan of study by adviser and proposed instructor required. Prereq: 24 cr. in M.S.W. coursework. May be repeated to maximum of 6 credits. Special fee. Cr/F.



## Zoology

### **ZOOL 801 - Conservation Biology**

**Credits:** 4.00

Critical and quantitative investigation of current issues in the conservation of biological systems. Habitat restoration, nonindigenous species, harvest strategies, conserving genetic diversity, population viability analysis, global climate change, endangered species recovery, habitat fragmentation, and reserve design are addressed. Case studies include examples drawn from terrestrial, aquatic, and marine systems. Weekly laboratories include trips to local habitats of concern. A statistics course is highly recommended. Prereq: general ecology or permission. Special fee. Lab. (Not offered every year.)

### **ZOOL 805 - Population Genetics**

**Credits:** 4.00

An exploration of the forces affecting the frequency and distribution of allelic variation in natural populations. Emphasis on the relative roles of mutation, selection, random drift and inbreeding in structuring genetic variation, and on the quantification of the genetic structure of populations. Prereq: principles of genetics; applied biostatistics I recommended. (Also offered as GEN 805.) Special fee. Lab. (Not offered every year.)

### **ZOOL 808 - Stream Ecology**

**Credits:** 4.00

Ecological relationships of organisms in flowing water; streams as ecosystems. Lectures on physical and chemical features of streams, floral and faunal communities, and factors controlling populations of benthic invertebrates. Laboratory exercises employ both field and laboratory experimental techniques. Weekly seminars on original research papers. Special fee. (Not offered every year.)

### **ZOOL #809 - Environmental Physiology of Animals**

**Credits:** 4.00

Animal responses to natural changes or extremes of the physical environment. Emphasis on adaptation of animals to major environmental parameters such as nutrient levels, light, temperature, and ionic environment, as well as temporal (seasonal, daily) changes in these major environmental factors. Examples from several levels of organization including biofeedback mechanisms. Prereq: general ecology; principles of animal physiology;/or equivalent. (Not offered every year.)

### **ZOOL 810 - Ichthyology**

**Credits:** 4.00

An introduction to the evolution, systematics, anatomy, physiology, and ecology of fishes, with an emphasis on New England species. Prereq: principles of biology or equivalent. Lab. (Offered alternate years.)

### **ZOOL 811 - Zooplankton Ecology**

**Credits:** 4.00

Methods of sampling populations; factors regulating temporal and spatial distribution; trophic interactions of communities; role of zooplankton in nutrient cycles of lakes. Experimental techniques employed in field trips to freshwater habitats. Seminars examine current research in the primary literature. Prereq: general ecology and limnology, ZOOL/PBIO 817, or equivalent; permission. (Not offered every year.)

### **ZOOL 812 - Mammalogy**

**Credits:** 4.00

Evolution, ecology, behavior, physiology, and diversity of mammals. Focuses on conceptual issues such as the relations of structure, function, physiology, and ecology of species; reproductive physiology and life history strategies; and the evolution of mating systems and social structure. Requires familiarity with mammalian groups to the family level and identification of local fauna to species. Prereq: principles of biology or equivalent. Lab. (Not offered every year.)

year.) Special fee.

### **ZOOL 813 - Animal Behavior**

**Credits:** 4.00

Introduces the naturalistic study of animal behavior. Emphasizes the evolution, development, physiology, and ecology of behavior. Topics include the genetic and acquired bases of behavior; neuroethology and behavioral endocrinology; communication; orientation; foraging strategies; reproductive ecology; and the evolution of altruistic behavior. Prereq: principles of biology I and II or equivalent. Lab.

### **ZOOL 815 - Molecular Evolution**

**Credits:** 4.00

Rates and patterns of evolutionary change in biomolecules; forces affecting the size and structure of genomes; molecular mechanisms of organismal evolution. Emphasis on integrating evidence from biochemistry, molecular genetics and organismal studies; as well as on methods for reconstructing phylogeny from molecular sequences. Some knowledge of statistics is recommended. Prereq: principles of genetics. (Also offered as GEN 815.) Special fee. Lab. (Not offered every year.)

