

## Accounting and Finance

### ACFI 820 - Corporate Taxation

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.

### ACFI 830 - Advanced Auditing

Credits: 3.00

This course is designed to establish an advanced competence in auditing theory and practice. Specifically, students will gain an in-depth understanding of current academic auditing research and the philosophy of strategic-systems auditing through readings, presentations, case studies, and a service learning project with a local non-profit organization.

### 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 paper on a topic approved by the program director. Prereq: M.S. in Accounting.

## Administration

### ADMN 823 - Topics in Finance

Credits: 3.00

Prereq: financial management.

### ADMN 829 - Financial Policy

Credits: 3.00

Analytical tools and practical skills for recognizing and solving complex problems of business finance. A complement to ADMN 930, this course covers the major decision-making areas of managerial finance and some selected topics in financial management such as real options, leasing, mergers and acquisitions, corporate re-organizations, financial planning, and working-capital management.

### ADMN 830 - Investments Analysis

Credits: 3.00

Discusses principles for selecting and managing financial assets, including equities, fixed-income securities, and alternative investments. Topics include asset pricing, efficient market hypothesis, arbitrage pricing theory, portfolio theory, and risk management.

### ADMN 832 - Exploration in Entrepreneurial Management

Credits: 3.00

Examination of the management of change and innovation especially the role of entrepreneur in managing new ventures. Uses case analysis, guest speakers, and business plan preparation to study the characteristic behavioral, organizational, financial, and market 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. Focus on U.S., Europe, and Asian markets.

### 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 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 845 - Supply Chain Management

Credits: 3.00

The purpose of this course is to learn how to design, plan, and operate supply chains for competitive advantage; to develop an understanding of how the key drivers of supply chain operations (inventory, transportation, information, and facilities) can be used to improve performance; and to develop knowledge of logistics and supply chain methodologies and the managerial context in which they are used.

#### ADMN 846 - International Financial Management

Credits: 3.00

Financial management problems facing multinational firms. Focus is on identifying and managing foreign exchange rate exposures and making financial decisions in a global context

#### 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 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 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

Uses extensive real world examples and written and video cases to develop diagnostic skills and a conceptual framework for designing integrated management systems. Assignments include individual exercises to develop skills in the use of process improvement tools and methods, and team projects to develop leadership skills in the implementation of total quality management initiatives.

### 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 - MBA Internship

Credits: 3.00

Provides students the opportunity to gain business experience in a professional setting, working for one company eight hours per week. Students explore the relationship between theory and practice and complete a research project. Students with less than two years work experience are required to take this course. 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 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 919 - Management Accounting

Credits: 3.00

An introduction to the preparation and interpretation of financial information, with emphasis on the use of accounting information for management decision-making. It highlights the guiding principles by which accounting reflects the underlying economic events. It also focuses on reporting and measurement issues that help managers make better decisions.

### 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 926 - Information Systems and Enterprise Integration

Credits: 3.00

Provides students with the background to understand how information systems are developed and used to support the operations and decision making functions within an organization. The course begins with a framework for understanding how these systems are developed and used. It continues with an emphasis on "action learning" where students build enterprise systems using spreadsheets and relational database software. Students develop these systems in groups and make several presentations during the semester.

#### 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 and risk management.

#### 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: 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 952 - Organizations, Leadership, and Environments

Credits: 3.00

Examines both private and public institutions as open systems whose effectiveness depends on the design of internal structures and cultures to fit external demand, opportunities and threats. Develops students' analytic and diagnostic skills as designers of ethical and socially responsible organizations.

#### ADMN 953 - The Social Power of Leadership in the 21 Century

Credits: 3.00

The goal of this cross-disciplinary course is to develop students' deep understanding of the dynamic, mutually reinforcing power of leadership follower relations in modern organizations - including both toxic and beneficial processes and outcomes. Readings draw on the literatures from business, social sciences, and philosophy to illuminate the complexities of leading in 21st century corporations, public service organizations, institutions of higher learning, and government agencies. A diverse cross-section of students from doctoral and master level programs across all UNH schools, colleges, and departments participate in the course in order to most broadly examine how the leader-follower relationship can succeed or fail in its pursuit of organizational strategies and objectives. Prereq: permission.

#### ADMN 955 - Quantitative Business Analysis

Credits: 3.00

The use of quantitative analysis as an aid in the decision making process. A thought process and an approach to the analysis of, and providing recommendations for, a complex decision making situation. Topics include linear programming, forecasting, simulation, and general modeling procedures. The course is a combination of a lecture, class discussion, problem solving, project presentations and "unstructured"

decision making problem approach.

ADMN 956 - Managerial Decision Making

Credits: 3.00

The use of quantitative information as an aid in the decision making process. A thought process and an approach to the analysis of, and providing recommendations for, a complex decision making situation. The course is a combination of a lecture, class discussion, problem solving, project presentations and "unstructured" decision making problem approach.

ADMN 960 - Marketing Management

Credits: 3.00

An analytical approach to the study of marketing problems. Examines the influence of the marketplace and the marketing environment on marketing decision making: the determination of the organization's products, prices, channels and communication strategies; and the organization's system for planning and controlling its marketing effort.

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 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

Managerial problem solving and decision making relative to economic, ethical, legal, political, social, and technological aspects of an organization's environment. Develops students' analytical and diagnostic skills as designers of ethical and socially responsible organizations. Case discussion, stakeholder analysis, managerial values and ethics, and social issues management are important course components.

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 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. Seven lab reports required. 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 853 - 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 P BIO 851.) Lab.

#### 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 up to a maximum of 4 credits. 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 - Practice of Research in the Life Sciences

Credits: 2.00

Designed to acquaint first-year master's and doctoral degree students with the tools and facilities for designing, conducting, and communicating research. Topics include the art of oral presentation, effective writing, bibliographic searches, graphics using computers, and ethics in animal and human research. Students are recommended to take this course during their first fall semester.

#### ANSC 902 - Philosophy of Research in the Life Sciences

Credits: 2.00

Designed to acquaint master's and doctoral students (second year and beyond) with the theories and principles for understanding, designing, conducting, and communicating research in the Life Sciences. Readings and class discussions will focus 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? Offered fall semester.

#### 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 - Non-thesis 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 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 897 - Seminar in Art History

Credits: 4.00

Topics and prerequisites to be announced before preregistration. May be repeated with permission instructor up to a maximum of 12 credits. (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 - Painting in Italy; L01 - 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 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 I

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 II

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. Prereq: general biochemistry, principles of biochemistry or permission. (Also offered as GEN 854 and P BIO 854.) Special fee.

### 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 883 - Proteomics for Biological Discoveries

Credits: 4.00

Proteomics is a cutting edge area of molecular biology that undertakes a systematic characterization of the entire set of proteins (proteome). This course develops an understanding on key technologies to study the expression levels, posttranslational modifications, cellular localization, three-dimensional structure, protein interactions, and dynamic changes of these properties during cellular processes. Topics to be covered include goals in proteomic analysis, major technology platforms, and pharmaceutical and biomedical applications.

#### 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 regulation, 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

May be repeated to a maximum of 10 credits. Cr/F.

#### BCHM #942 - Biochemical Regulatory Mechanisms

Credits: 3.00

Transcriptional control and post-transcriptional processing of mRNA; regulation and formation of chromatin structure; mRNA transport; degradation of mRNA nonsense mediated decay; integration of decay, decapping, and translational control. 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, hereto assembly, cooperativity, ligand linkage and methods for their analysis. Prereq: physical chemistry I, II or BCHM 850. May be repeated. (Also listed as MS 910.)

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

Credits: 3.00

Examination of current topics in signal transduction mechanisms. 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.

#### BCHM 999 - Doctoral Research

Credits:

Cr/F.

## Biology

### BIOL 811 - Applied Biostatistics II

Credits: 4.00

Design and analysis of biological and ecological research experiments. "Real world" studies used to discuss the identification of hypotheses, appropriate experimental design, and the application of statistical analyses including ANOVA, ANCOVA, correlation and regression, cluster analysis, classification and ordination techniques. Theoretical statistical concepts tailored to consider student's own thesis and dissertation research, allowing statistical problems to be addressed at various stages of the research process. Common computer packages used for analyses. Prereq: BIOL 528; permission.

### BIOL 895 - Biology Special Investigations

Credits: 1.00 to 4.00

### BIOL 896 - Special Investigations

Credits: 1.00 to 4.00

### BIOL 901 - Research Methods

Credits: 2.00

Introduction to the range of research approaches in biology 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.

## 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 822 - Introduction to Microfluidics

Credits: 4.00

Fundamentals and applications of microfluidics; scaling laws; microfabrication technology; hydrodynamics and electrohydrodynamics; interfacial phenomena; capillary effects and diffusion; microvalves; micropumps; lab-on-a-chip systems; biochips. Prereq: fluid mechanics course or permission of instructor.

### 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 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 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. (Not offered every year.)

CHE 899 - Master's Thesis

Credits: 1.00 to 6.00

May be repeated to a maximum of 6 credits. Cr/F.

CHE 900 - Seminar

Credits: 1.00

Topics of interest to graduate students; 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.

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 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 multi-component open system; the volumetric and phase behavior of pure substances and of multi-component 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; non-isothermal kinetics; heat and mass transfer in non-equilibrium, chemically reacting systems.

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. Pre-semester sessions and periodic seminars during semester. Cr/F.

### CHEM 808 - Spectroscopic Investigations of Organic Molecules

Credits: 3.00

Identification and structural analysis of chemical compounds by selected instrumental methods. Typical topics include proton and carbon-13 NMR spectroscopy, IR and UV spectroscopy, and mass spectrometry.