### **ZOOL 817 - General Limnology**

**Credits:** 4.00

Introduction to the ecology of freshwater systems, with emphasis on lakes. Origins of lakes and effects of watersheds on lake chemistry, nutrient cycling, and the lake food web are explored. Other topics include the impact of human disturbances on productivity and aquatic food web and methods used for the management and restoration of lakes. Comparisons are made of the structure and functions of lake ecosystems found in temperate, tropical and arctic regions. Prereq: general ecology or equivalent. (Also offered as P BIO 817.)

### **ZOOL 819 - Field Studies in Lake Biology**

**Credits:** 4.00

Ecology of lakes and other freshwater habitats examined through field studies. Emphasizes modern methods for studying lakes, analysis and interpretation of data, and writing of scientific papers. Seminars on research papers and student presentations of class studies. Field trips to a variety of lakes, from the coastal plain to White Mountains; investigate problems, such as eutrophication, acidification, biodiversity and biotoxins. Capstone experiences include interaction with state agencies, lake stakeholders and the submission of written manuscripts for publication. Prereq: introductory biology. (Also offered as P BIO 819.) Special fee. Lab.

### **ZOOL 823 - Quantitative Genetics**

**Credits:** 4.00

Analysis of continuous variation in populations simultaneously segregating at multiple loci. Genetic and nongenetic factors and the complex interactions between them; models and methods of analysis, for both theoretical and practical applications. Prereq: principles of genetics; applied biostatistics I is strongly suggested. (Also offered as GEN 823.) Special fee. Lab. (Not offered every year.)

### **ZOOL 825 - Marine Ecology**

**Credits:** 4.00

Marine environment and its biota, emphasizing intertidal and estuarine habitats. Includes field, laboratory, and an independent research project. Prereq: general ecology; permission. Marine invertebrate zoology, oceanography, and statistics are desirable. (Also offered as P BIO 825.) Special fee. (Not offered every year.)

### **ZOOL #831 - Systems Approach to Biological Ocean Science**

**Credits:** 3.00

Broad survey of biological ocean science for advanced undergraduate and graduate students. Uses an interdisciplinary, "systems" approach to focus on major opportunities and challenges for ocean science in the future. Classes meet for one three-hour session each week and include lecture, discussion, demonstration, and laboratory sessions appropriate to the subject material with presentations by guest speakers. Focus of the course is different each time it is offered; topics have included temporal and spatial scales of variation, estuarine ecosystem dynamics. May be repeated. Prereq:

permission. (Also offered as EOS 831.)

### **ZOOL 832 - Lake Management: A Multidisciplinary Approach**

**Credits:** 4.00

Lectures and seminars on interpreting lake water quality, developing a natural history inventory for lakes, the process of creating a lake management plan, and resolution of conflicting uses of lakes. Students develop actual lake management plans in cooperation with government agencies and lake associations. Guest speakers from state agencies and non-governmental organizations. Introductions to and use of GIS (Geographic Information Systems) methods for the analysis of lakes and watersheds. Present lake management issues from scientific and social science points of view. Open to students from all disciplines. (Also offered as PBIO 832.) Special fee. Lab.

### **ZOOL #833 - Behavioral Ecology**

**Credits:** 4.00

Behavioral adaptations of animals to their environment including the evolution of behavior and behavioral genetics; foraging and competition for resources; reproductive ecology, mating systems and parental care; and the evolution of cooperative behavior. Examples include both vertebrates and invertebrates. Emphasis is on critical understanding of concepts as exhibited in oral and written exercises. Students conduct independent investigations. Prereq: animal behavior or ecology or evolution course. Lab. (Offered in alternate years.)

### **ZOOL 840 - Introduction to Biogeography**

**Credits:** 4.00

Biogeography is an integrative field of inquiry that unites concepts and information from evolutionary biology, ecology, systematics, geology, and physical geography. This course covers theories and data from several disciplines with emphasis on evolutionary aspects of biogeography. Attention is given to the biogeography of individual taxa rather than groups of species or communities. Prereq: General Ecology. An evolution course is strongly recommended. Recitation.