### 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. (Not offered every year.)

### CHEM 899 - Thesis/Problems

Credits: 1.00 to 10.00

Conferences, library, and experimental work in some field of chemistry. May be repeated to a maximum of 10 credits. Cr/F.

### CHEM 902 - Theoretical Organic Chemistry II

Credits: 3.00

A continuation of CHEM 901. (Not offered every year.)

### 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

Overview of current trends in inorganic research, including transition metal reactions and mechanisms and organometallic chemistry. (Not offered every year.)

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 911 - Synthetic Organic Chemistry I

Credits: 4.00

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 sub-disciplines of organic chemistry. (Not offered every year.)

CHEM 918 - Special Topics in Organic Chemistry

Credits: 2.00 to 4.00

Advanced courses dealing with specialized sub-disciplines of organic chemistry. (Not offered every year.)

CHEM 926 - Physical Chemistry of Solutions

Credits: 3.00

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

CHEM 927 - Molecular Reaction Dynamics

Credits: 3.00

The course will investigate the microscopic origins of rate processes. Overview of atomic and molecular structure. Scattering theory. Transition state theory. Uni-molecular and bi-molecular processes. Introduction to simulation software. (Not offered every year.)

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 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 - Electrical Methods of Analysis

Credits: 3.00

Introductory electronics for chemists and electrochemical methods of analysis. The electronics emphasizes how components and circuits affect acquisition, manipulation, and quality of chemical information. Electrochemical methods include potentiometry and voltammetry. Permission required. (Not offered every year.)

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. (Offered every other year.)

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 991 - Graduate Presentation Portfolio

Credits: 1.00

A graduate course for Chemistry Master of Science students designed to provide them with expertise in preparing, organizing, and giving research presentations. Cr/F.

CHEM 992 - Graduate Writing Portfolio

Credits: 1.00

A graduate course for Chemistry Master of Science students to acquire and practice appropriate professional data documentation and writing skills. Cr/F.

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. (Not offered every year.)

CHEM 996 - 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. (Not offered every year.)

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 #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: 4.00

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 851 - Introduction to Sustainable Engineering

Credits: 3.00

Course begins with exploration of the precept that we live in, and must design engineering works for, a world with a finite supply of natural resources and with limited life support capacity. Tools for sustainability engineering are the major focus of the course, which include life cycle, analysis and life cycle impact analysis, the metrics and mass and energy flow analyses used in the field of industrial ecology, and environmental management systems.

#### 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 Pressurized Water Transmission Systems

Credits: 4.00

Theory developed for individual components to large complex systems. Analysis and designs of components and systems. Topics include steady and unsteady closed conduit flow, valves and meters, pump requirements, pump selection, system planning and layout, water hammer, and system operation and maintenance. Pressure system modeling with program EPANET. Prereq: Fluid mechanics, 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. 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 858 - Stormwater Management Designs

Credits: 3.00

Historic review of stormwater management leading up to the current regulatory framework. Overview of stormwater management strategies, strategy selection and the targeting of specific contaminants, contaminant removal efficiencies, construction and site selection, and system maintenance. Hydrologic concepts including watershed and storm characteristics, design hydrology (peak flows, storm and treatment volumes), hydrograph routing, and critical review of hydrology and drainage reports. Design and sizing of treatment systems including conventional BMPs, low impact development, and manufactured devices. Rainfall runoff calculations with US SCS TR55 model. Prereq: Fluid mechanics or permission.

### CIE 859 - Stream Restoration

Credits: 3.00

Explores the assessment, planning, design, engineering, and monitoring of stream and watershed practices intended to protect and restore the quality and quantity of flowing and surface waters and stream corridors. Lecture topics include hydrology, geomorphology, and ecosystems, with the intent of understanding the variables associated with stream systems and their interplay. Students will measure field variables and then be challenged with actual designs. Examples of stream restoration issues include in-stream flow, dam removal, induced recharge, improvements to fish habitat, and channel stabilization.

### 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 - 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 876 - Structural Design in Masonry

Credits: 3.00

Introduces the design of reinforced masonry structural members by the stress and strength method and considering deflection and other serviceability performance criteria. Includes development of wind and seismic load, curtain wall, shear wall, lintels and columns. Prereq: CIE 622, 681; or permission.

#### 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 887 - Dynamics of Structures

Credits: 3.00

Dynamics of single- and multi-story buildings. Response due to earthquakes, blasting, traffic, and mechanical equipment. Analysis in the time domain and through the Fourier Transform. Fundamentals of structural vibration measurement. Prereq: CIE 885 or permission.

### CIE 888 - Master's Project Paper

Credits: 3.00

Concluding project paper required of Master's level students who utilize the non-thesis option. Prereq: permission.

### CIE 891 - Pre-stressed Concrete

Credits: 3.00

Analysis and design of pre-stressed and post-tensioned concrete sections in flexure and shear. Strength, deflection, and losses in flexural members. Optimization of section and pre-stressing 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: senior-level structural design course or permission.

Co-requisites:

### 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

May be repeated up to maximum of 6 credits. 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. (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.

#### 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: undergraduate-level course in water and waste water engineering or water chemistry, or permission. 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: environmental engineering microbiology course, or permission

#### CIE 960 - Advanced Soil Mechanics

Credits: 4.00

Numerical and physical modeling of the mechanical behavior of soils. Cam-clay and other predictive models. Laboratory studies of mechanical behavior and measurement of input parameters to soil models. Prediction of soil behavior based on laboratory results. Applications to numerical modeling of soil masses. Prereq: soil mechanics, and foundation design, 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 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 825 - Cued Speech

Credits: 3.00

This course covers the fundamentals of the Cued Speech system, its applications and research as well as its relevance to other communication options for children who are deaf or hard of hearing. Various topics are covered, including CS and language development, reading, auditory and speech skill development, auditory processing, bilingualism, Down Syndrome, Autism, cochlear implants and transliteration.

### 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: 2.00

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 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 - Advanced Audiology for Speech-Language Pathologists

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. May be repeated for a maximum of 6 credits. Cr/F.

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

Credits: 3.00

Phonological theories as they relate to analysis and remediation of phonological disorders. Prereq: COMM 524 Clinical Phonetics.

### 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: 2.00

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 - Disorders of Language and Literacy I

Credits: 3.00

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

COMM 909 - Disorders of Language and Literacy II

Credits: 3.00

The writing problems commonly observed in children with language disorders are reviewed from the perspective of language: writing relationships, meta-cognition, and memory. Current diagnostic and instructional approaches are discussed. Prereq: COMM 522.

COMM 910 - On-Campus Clinical Practicum

Credits: 1.00 to 3.00

On-campus practicum provides graduate students with the opportunity to apply advanced theoretical knowledge in clinical setting with clients demonstrating speech, language, hearing, and/or swallowing disorders. Students acquire therapy and diagnostic experience under supervision. A minimum of 3 credits

is required for the M.S. degree. May be repeated up to 3 times for a maximum of 3 credits. Variable 1-2 credits. Special fee.

#### COMM 911 - Off-Campus Clinical Practicum

Credits: 1.00 to 4.00

Application of advanced theoretical knowledge through clinical work in an off-campus clinical setting.

Prereq: COMM 910, On-campus Clinical Practicum with a grade of "B" or above. A minimum of 6 credits is required for the M.S. degree. May be repeated up to 3 times for a maximum of 6 credits. Variable, 1-4 credits.

#### COMM 912 - Language Disorders Birth to Five

Credits: 3.00

Trans-disciplinary 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 Disorders

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 and Alternative Communication

Credits: 3.00 to 4.00

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 915 - Counseling Clients and Families with Communication Disorders

Credits: 2.00

Course enables learners to understand essential elements of interaction with other human beings with whom they are working, and to apply therapeutic principles in clinical settings with people who have speech, language, and hearing difficulties. Learners are also able to identify which areas of counseling are outside their scope of practice. More specifically, this course is intended to: provide the learner with a broad overview of contemporary counseling approaches and issues; and apply these issues to the speech and hearing clinician. In addition we touch upon family systems and how they are affected by the presence of a communication disorder. The course involves formal lectures and group discussion. The course also offers unstructured time for the class members to use as they see fit.

#### 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 mid-semester report and a final report are required. Permission required. May be repeated up to a maximum of 3 credits. 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; code generation. LL and LR parsing; automatic generation of scanners and parsers from high-level descriptions. Implementation of features from imperative and object-oriented languages. Students are required to design and implement a compiler for a simple language. This course is implementation-intensive. Prereq: Machine Organization; Theory of Computation.

### CS 818 - Software Systems Engineering Process

Credits: 3.00

Contemporary software-intensive systems are distinguished by their complex intellectual content, evolving and changing requirements, difficult technical and organizational interfaces, multiple stakeholders with differing perspectives on project objectives, integration intensity, and high customer expectations for system robustness. To meet these formidable challenges, this course addresses an interdisciplinary set of processes across the full life-cycle (from concepts to deployment and enhancement) that balances competing technical/management parameters toward a design solution meeting stakeholder needs. Prereq: permission of instructor.

### 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 inter-process 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 823 - Performance Evaluation of Computer Systems

Credits: 3.00

This class introduces the main concepts, techniques, and tools needed to evaluate the performance of computer systems under various configurations and workloads. The techniques allow one to perform capacity planning based on quality of service requirements of users and workload characteristics. The course is mainly based on the use of analytic queuing network models of computer systems. The performance techniques are applied to study the performance of centralized, distributed, parallel, and client/server systems. The course also discusses performance measuring tools for operating systems such as Unix and Windows NT. Prereq: operating systems fundamentals or equivalent.

## 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 Specification and Verification of Software Systems

Credits: 3.00

Course focuses on the formal specification and verification of reactive systems, most notably concurrent and distributed systems. Topics relevant to these systems, such as non-determinism, safety and liveness properties, asynchronous communication or compositional reasoning, are discussed. We rely on a notation (T LA+, the Temporal Logic of Actions) and a support tool (TLC, the TLA+ Model Checker). 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 post-condition is also assumed.

## CS 851 - System Requirements Engineering

Credits: 3.00

This course focuses on the skills required to identify, analyze, synthesize, and manage system requirements. It addressed the key requirements gathering and analysis tasks throughout the system life cycle. Participants learn about the requirements process, explore what constitutes good requirements, and understand how requirements are documented. A case study provides practice and feedback on key skills of the requirements process. Techniques and models are introduced that must be considered in defining systems that achieve higher customer satisfaction within constraints. Interpersonal skills critical to interacting with stakeholders (e.g., customers and users) are emphasized coequally with technical issues.

## CS 852 - Software Architecture Concepts

Credits: 3.00

A software architecture concerns the top-level structures of a software system, the externally visible properties of those structures, and their interrelationships. This course examines the role of architecture in satisfying an organization's business requirements. The hard choices that must be made by the architect to fulfill the often conflicting needs of performance, availability, security, interoperability, and modifiability are highlighted. Other topics include representations of architectures, case studies, and the role of architecture in product lines.

### CS 853 - Software Project Management

Credits: 3.00

This course addresses an advanced set of software project management essentials that can affect the bottom line of project technical and business performance. The focus is on larger scale complex projects that a student is likely to encounter in the workplace after 3-5 years of experience. These essentials are termed "best practices," and those addressed are: formal risk management, agreement on interfaces, metrics based scheduling/tracking, frequent binary completion milestones, incremental development, people aware management style, and change management. The emphasis is on software intensive projects; however, the basic principles are pertinent to a wider class of project domains that involve intellectual product development where problem discovery is a main characteristic.

### CS 858 - Algorithms

Credits: 3.00

An introduction to important concepts in the design and analysis of algorithms and data structures, including implementation, complexity, analysis, and proofs of correctness. Prereq: understanding of basic data structures, familiarity with proof methods and basic concepts from discrete mathematics and the ability to program with recursion.

### 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 non-literal 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 871 - Web Programming Paradigms

Credits: 3.00

In this course you will learn languages to program the Web. Languages integrated into browsers, like Javascript, and languages invoked on the server, like Ruby. You will also learn about frameworks, like Rails, and various techniques used to support the programming process. In addition, you will learn languages you will need to create, modify and process Web documents. Although we will learn how to read and write in these languages, our primary goal will be on understanding how the design of these multi-paradigm dynamic languages support the process of developing Web applications. Prereq: programming language concepts or permission.

### 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: 1.00 to 4.00

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

May be repeated up to a maximum of 6 credits. 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 920 - Advanced Operating Systems

Credits: 3.00

This course covers techniques for formally analyzing various fundamental concepts and mechanisms which form the basis of the design of advanced operating systems, including distributed, database, and multiprocessor operating systems. Topics covered include synchronization, mutual exclusion, distributed algorithms, security, fault-tolerance, and distributed resource management. Prereq: operating system 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 931 - Combinatorial Search and Heuristic Optimization

Credits: 3.00

The goal of this class is to teach you how to cope with intractable combinatorial optimization problems. Focuses on techniques from artificial intelligence that attempts to combat intractability by exploiting as much available information as possible. Covers concepts and algorithms for solving shortest-path, constraint satisfaction, and combinatorial optimization problems, and their application in areas such as planning, robotics, and bioinformatics. Emphasis on important or recent papers in the field. Prereq: Introduction to Artificial Intelligence.

### 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 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. May be repeated up to a maximum of 6 credits.

### 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 pseudo color 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 845 - Environmental Acoustics I: Air and Water

Credits: 4.00

Sound and vibration; simple harmonic oscillators; characteristics and measurements of sound sources and receivers; acoustic wave equation (1D, 2D, 3D); sound reflection, transmission, refraction, and absorption in various media; room acoustics; basic sonar equation. Lab. (Also listed as OE 845.)

#### 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 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 feed-forward 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 non-digital 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 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, electromyogram, electroencephalogram, pulse, and temperature. Current research topics, such as biotelemetry, ultrasonic diagnosis, and computer applications. Lab.

#### ECE 885 - Environmental Acoustics II: Air and Water

Credits: 4.00

General sonar equation: active, passive; sound generation, source level, directivity, calibration methods; sound propagation, rays and normal modes, acoustic waveguides; transmission loss, reverberation, scattering; ambient noise characteristics and measurements; sound reception and processing. Lab. (Also listed 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

May be repeated up to a maximum of 6 credits. Cr/F.

#### ECE 900 - Seminar

Credits: 2.00

This seminar course exposes students to advances in various fields of science and technology. Researchers and practitioners from industry and academia present their work. May be repeated up to a maximum of 4 credits.

#### 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 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

Discrete-time stochastic signals, signal modeling, parameter estimation, optimal filtering and decision making, with application to adaptive filters, echo cancellation, channel equalization and parametric spectral estimation. Requires prior coursework in discrete-time LTI systems, analysis and design of recursive and non-recursive linear digital filters, and Fourier based 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 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 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: 3.00

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 825 - Mathematical Economics

Credits: 3.00

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 847 - Multinational Enterprises

Credits: 3.00

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 868 - Seminar in Economic Development

Credits: 3.00

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: 1.00 to 3.00

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

### ECON 908 - Environmental Economics: Theory and Policy

Credits: 3.00

Applies microeconomic tools to issues in environmental economics. Considers the role of government, externalities, public goods, property rights, and market failure. Identifies and compares different policy instruments such as administrative regulation, marketable permits, tax incentives, and direct subsidies, along with consideration of complicating factors such as information, uncertainty and risk. These tools are applied to various policy issues such as air pollution, solid waste management, and recycling. Prereq: ECON 926 and 976.

### ECON 909 - Environmental Valuation

Credits: 3.00

Focuses on the theory and methods for estimating the economic values of environmental resources and public goods (such as clean air and water, preservation of wetlands or coastal resources, etc.) many of which are not exchanged in established markets and therefore do not have prices associated with them. The valuation of environmental resources is an important component in benefit-cost analyses which are used in policy making. Provides a blend of theory and hands-on applications of methods and real data sets. Prereq: ECON 926, 927, 976.

### ECON 926 - Econometrics I

Credits: 3.00

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: 3.00

Asymptotic theory, likelihood estimation, simultaneous equations, panel data analysis, binary and multiple choice models, count data analysis, selection models, survival analysis. Prereq: ECON 926.

### ECON 928 - Econometrics III

Credits: 3.00

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. Prereq: ECON 926 and 927 or equivalents.

### ECON 941 - Survey of Health Economics

Credits: 3.00

An Introduction to the health care sector of the economy designed to provide students with: an overview of the scope of issues covered in the field; a basic analytical and empirical "tool kit" that will enable them to ask and answer questions as a health economist; and an understanding of the most important institutional features of the United States health care system. Topics include market failures in health care, demand for health, public and private insurance programs, health behaviors, and the relationship between health, income, and inequality. Prereq: ECON 926 and 976 (927 recommended).

### ECON 942 - Selected Topics in Health Economics

Credits: 3.00

Covers broad range of health-care-related issues and analytical tools with the aim of helping students to successfully compete for career opportunities in health care education, research, and policy and to initiate possible dissertation essays. Topics vary each year in response to specific student interests and current events may include cost-benefit and cost-effectiveness analysis, comparative health systems (international institutions) and pharmaeconomics. Prereq: ECON 926 and 976 (927 recommended).

### ECON 945 - International Trade

Credits: 3.00

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

### ECON 946 - International Finance

Credits: 3.00

Topics include the marcoeconomics of open economics, balance of payments, international financial markets, exchange rate fluctuations and puzzles, currency crises, and exchange rate policy.

### ECON 957 - History of Economic Thought

Credits: 3.00

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: 3.00

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

#### ECON 970 - Advanced Economic Theory

Credits: 3.00

Advanced topics in both microeconomic and macroeconomic theory. Topics covered may include cooperative and non-cooperative game theory, general equilibrium models, and dynamic optimization. Prereq: ECON 972 and 976.

#### ECON 972 - Macroeconomics I

Credits: 3.00

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: 3.00

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: ECON 926 and 972.

#### ECON 976 - Microeconomics I

Credits: 3.00

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

#### ECON 977 - Microeconomics II

Credits: 3.00

Analysis of stability, cooperative and non-cooperative game theory, information economics, exhaustible resources, disequilibrium, public goods, public choice, and input-output analysis. Prereq: ECON 976.

#### ECON 978 - Teaching Economics

Credits: 4.00

This seminar-style course helps prepare graduate students to become effective teachers of economics at the college level. Emphasis is on teaching at the principles level. Students study and discuss key issues, including the learning process, the objectives of principles classes and of the economic major, heterogeneous learning styles, chalk and talk, vs. active learning, testing and the testing effect, homework, and the role of textbooks. Students also write teaching philosophies, lead discussion sessions, present research on teaching, and deliver short lectures to the class on specific topics at the principles level.

#### ECON 979 - Research Skills

Credits: 3.00

Aids students in completing their master's paper for which they conduct research on a particular economic problem or issue using the knowledge and skills they have gained from their other classes. While the use of data and econometric analysis are encouraged, students may choose a topic that contains neither, such as a paper on the history of thought or on economic theory. Students meet regularly with their faculty advisor throughout the term. They also present their work at various stages of completion. Presentations of students' topics and final papers are made to the faculty. Prereq: ECON 926, 972 and 976.