### **ZOOL 845 - Biology and Diversity of Insects**

**Credits:** 4.00

Study of the biology of insects, the most diverse group of organisms, focusing on why they are unique, how they have become so diverse, and the basis of their success. The laboratory is designed to develop an understanding of insect diversity through utilization of different sampling techniques in several habitats, sorting to "morphospecies", and use of biodiversity indices. Prereq: principles of biology I and II or equivalent. Special fee. (Not offered every year.)

### **ZOOL 850 - Biological Oceanography**

**Credits:** 4.00

Biological processes of the oceans, including primary and secondary production, trophodynamics, plankton diversity, zooplankton ecology, ecosystems and global ocean dynamics. Field trips on R/V Gulf Challenger and to the Jackson Estuarine Laboratory. Prereq: one year of biology or permission of instructor. (Also offered as EOS 850, ESCI 850.) Special fee. Lab. (Not offered every year.)

### **ZOOL 872 - Fisheries Biology**

**Credits:** 3.00

Principles of fisheries science, with emphasis on techniques used to assess the biological characteristics of exploited fish populations and the use of such information for fisheries management. Prereq: ZOOL 810; permission. (Not offered every year.)

### **ZOOL 873 - Physiology of Fish**

**Credits:** 4.00

Investigation of the physiological processes responsible for maintaining homeostasis in fishes. Focus is on the function and regulation of the major organ systems during stress and environmental adaptation. Topics include reproduction, osmoregulation, digestion, endocrinology and sensory perception. Prereq: animal physiology or equivalent;/ or permission.

### **ZOOL 877 - Neurobiology and Behavior**

**Credits:** 4.00

Survey of fundamental concepts and recent discoveries in neurobiology. Topics include structure and function of neurons, development, cellular basis of behavior (sensory and motor systems), neuropharmacology, and neural plasticity (learning). Prereq: principles of biology I and II or permission. Physiology also desirable.

**ZOOL #878 - Neuroscience Techniques****Credits:** 4.00

A techniques- and laboratory-oriented course designed for students of the behavioral and physiological sciences who wish to understand the basic electrophysiological properties of neurons and how they interact. Both invertebrate and vertebrate systems to illustrate principles of synaptic transmission, integration, sensory information processing, and the control of movement. Prereq: ZOOL 877 or equivalent. Lab. (Not offered every year.)

**ZOOL 895 - Advanced Studies****Credits:** 1.00 to 4.00

Independent study in various areas, including but not limited to: animal behavior; departmental biology; ecology; electron microscopy; evolution; genetics; histology; history of biology; invertebrate biology; neurobiology and behavior; physiology; teaching practices; underwater research; vertebrate biology; biological techniques. Course sections for advanced work, individual or group seminar. May include reading, laboratory work, organized seminars, and conferences. Prereq: permission of department chairperson and staff concerned.

**ZOOL 896 - Advanced Studies****Credits:** 1.00 to 4.00

See description for ZOOL 895.

**ZOOL 899 - Master's Thesis****Credits:** 1.00 to 10.00

Prereq: permission of department chairperson and prospective supervisor. Cr/F.

**ZOOL 901 - Research Methods****Credits:** 2.00

Introduction to the range of research approaches in zoology and to the skills needed for success in graduate school and beyond. Topics include scientific writing, graphical methods, library techniques, scientific methods and experimental design, research techniques available, and seminar presentation. Cr/F. (Offered every fall.)

**ZOOL #926 - Comparative Physiology****Credits:** 4.00

Laboratory modules designed to enable students to investigate nutrition, metabolism, neural function, reproduction, and homeostatic mechanisms, of animals, especially invertebrates. Emphasis on conducting effective physiological studies. Prereq: principles of animal physiology or equivalent; permission. Special fee. (Not offered every year.)

**ZOOL 997 - Seminar****Credits:** 1.00 to 2.00

Reports on recent zoological literature. Subject fields are those listed under ZOOL 895, 896; not all areas available every semester. Required of graduate students in zoology. Cr/F.

**ZOOL 998 - Seminar****Credits:** 1.00 to 2.00

See description for ZOOL 997. Cr/F.

**ZOOL 999 - Doctoral Research****Credits:**

Cr/F.