#### ECON 988 - Graduate Economics Seminar

Credits: 2.00 to 12.00

Attend weekly graduate economics seminars; write reviews and critiques of seminar papers; participate in discussion at seminars. May be repeated up to a maximum of 6 credits for Masters students and up to 12

credits for Ph.D. students

ECON 992 - Field Workshop

Credits: 3.00

Provides a platform for students to become well read in their chosen major field. Students receive a field-specific reading list at the beginning of the term, which they are expected to work through independently. Students present papers and chapters from their reading lists in class. They also write a literature review on a topic in their chosen field and present this research at various stages of completion. Presentations of students' final papers are made to the faculty. Prereq: One approved field class.

ECON 995 - Independent Study

Credits: 1.00 to 6.00

Prereq: permission of adviser and instructor.

ECON 996 - Research Workshop

Credits: 2.00

Present research papers in the graduate economics seminar series; serve as a discussant for seminar presentations; write reviews and critiques of seminar papers; participate in discussion at seminars. May be repeated up to a maximum of 4 credits for 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 800G. 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. 803F has a special fee when taught in Manchester.

### 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 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 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 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 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 818 - Early Adolescent Development and Learning

Credits: 4.00

Course examines the nature of early adolescence from a psychological point of view, with a strong emphasis on creating learning environments that promote growth and development at this age. Developmental psychology suggests the importance of stage-environment fit especially during early adolescence in promoting socialization, achievement motivation, and learning outcomes. Participants develop their understanding of research on early adolescence as well as their knowledge of educational practices in middle level schools and classrooms. The course is geared toward present and future middle level school teachers, counselors, and administrators.

#### EDUC 820 - Integrating Technology into the Classroom

Credits: 4.00

Participants gain practical experience that takes specific advantage of technology to enhance and extend student learning. State academic standards and national technology standards are used to make decisions about curriculum content and to plan technology-based activities. Participants use electronic management tools such as iMovie, Powerpoint, podcast, webcast, Comic Life, Audacity, and Garage Band are featured in this hands-on course.

#### 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. 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 - Facilitating Social Understanding and Relationships for Students with Disabilities

Credits: 2.00

The course will focus on the classroom and individual supports needed by students with intellectual and other developmental disabilities, including autism spectrum disorders, in order to have a wide variety of satisfying social relationships. Participants identify the factors that (a) are essential to the development of shared social understanding between students with and without disabilities; (b) promote reciprocal social relationships; and (c) how to recognize and mitigate barriers to reciprocal relationships.

### EDUC 856 - 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 857 - Contemporary Issues in Autism Spectrum Disorders

Credits: 4.00

The goal of this course is to enhance students' understanding of contemporary issues related to educating students with autism spectrum disorders (ASD). The course is grounded in a theoretical foundation that values the perspectives of individuals with ASD in academic, research, policy, and clinical endeavors. Learning outcomes focus on strategies for identifying opportunities for learning, communication, literacy, and social relationships in a variety of inclusive environments. May be repeated up to a maximum of 8 credits. Permission required. Prereq: UNH Summer Institute on Autism.

#### 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 - Pro-seminar 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 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. May be repeated up to a maximum of 10 credits. 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 bi-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 902 - Doctoral Pro-seminar

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 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 and writing 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, and diagnosis/remediation. Prereq: permission.

EDUC 918A - Seminar on Research in Literacy Instruction

Credits: 2.00

The purpose of this seminar is to study the disciplinary traditions that inform contemporary conceptions of literacy instruction both in and out of school. It will draw on research from social and cognitive psychology, literary theory, cultural studies, and feminist epistemology. An emphasis will be placed on preparing doctoral students to meet the needs of students in an increasing pluralistic population.

EDUC 918B - Seminar on Research in Literacy Instruction

Credits: 2.00

See description for EDUC 918A.

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 foundational 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 supervised field experience at approved internship site. Small group format uses audio-taped samples of counseling sessions, providing critiques and educational supervision of counseling and consulting activities. Prereq: EDUC 925.

#### EDUC 927 - Human Growth & Development: Personality Theory

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 929 - Advanced Counseling Internship

Credits: 4.00

Seminar accompanies supervised field experience at approved internship site. Weekly critiques of audio-taped 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 diagnostic 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 pro-social 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 - Socio-cultural 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 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. Ethno-psychology 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 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 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 - School Law

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 - Foundations for Leadership in Higher Education

Credits: 4.00

Seminar for master's and doctoral level students in education and related fields. Focus on the organization, structure, function, and dynamics of institutions of higher education, and the corollary roles and

responsibilities of leaders in academic and student affairs. Intended for those currently in or planning to enter into leadership roles in a college or university.

#### 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 - Policy, Politics, and Planning in Education

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 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 978 - Applied Regression Analysis in Educational Research

Credits: 4.00

This course introduces students to simple and multiple regression analysis, specifically as the methods are applied to research questions in educational research. Students learn about the linear regression model and its assumptions, how to use SPSS to fit the model to data, and how to interpret results. Students will also learn how to: evaluate the tenability of the model's assumptions; conduct thoughtful model building; model the effects of categorical predictors and statistical interactions; and handle multi-collinearity. The use of statistical techniques are modeled in class and then students apply these new techniques to datasets of educational relevance from a variety of sources, including educational surveys, observational

studies, and randomized experiments. Students learn how to interpret the outcomes of their analyses thoughtfully and meaningfully and are asked to communicate these interpretations clearly and concisely in writing. Prereq: EDUC 881 or equivalent.

#### EDUC 979 - Applied Multilevel Modeling

Credits: 4.00

This applied course in multilevel modeling is designed for graduate students in education and the social sciences who are interested in conducting statistical analysis to answer questions about (1) contextual effects on individual outcomes, and (2) individual change over time. Topics addressed include exploratory analyses of multilevel data, conditional and unconditional models, fixed and random effects, model assumptions, model fit, non-linear change, discontinuous change, time-varying predictors, unequally spaced measurement occasions, and three-level multilevel models. Prereq: EDUC 978 or the equivalent.

#### 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 - Teacher as Researcher

Credits: 4.00

This course addresses the twofold aim of (a) preparing educational practitioners to conduct systematic inquiry in their classrooms and/or schools and (b) introducing strategies and criteria for understanding, evaluating, and applying educational research.

#### 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 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 Environmental Values, Policy, and Planning. A four week program, meeting four days/weeks for six-eight hours/day, with out-of-class assignments 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

This course is the capstone experience for students in the MA Program in Environmental Education. It combines a field placement in environment education with a Practicum Seminar to give students the opportunity to put what they have learned into practice in a context that is appropriate for their professional development and career goals. The Practicum also provides students with support in completing the Program Portfolio requirement for the master's degree.

## English

### ENGL 800 - Studies in Literature

Credits: 4.00

Students in the MAT, MEd, and MST programs, as well as non-degree students, can register for graduate course work in English under this number. The precise topics and focus of each section vary. Topics include Old English Literature, Medieval Literature, 16th century, 17th century, 18th century, English Romantic Period, Victorian Period, 20th and 21st Century, Drama, Novel, Poetry, Fiction, Nonfiction, A Literary Problem, Literature of the Renaissance, Postcolonial Literature, 20th to 21st Century American Literature. Barring duplication of subject, may be repeated for credit. Note: Students in the MA and PhD programs in English may not take English 800 for credit toward their degrees. English 800 will only be offered on the Manchester campus.

### 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 - The Art of Research for Creative Writers

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 - Fiction: Form and Technique

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 - Nonfiction: Form and Technique

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 - Poetry: Form and Technique

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 812 - Writing the Creative Nonfiction Book

Credits: 4.00

In this course, students learn to flesh out an idea for a book of creative nonfiction, which could either be literary journalism - a tale based on reportage - or memoir. Students focus on pulling multiple themes together in a strong narrative. By semester's end, students have written a book proposal and a first chapter. Students are asked to arrive at the first class with a topic researched enough to begin the book process. Permission of instructor required. May be repeated for credit up to 8 credits.

### ENGL 814 - 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? Lecture-discussion format.

### 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 830 - Practicum in Teaching English and the Language Arts

Credits: 1.00 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 838 - Topics in Asian American Studies

Credits: 4.00

Study of literature, history, scholarship, and current thought by and about Asian America. Representative works from among Japanese Americans, Chinese Americans, Korean Americans, Southeast Asian Americans, South Asian Americans.

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 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. May be repeated for credit, barring duplication of topic. (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. May be repeated for credit, barring duplication of topic. (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. May be repeated for credit, barring duplication of topic. (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. May be repeated for credit, barring duplication of topic. (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. May be repeated for credit, barring duplication of topic.

### 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 858 - Shakespeare

Credits: 4.00

A few plays studied intensively. Live and filmed performances included as available.

#### 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 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 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 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 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 899 - Master of Fine Arts in Writing Thesis

Credits: 1.00 to 8.00

Eight credits required, that can be taken in any combination during the student's academic coursework. Maximum of 8 credits. IA (Continuous grading). Cr/F.

#### 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 902 - Master Fiction Workshop

Credits: 4.00

A fiction workshop for third-year M.F.A. students to refine the drafts of their book-length M.F.A. thesis. Completion drafts will be workshopped and revised. Various directed readings. May be repeated for credit up to 8 hours. Special fee.

ENGL 903 - Advanced Memoir Writing

Credits: 4.00

Workshop of essays/chapters in memoir, and discussion of current models of the form. Individual conferences with instructor. Written permission of 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. May be repeated for credit, barring duplication of topic.

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: 1.00 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. May be repeated to a maximum of 8 credits.

#### 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: 1.00 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) Ethnographies 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 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.

## Engineering

### ENGR 891 - Engineering Fundamentals I

Credits: 4.00

The purpose of this course is to provide recent hires into the ELDP (Engineering Leadership Development Program) at BAE Systems with the engineering fundamentals needed to address the complex problems that face BAE Systems engineers. The focus of the course is to help one develop the ability to solve difficult and complex problems within interdisciplinary engineering teams. Engineering breadth is gained through a series of modules. This is the first of two courses taken by BAE Systems engineering in the ELDP during their first year, in order to take the class a person must be in the BAE Systems ELDP program.

### ENGR 892 - Engineering Fundamentals II

Credits: 4.00

The purpose of this course is to provide recent hires into the ELDP (Engineering Leadership Development Program) at BAE Systems with the engineering fundamentals needed to address complex problems that face BAE Systems engineers. The focus of the course is to help one develop the ability to solve difficult and complex problems within interdisciplinary engineering teams. Engineering breadth is gained through a series of modules. This is the second of two courses taken by BAE Systems engineering in the ELDP during their first year. In order for a student to take this course they must be in the BAE Systems ELDP program.

### ENGR 999 - Doctoral Research

Credits:

Cr/F.

## Earth, Oceans, & Space

### EOS 807 - Environmental Modeling

Credits: 4.00

Environmental Modeling introduces students to a range of key mathematical and computer modeling concepts and the ways they can be used to address important scientific questions. The course is divided into four topical sections: Population and Community Ecology, Hydrology, Biogeochemistry, and Ecosystems. In each section, modeling concepts and skills are presented together with environmental information to emphasize the linkage between quantitative methods and relevant scientific results. Prereq: MATH 425. (Also listed as NR 807.)

### 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.) (Alternate years only.) Cr/F.

### EOS 812 - Introduction to Space Plasma Physics

Credits: 4.00

Introduction to the subject of space plasma physics including solar physics, heliospheric physics, magnetospheric physics, and ionospheric physics. The course provides an overview of the basic phenomena and processes (e.g. particle acceleration and transport, shock formation, magnetic structures and reconnection, wave propagation, wave-particle interactions, instabilities), theoretical techniques (e.g. single-particle orbits, kinetic and fluid descriptions), and experimental techniques. (Also offered as PHYS 812.) (Alternate years only.)

### 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 817 - Macro-Scale Hydrology I

Credits: 3.00

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: 3.00

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 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 844 - Biogeochemistry

Credits: 4.00

Examines the influence of biological and physical processes on elemental cycling and geochemical transformations from the molecular to the global scale, involving microorganisms, higher plants and animals and whole ecosystems; factors that regulate element cycles including soils, climate, disturbance and human activities; interactions among the biosphere, hydrosphere, lithosphere, and atmosphere; transformations of C, N, S, and trace elements. Prereq: one semester each of biology and chemistry. (Also offered as NR 844.)

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 864 - Data Analysis in Earth System Science

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 ESCI 864.) Special fee.

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 867 - Earth System Science

Credits: 4.00

This course provides an introduction to the study of Earth as an integrated system. It investigates the major components (e.g. atmosphere, biosphere, cryosphere, hydrosphere, and lithosphere), dynamics (e.g., energy balance, water cycle, biogeochemical cycles), and changes within the earth system. Particular emphasis placed on the interactions and feedbacks within the system. The links between

components will be presented by examining present day processes and selected events in Earth's history. The lab portion examines these concepts through the development and use of computer models of Earth system processes. Prereq: Calculus. Permission. Lab. (Also offered as NR 867.)

#### 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 954 - Heliospheric Physics

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 PHYS 954.

#### 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;/ 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 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 817 - Macro-scale Hydrology I

Credits: 3.00

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: 3.00

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 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, multi-systems, 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 834 - Geophysics

Credits: 4.00

The structure of the solid Earth, including the continental and oceanic lithosphere and the deep interior as revealed by investigations of seismic waves, the Earth's gravitational and magnetic fields, heat flow, and earthquakes. Prereq: ESCI 401; one year of calculus; one year of college physics; or permission. Special fee. Lab.

#### ESCI 841 - Geochemistry

Credits: 4.00

Course focuses on the application of chemical principles to solve problems in the Earth sciences. Students learn the chemical tools of thermodynamics and kinetics, element partitioning, conservation of mass, and isotope geochemistry. Explore geochemical properties/processes in the deep Earth and the Earth surface, atmosphere and marine systems, and cosmo-chemistry and investigate the interactions between these components of the Earth system. Lab.

#### ESCI 845 - Isotope Geochemistry

Credits: 4.00

Course focuses on the application of radiogenic, radioactive and stable isotopes to improve students' knowledge about the processes and timescales relevant to the formation of the planet and solar system, the evolution of the Earth system and interactions in the hydrosphere and biosphere. Topics include geochronology, tracer applications, Earth surface applications, as well as applications in the hydrosphere and biosphere. Systems discussed include the classic radiogenic systems (K-Ar, Rb-Sr, Sm-Nd, Lu-Hf and U-Th-Pb), traditional (H, C, N, O) as well as nontraditional (e.g., Mg, Ca, Fe) stable isotope systems, and radioactive isotopes (e.g., radiocarbon). Course consists of lecture, where students are exposed to these applications, and a lab section to work through any questions on the homework assignments, discuss relevant papers from the literature, and carry out a project. 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 854 - Sedimentology

Credits: 4.00

This course focuses on modern sedimentary processes and ancient sedimentary records through the examination, identification, and interpretation of sediments and sedimentary rocks. Topics such as sediment transport mechanisms, depositional environments, and time in sedimentary records will provide a strong framework for any student studying Earth processes and sedimentary systems. Special fee.

#### ESCI 856 - Geotectonics

Credits: 3.00

The geological record of plate tectonics past and present. The first part of the course focuses on modern tectonic settings with an emphasis on plate geometries, geodynamical processes, and sedimentary products. The second part of the course focuses on reconstructing ancient tectonic settings with an emphasis on methodology (paleomagnetism, basin analysis, provenance) and case studies (e.g. India-Asia collision). Field trip. Prereq: ESCI 614 or ESCI 631 or permission. Special fee.

#### 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 862 - Glacial Geology

Credits: 4.00

Course provides a survey of glacier dynamics and processes, with an emphasis on understanding the origin and significance of glacial deposits and landforms. The first half of the course examines the physics of glaciers, and the second half focuses on glacial geologic processes. Lectures discuss glaciers and ice sheets as key agents of large-scale geomorphic change, as well as their central role in the Earth's past and present climate system. Labs involve analysis of glaciological data, glacial-geologic map interpretation, and short field exercises. Course incorporates one mandatory weekend field trip that explores the glacial landscapes of New England. Special fee. Lab.

#### ESCI 864 - Data Analysis in Earth System Science

Credits: 4.00

Analytical and numerical methods used to understand geospatial and time series data sets encountered in Earth system science research. Students develop skills in data analysis, primarily through writing and modifying their own computer programs, focused on particular aspects of real data sets. Understanding various data types, formats, and projections, and how to handle them, are also covered. Prereq: one year calculus, one year chemistry, basic statistics;/or permission. (Also listed as EOS 864.) Special fee.

#### ESCI 865 - Paleoclimatology

Credits: 3.00

Course reviews the study of past changes in the Earth's climate system. Main discussion topics include

astronomical theories of ice ages, Quaternary dating methods, Antarctic and Greenland ice core records, greenhouse gases, marine-based climate proxies, glacial mega-floods, and linkages between ocean circulation and abrupt climate change. Emphasis on climate variability during the Quaternary period (the last approximately 1.8 million years), a time interval dominated by cycles of global glaciation. Lectures include discussion of recent and emerging scientific papers in order to keep pace with the latest findings in paleoclimatic research.

#### ESCI 866 - Volcanology

Credits: 4.00

Provides a comprehensive overview of volcanic processes and their influences on planetary evolution and modern-day Earth systems. Lectures discuss the generation and properties of magma, tectonic setting of volcanism, eruption styles, volcanic landforms and products, monitoring of active volcanoes, volcanic hazards, and volcanism on other planets. Laboratory topics include modeling volcanic processes, hand-sample observation, topographic map interpretation, volcanographical data analysis, and two afternoon field trips. As volcanology is a rapidly developing field of active research, the course incorporates discussions of recent and emerging scientific papers from the literature and student-led updates of ongoing volcanic activity. Prereq: on year of calculus and one Earth Science course or permission. Special fee. Lab.

#### ESCI 870 - Fundamentals of 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: 4.00

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

May be repeated up to a maximum of 6 credits. 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 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. (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, multi-beam 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 up to a maximum of 4 credits.

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. Special fee. 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. Special fee. 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. Special fee. 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, trans-generational, 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 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 876 - Children, Adolescents and the Law

Credits: 4.00

This course is designed to familiarize students with the specialized laws and adjudicative systems that govern children, adolescents and families and reflect society's effort to balance competing interests and goals. It provides the chance to explore laws and processes that affect children and adolescents as they interact with their caregivers, families and society at large; permission.

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

May be repeated up to a maximum of 10 credits. Cr/F.

### FS 911 - Graduate Internship

Credits: 2.00 to 8.00

Advanced, supervised internships in professional setting. A) Child Development; B) Adolescent Development; C) Child Advocacy and Family Policy. May be repeated to up to a total of 8 credits. Prereq: instructor's permission. Cr/F.

### FS 930 - Child Development in Context

Credits: 4.00

Theory and research on social, cultural, and developmental issues of early childhood with a particular emphasis on ecological and social constructivist frameworks. Prereq: instructor's permission.

### 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 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 950 - Contemporary Issues in Adolescent Development

Credits: 4.00

This course is a graduate-level seminar that focuses on contemporary issues faced by youth, adolescents, and emerging adults in our society. Focus is also on the social ecology of adolescent development, which means understanding adolescents within the contexts of families, peers, schools, communities, and the broader culture. This course also emphasizes the positive youth development perspective and approaches aimed at enhancing the lives of youth, adolescents, and emerging adults.

### FS 952 - Clinical Interventions in Couples Therapy

Credits: 4.00

This course will explore interventions that target problems faced by couples at various ages and stages of their relationship. The focus will be on developing and implementing effective strategies for enhancing attachments as well as approaches for improving communication and problem-solving skills in Couples Therapy. The format will be interactive with illustrative demonstration.

### FS 954 - Human Sexuality, The Treatment of Sexual Problems, and the Clinical Applications of Sexual Therapy

Credits: 4.00

This course begins preparing graduate student therapists to address sexual topics with clients. Using a foundation grounded in the physiology, psychology, and sociology of human sexual development, this course explores problems in sexual interaction and treatment options available through sex therapy, focusing on the integration of sex therapy with couples therapy. Students are encouraged to examine their own attitudes, values, and beliefs regarding sexuality, and will deconstruct "sexual dysfunction".

### 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: 5.00

Expression and transfer of genetic elements (chromosomal and non-chromosomal) 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. Special fee.

### 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: 604; BIOL 528 recommended. (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. Prereq: BIOL 604 or ANSC 612. (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: BIOL 604 or equivalent. Lab. (Also listed as BCHM 811.)

### GEN 812 - Introduction to Perl programming for Bioinformatics

Credits: 4.00

This first course in Perl programming is designed to enable undergraduate and graduate students in the life sciences to solve fundamental biological questions of simple to moderate complexity that require the use of computers to automate repetitive, exhaustive tasks and handle query results efficiently including: computing values of important parameters of biological sequence data, writing pattern search and motif discovery scripts, accessing, querying, manipulating, retrieving, parsing, analyzing and saving data from local and remote databases. Prereq: BIOL 604 or permission.

### GEN 813 - Microbial Ecology and Evolution

Credits: 4.00

Functional roles of microorganisms, their population dynamics and interactions, and their mechanisms of evolutionary change in natural communities, laboratory experiments, and simple mathematical models. Special emphasis on the tempo and mode of prokaryotic adaptation, the evolution of virulence, and the origin of new pathogens. Prereq: General Microbiology (Also listed as MICR 813.) Special fee.

### 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: BIOL 604 or equivalent; some knowledge of statistics is recommended. Special fee. Lab. (Not offered every year.)

#### GEN 828 - Statistical Genomics

Credits: 4.00

The primary objective of this course is to provide a strong foundation in fundamental statistical concepts, particularly as they relate to genomics. Topics will include: linkage disequilibrium, haplotypes, statistical tests used for evolutionary genetic and genomic analysis, recombination, selective sweeps, detecting gene variants in common diseases, modeling methods used in genomics, quantitative trait loci, Bayesian methodology, Markov Chain Monte Carlo methods, epistasis, and analysis of microarray databases.

#### 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: BIOL 604 or equivalent. (Also offered as P BIO 853.) Special fee. Lab. (Not offered every year.)

#### 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: BCHM 658/659 or 751; BIOL 604 or equivalent;/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. Lab. Prereq: principles of genetics or equivalent; introductory botany or principles of biology I and II or equivalent. (Also offered as P BIO 872.) (Not offered every year.)

#### 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.) (Not offered every year.)

#### 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 895 - Special Topics

Credits: 2.00 to 4.00

GEN 899 - Master's Thesis

Credits: 1.00 to 10.00

May be repeated up to a maximum of 10 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 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. May be repeated up to a maximum of 9 credits. Cr/F.

### GRAD 890 - UNH Law Exchange

#### Credits: 1.00 to 3.00

Graduate degree students may enroll for courses at the UNH School of Law that are not offered through the Graduate School and will normally fulfill elective degree requirements in the students major program. Eligibility requirements include good academic standing (3.0 or better), good financial standing, permission of the graduate program committee or advisor and permission of the graduate school. For information contact the Graduate School. May be repeated up to a maximum of 9 credits. Normally no more than one course can be taken at the law school in any one term.

### 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 920 - Qualitative Institute

#### Credits: 2.00

This course explores strategies for navigating crucial junctures in qualitative data analysis. Through focused applications including ethnographic, grounded theory, and/or case study approaches, we examine how the researcher's question(s), theoretical stance, unit of analysis, and case-specific of collective orientation shape analytic options and decisions. Students work with data already in the process of being generated and analyzed. Prior coursework or experience in qualitative research is required.

### GRAD 930 - Ethics in Research and Scholarship

#### Credits: 2.00 or 3.00

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 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 application of best teaching practices. Includes a formal examination on the scholarship of teaching and learning. Capstone course for experienced faculty. By permission only.

#### GRAD 950 - Issues in College Teaching

Credits: 2.00

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 to 2.00

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 3 credits. Cr/F.

#### GRAD #955 - Gender in College Teaching

Credits: 2.00

Issues of gender difference and similarity in college teaching and learning. Examination of gender-related issues from both a student and faculty perspective, including classroom interactions, student learning styles, course design, and faculty development. Application to specific fields and disciplines. 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 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 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 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 898 - Special Topics

Credits: 1.00 to 8.00

Special fee on some topics.

## 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 Historical Explorations

Credits: 4.00

A seminar for advanced undergraduates and graduate students on a selected topic. Topics will vary by semester. This course will be discussion-based and meet once a week. There are no prerequisites for this course, but students should expect to be assigned substantial reading and writing.

### HIST 802 - Holocaust: The War on Europe's Jews

Credits: 4.00

The attempted destruction of European Jewry during the Third Reich is one of the pivotal events in the history of modern Western Civilization. This course explores the circumstances and behavior of the Jews (as victims, resisters, survivors), the perpetrators (German and non-German), bystanders (German, European, and American), and rescuers (German and non-German). Attention is also given to such post-1945 matters as justice, compensation, and memory.

### 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 804 - History of Medicine in the United States

Credits: 4.00

Have you been a patient, a nurse, or a holder of insurance? Almost everyone in the United States has a role in health care. We study the growth and development of the field of American medicine from colonial times to the present, examining the changing relationships between patients, health care professionals, technology, government, and others. The focus will be shifts in responsibility and authority over time from patients, to doctors, and even to businesses.

### 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 813 - American Ways of War

Credits: 4.00

"Is there an American way of war?" This commonly asked question will be the focal point of the course. To answer that we will study the interactions of both war and society in the United States from the Civil War onwards, addressing such issues as the causes, courses, diplomacy, homefront, legacy, and the art of the great and small wars.

#### 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 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 833 - Medieval England 800-1300

Credits: 4.00

The purpose of this course is to provide students with an opportunity to gain an in-depth understanding of the history of medieval England from the beginning of the period of consolidation under the Wessex dynasty in the ninth-century through the end of the thirteenth century. In addition to obtaining a large corpus of information through the reading of significant monographs dealing with England during this period, students will be challenged to develop the critical analytical skills necessary for the thorough understanding and practice of historical methodologies, with a particular focus on the practice of historical method in writing medieval history. Finally, students will be given the opportunity to improve their communication skills through extensive class discussions dealing with the scholarly works read for this course, and in writing assignments.

## HIST 834 - Medieval Empires

Credits: 4.00

This course will explore the intellectual and political foundations of imperial rule in the Middle Ages with a particular focus on the Carolingian, German, and Byzantine empires of the early and high Middle Ages.

The course will begin with the development of the idea of empire under Alexander the Great and then during the Roman empire. The course will then turn to an examination of how the rulers of the three great empires of the western Middle Ages adapted the classical ideas and practices of empire for their purposes. The course focuses on sources. Background material will be provided in short lectures.

#### 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 - Saints, Sinners, and Heretics: Europe in the Age of Religious Reform

Credits: 4.00

Examines the history of Western Christendom from roughly 1400 to 1600, a period of tumultuous religious change throughout Europe. We begin in the Middle Ages where the seeds of religious division were sown. We then tackle Martin Luther's challenge to the Catholic church, trace the diffusion of his message throughout Europe, and address the Catholic response to the evangelizing movements that he inspired. Finally we investigate some of the regional varieties of Protestantism that developed in the latter half of the sixteenth century with a particular focus on Switzerland, Germany, England, Scotland, France, and the Netherlands.

#### 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 845 - 19th Century European Great Powers - Diplomacy and International Law

Credits: 4.00

In this lecture and discussion class, we will study Europe during the apogee of that region's strength, emphasizing events such as the creation of Italy, the Scramble for Africa, and the Hague Convention efforts to limit war. To do so, we will focus on those who wielded power, including deal-makers, deal-breakers, manipulators, and idealists like Napoleon, Bismark, and Gladstone. Examining the interactions of these people and events illuminates international law as well as traditional diplomacy.

### 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 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 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 862 - England in the Tudor and Stuart Periods

Credits: 4.00

See description for HIST 861.

### 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 ground-fishing 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 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 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 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

May be repeated up to a maximum of 6 credits. 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 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. May be repeated up to a maximum of 12 credits. 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. Prereq: enrollment in nursing master's program; HMP majors and MBA students not allowed. Permission.

### 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 830 - Theories of Justice

Credits: 4.00

The idea of justice is central to social, political, and legal theory. Considerations of justice are appealed to in assessing the legitimacy of governments, the fair distributions of goods and opportunities both with nation-states and globally, and to address specific social concerns such as racial or gender discrimination or access to health care. Course examines both historical sources and contemporary debates about the nature of justice.

### JUST 865 - 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.

### 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: 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. May be repeated up to a maximum of 4 credits. 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. May be repeated up to a maximum of 8 credits. Cr/F.

### JUST 901 - Pro-seminar: 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 907 - Applied Research Methods

Credits: 4.00

This is the second course in the Justice Studies graduate program sequence on research methods and it focuses on how to conduct applied research in the Justice Studies field including how to use quantitative methods in more applied settings and specific research tools frequently used in applied settings (e.g. qualitative methods and program evaluation). Students will work on a class research project as well as their own individual projects.

JUST 950 - Internship

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 Internship

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 for a maximum of 16 credits, but not duplicate content.

JUST 995 - Reading and Research

Credits: 1.00 to 4.00

A) Criminology; B) Law and Society; C) Law and Psychology; D) Philosophy of Law; E) Courts. The students does independent work under the supervision of a faculty member. The student may plan (1) broad reading in an area; (2) intensive investigation of a special problem; or 3) empirical testing on a particular question. May be taken for 1-4 credits. This course is by permission only and requires a signed agreement/proposal prior to registration. Prereq: JUST 901.

## 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: 2.00

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. Prereq: ZOOL 507-508 or COMM 521 or equivalent. 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 831 - Inclusive Teaching Through Sport

Credits: 4.00

This course examines the use sports, including disability sports such as boccia, sit-volleyball, goalball and wheelchair basketball as a program of instruction for individuals of all abilities. The course adopts a holistic approach to inclusion that examines best practices within specific contexts. The medical, social, and relational models of disability are used as a format for discussion and the inclusion spectrum is adopted as the underlying format for instruction.

### KIN 836 - Fitness and Graded Exercise Test 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. Special fee.

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 - PE Practicum for Students with Disabilities

Credits: 4.00

This experience is part of the required coursework for the Adapted Physical Education (PE/APE) certificate through the Graduate School. As a bi-weekly seminar intergrates the field experience with general physical education (GPE) and adapted physical education (PE/APE) concepts through class discussion, exercises, readings, and written assignments. The seminar format provides an opportunity for refinement and continued development of teacher skills and attributes for working with students with disabilities. Students learn to instruct effectively, to participate in the Individual Education Plan (IEP) process, and to manage their time.

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 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. (Also listed as SW 882.)

### KIN 883 - Pysch Factors of Adventure Ed

Credits: 4.00

Adventure educators are often called to work with people facing short-term psychological challenges like being effective in a group or managing fear and discomfort in a vigorous learning environment. Because the adventure environment can be pyschologically demanding, an understanding of basic psychology is an advantage both for effective practice and research. Course emphasizes the history of psychological research to provide a foundation for the adventure educator's work leading, designing and evaluating adventure-based programs.

### KIN 884 - Foundations of Adventure Education

Credits: 4.00

Students study the foundational ideas in adventure education and discuss their historical applications to the field. Contemporary perspectives on adventure education are also examined, and students forecast future directions for inquiry and practice. Topics include human learning and development, social theory, critical perspectives.

### KIN 885 - Program Models and Evaluation in Outdoor Education

Credits: 4.00

Provides an understanding of the major outdoor education program models currently being used. Students also analyze the principles underlying program development and examine current trends and program evaluation approaches. Topics include research methods, evidenced-based practices, and ethics.

### KIN 886 - Organization and Administration of Outdoor Education Programs

Credits: 4.00

Study of administration of outdoor education programs using a variety of organizational models. Students use simulated exercises and work with outdoor agencies on special projects to learn the key factors necessary to manage a program. Field experience. Special fee.

### KIN 887 - Theory of Adventure Education

Credits: 4.00

Provides an in-depth investigation of the theories that underpin professional practice and research in Adventure Education. Students examine program applications in different settings, analyze pertinent outdoor education and social science research, and independently complete a research or applied project. Special fee.

### 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: 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 897 - Advanced Research in Outdoor Education

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. Special fee on some sections.

#### KIN 899 - Master's Thesis

Credits: 1.00 to 6.00

May be repeated up to a maximum of 6 credits. 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. May be repeated up to a maximum of 8 credits. Cr/F.

#### KIN 909 - PE Practicum for Students with Disabilities

Credits: 2.00 to 4.00

This experience is part of the required coursework for the Adapted Physical Education (PE/APE) certificate through the Graduate School. Students are expected to accumulate 30 hours of teaching experience in the schools for every two credits. In addition, attendance at a bi-weekly seminar integrates the field experience with general physical education (GPE) and adapted physical education (PE/APE) concepts through class discussion, exercises, readings, and written assignments. The seminar format provides an opportunity for refinement and continued development of teacher skills and attributes for working with student with disabilities. Students learn to instruct effectively, to participate in the individual Education Plan (IEP) process, and to manage their time.

#### KIN 910 - Curricular Issues in Health Pedagogy

Credits: 4.00

Examines health education and various health promotion programs in school settings using an ecological framework.

#### 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 998 - Special Topics

Credits: 2.00 to 4.00

Occasional, new, or experimental courses for graduate students in both KIN: Sport Studies and RMP.

Prereq: permission. May be repeated for different topics up to a total of 8 credits.

## Languages, Literatures & Cultures

### LLC 842 - Theory and Practice of Translation

Credits: 3.00

This course is designed both as an introduction to various theories and philosophies of translation and as an intensive workshop on different types of translation (literary, technical, professional, business, and health related, etc.). Translation is both a simple matter of transferring content and an intensely complex process of adapting linguistic, tonal, and cultural components of communication. The course works extensively on the craft of translation while developing detailed analyses of the theoretical and philosophical implications of choices made. Students complete various translation exercises and develop a significant final project. It is open to students at different levels of language ability but requires at least an intermediate competency. Students work at their own level. Taught in English. Prereq: Intermediate language or permission.

### LLC 891 - Methods of Foreign Language Teaching

Credits: 3.00

Objectives, methods and techniques in teaching foreign languages from elementary grades through college. Discussion, demonstration, preparation of instructional materials, microteaching of the language skills, including developments in computer-assisted instruction. Special fee.

## 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. May be repeated up to a maximum of 6 credits. 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. May be repeated up to a maximum of 6 credits. 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.)

## Mathematics

### MATH 835 - Statistical Methods for Research

Credits: 3.00

This course provides a solid grounding in modern applications of statistics to a wide range of disciplines by providing an overview of the fundamental concepts of statistical inference and analysis, including t-tests and confidence intervals. Additional topics include: ANOVA, multiple linear regression, analysis of cross classified categorical data, logistic regression, nonparameteric statistics and data mining using CART. The use of statistical software, such as JMP, S PLUS, or R, is fully integrated into the course.

### MATH 836 - Advanced Statistical Methods for Research

Credits: 3.00

An introduction to multivariate statistical methods, including principal components, discriminant analysis, cluster analysis, factor analysis, multidimensional scaling, and MANOVA. Additional topics include generalized linear models, general additive models, depending on the interests of class participants. This course completes a solid grounding in modern applications of statistics used in most research applications. The use of statistical software, such as JMP, S PLUS, or R, is fully integrated into the course. Prereq: MATH 835 or MATH 839.

### MATH 837 - Statistical Methods For Quality Improvement

Credits: 3.00

Introduces scientific data collection and analysis with an emphasis on industrial and service provider applications. Topics include descriptive and graphical statistical methods, confidence intervals and hypothesis testing, regression, ANOVA, statistical process control (SPC), failure modes and effects analysis (FMEA), Six-Sigma concepts and methods, introduction to reliability, quality tools, MSA, and process capability studies, introduction to Lean methodology, such as 5S, Kaizen, and VSM. Use of a statistical software package is an integral part of the course. Prereq: basic introductory statistics.

### MATH 839 - Applied Regression Analysis

Credits: 3.00

Statistical methods for the analysis of relationships between response and input variables: simple linear regression, multiple regression analysis, residual analysis model selection, multi-collinearity, nonlinear curve fitting, categorical predictors, introduction to analysis of variance, analysis of covariance, examination of validity of underlying assumptions, logistic regression analysis. Emphasizes real applications with use of statistical software. Prereq: basic introductory statistics.

### MATH 840 - Design of Experiments I

Credits: 3.00

First course in design of experiments with applications to quality improvement in industrial manufacturing, engineering research and development, or research in physical and biological sciences. Experimental factor identification, statistical analysis and modeling of experimental results, randomization and blocking, full factorial designs, random and mixed effects models, replication and sub-sampling strategies, fractional factorial designs, response surface methods, mixture designs, and screening designs. Focuses on various treatment structures for designed experimentation and the associated statistical analyses. Use of statistical software. Prereq: basic introductory statistics; permission.

### MATH 841 - Survival Analysis

Credits: 3.00

Explorations of models and data-analytic methods used in medical, biological, and reliability studies. Event-time data, censored data, reliability models and methods, Kaplan-Meier estimator, proportional hazards, Poisson models, loglinear models. Suitable statistical software, such as SAS, JMP, S-Plus, or R, are used. Prereq: basic introductory statistics. (Offered in alternate years.)

#### MATH 843 - Time Series Analysis

Credits: 3.00

An introduction to univariate time series models and associated methods of data analysis and inference in the time domain and frequency domain. Topics include: Auto regressive (AR), moving average (MA), ARMA and ARIMA processes, stationary and non-stationary processes, seasonal ARIMA processes, auto-correlation and partial auto-correlation functions, identification of models, estimation of parameters, diagnostic checking of fitted models, forecasting, spectral density function, periodogram and discrete Fourier transform, linear filters. parametric spectral estimation, dynamic Fourier analysis. Additional topics may include wavelets and long memory processes (FARIMA) and GARCH Models. The use of statistical software, such as JMP, or R, is fully integrated in to the course. Prereq: MATH 835 or MATH 839. Offered in alternate years in the spring.

#### MATH 844 - Design of Experiments II

Credits: 3.00

Second course in design of experiments, with applications in quality improvement and industrial manufacturing, engineering research and development, research in physical and biological sciences. Covers experimental design strategies and issues that are often encountered in practice complete and incomplete blocking, partially balanced incomplete blocking (PBIB), partial confounding, intra and inter block information, split plotting and strip plotting, repeated measures, crossover designs, Latin squares and rectangles, Youden squares, crossed and nested treatment structures, variance components, mixed effects models, analysis of covariance, optimizations, space filling designs, and modern screening design strategies. Prereq: MATH 840; 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, joint probability distributions, conditional 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

Introduces the basic principles and methods of statistical estimation and model fitting. One- and two-sample procedures, consistency and efficiency, likelihood methods, confidence regions, significance testing, Bayesian inference, nonparametric and re-sampling methods, decision theory. Prereq: MATH 855; or permission.

#### 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 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 in Mathematics and Statistics

Credits: 1.00 to 4.00

New or specialized courses not covered in regular course offerings. Prereq: permission of instructor. May be repeated.

### 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

May be repeated up to a maximum of 6 credits. Cr/F.

### MATH 903 - Higher Algebra for Teachers I

Credits: 3.00

First course in a two-course sequence covering key concepts in abstract and linear algebra that provide the mathematical foundation for the precollege algebra curriculum. Content includes integers, integral domains, topics from number theory, equivalence relations, congruences, real numbers, complex numbers, polynomials, group theory, matrix theory, vectors, vector spaces, rings, and fields.

### MATH 904 - Higher Algebra for Teachers II

Credits: 3.00

Second course in a two-course sequence covering key concepts in abstract and linear algebra that provide the mathematical foundation for the precollege algebra curriculum. Content includes integers, integral domains, topics from number theory, equivalence relations, congruences, real numbers, complex numbers, polynomials, group theory, matrix theory, vectors, vector spaces, rings, and fields.

### MATH 905 - Higher Geometry for Teachers I

Credits: 3.00

First course in a two-course sequence covering key concepts in geometry. Content includes: systems of postulates of various geometries; finite geometries, geometric transformations and isometrics, geometric invariants; synthetic and analytic projective geometry; and an introduction to non-Euclidean geometry.

### MATH 906 - Higher Geometry for Teachers II

Credits: 3.00

Second course in a two-course sequence covering key concepts in geometry. Content includes: systems of postulates of various geometries; finite geometries, geometric transformations and isometrics, geometric invariants; synthetic and analytic projective geometry; and an introduction to non-Euclidean geometry.

### MATH 907 - Higher Analysis for Teachers I

Credits: 3.00

First course in a two-course sequence covering key concepts in real analysis that provide the mathematical foundation for calculus. Content includes the real number system, functions and limits, elements of set theory, numerical sequences and series, continuity, the derivative and the Riemann integral.

### MATH 908 - Higher Analysis for Teachers II

Credits: 3.00

Second course in a two-course sequence covering key concepts in real analysis that provide the mathematical foundation for calculus. Content includes the real number system, functions and limits, elements of set theory, numerical sequences and series, continuity, the derivative and the Riemann integral.

### MATH 909 - Probability and Statistics for Teachers

Credits: 3.00

Permutations and combinations; finite sample spaces; random variables; binomial distributions; statistical applications.

### MATH 910 - Selected Topics in Mathematics Education for Teachers

Credits: 1.00 to 4.00

Current developments and issues in mathematics education; content, curricula, methods, and psychology of teaching mathematics. Can be repeated for credit.

### 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 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: 1.00 to 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 941 - Bayesian and Computational Statistics

Credits: 3.00

Current approaches to Bayesian modeling and data analysis and related statistical methodology based on computational simulation. Fundamentals of Bayesian estimation and hypothesis testing. Multi-level and hierarchical Bayesian modeling for correlated data. Introduction to Markov chain Monte Carlo based estimation approaches such as the Gibbs sampler and the Metropolis-Hastings algorithm. Prereq: knowledge of intermediate statistics: distributions, discrete and continuous random variables, transformation of variables (calculus based), bivariate and multivariate normal distribution, maximum likelihood estimation; working knowledge of linear regression and analysis of variance; basic linear algebra: vectors and matrices, linear spaces, matrix multiplication, inverse of a matrix, positive definiteness. Matrix-vector notation for linear regression and ANOVA.

#### MATH 942 - Beyond ANOVA: Generalized Linear and Semi-parametric Smoothing Methods

Credits: 3.00

Regression model fitting beyond the linear regression and ANOVA framework. Introduction to generalized linear models for categorical data, logistic and Poisson regression. Scatterplot smoothing methods. Spline bases for linear regression: natural and B-splines, truncated polynomial splines. Regularization by smoothing splines. Selection by cross validation and by mixed effects modeling. Application to multivariable predictor situation; additive and generalized additive models, interaction and varying coefficient models. Prereq: Intermediate statistics including basics of maximum likelihood estimation; linear regression modeling including familiarity with matrix notation, basic concepts of calculus including partial derivatives.

#### MATH 944 - Spatial Statistics

Credits: 3.00

Frequentist and Bayesian methods for estimation of characteristics measured in space (usually 2-dimensional Euclidean space). Spatial averaging. Spatial point processes: models for clustering and inhibition. Cluster detection. Point referenced data: variogram estimation, Kriging, spatial regression. Lattice based data: spatial auto-regression, Markov random field models. Spatial regression models. Non-Gaussian response variables. Hierarchical Bayesian spatial models and Markov chain Monte Carlo methods. Multivariable spatial models. Prereq: Intermediate statistics including basics of maximum likelihood estimation; linear regression modeling including familiarity with matrix notation, basic concepts of calculus including partial derivatives.

#### 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, latitudinal 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.

## **Molecular, Cellular, Biomedical**

MCBS 901 - Introduction to Research in the Life Sciences

Credits: 2.00

This two-credit graduate course is designed to acquaint first-year master's and doctoral students with facilities and tools for designing, conducting, and communicating research. Topics include: acquiring proper background information; the art of oral presentation; effective writing; data analysis and graphics using computers; ethics in science; and issues in research.

MCBS 905 - Contemporary Topics in Molecular, Cellular and Biomedical Sciences

Credits: 1.00

Presentation, discussion, and critical evaluation of current research literature in molecular/cellular life sciences and in biomedical sciences. Topics will vary each semester. May be repeated for a maximum of 5 credits. Cr/F.

MCBS 995 - Special Topics

Credits: 1.00 to 4.00

Special topics course.

MCBS 996 - Special Topics

Credits: 1.00 to 4.00

Special topics course.

MCBS 997 - Seminar

Credits: 1.00

Graduate student and faculty presentations on current topics in the molecular life sciences and biomedical sciences. Graduate students are expected to present one seminar per year and attend all seminars each semester. May be repeated. Cr/F. (Offered both fall and spring).

## Mechanical Engineering

### 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 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 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: statics; dynamics 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: strength of materials 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: strength of materials or permission.

### 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.

#### 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. 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 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: Strength of materials or permission. Special fee. Lab.

#### ME 895 - Special Topics

Credits: 1.00 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

May be repeated up to a maximum of 8 credits. 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 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: analytical fluid dynamics 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: analytical fluid dynamics or permission.

#### 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 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 935 - Micromechanics of Composite and Porous Materials

Credits: 4.00

Classification of composites, periodic and random microstructures. Mechanics of materials approach to micro-mechanical modeling. Representative volume element, analytical and numerical modeling of the effective properties. Micromechanics of failure of composite and porous materials. Prereq: mechanics of composites 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: advanced control systems I. (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: control systems. (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: advanced control systems I. (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 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: finite element analysis 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: 1.00 to 4.00

Investigations of graduate-level problems or topics in mechanical engineering.

ME 999 - Doctoral Research

Credits:

Cr/F.

## Microbiology

### MICR 805 - Immunology

Credits: 3.00

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. This course must be taken in conjunction with MICR 815 to receive major credit in Microbiology. Prereq: MICR 503.

### 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: BMS 503.

Co-requisites:

### 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: BMS 503. Special fee.

Co-requisites: MICR 806

### 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 830 - Ethical Issues in Biomedical Science

Credits: 4.00

Advances in the biological sciences impact 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 are presented and discussed in a format that encourages both an appreciation of established guidelines and an opportunity to critically examine them. Prereq: BIOL 411, BMS 503.

### 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 sub-culturing, 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 P BIO 851.) Special fee. Lab.

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

May be repeated up to a maximum of 10 credits. 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 for a maximum of 5 credits. Cr/F.

MICR 907 - Instrumentation

Credits: 1.00

Introduction to safety and principles of use in instrumentation in microbiology. May be repeated to a maximum of 5 credits. Cr/F.

MICR 999 - Doctoral Research

Credits:

Cr/F.

## Management of Technology

### MOT 898 - Advanced Topics

Credits: 3.00

Provides participants an opportunity to discuss the current research associated with emerging technologies. Emphasis on relevant technologies with case examples drawn from participants' own backgrounds. Program fee.

### 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. Program fee.

### MOT 934 - Management of Technology and Innovation

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. Program fee.

### MOT 935 - Quantitative Methods

Credits: 3.00

Familiarization with concepts and analytical methods useful in understanding the management of firms' operations, including materials, information technology, and people. Helps develop an understanding of process flow, inventory management, capacity planning, quality resource management, operations strategy and quantitative decision-making. Will introduce students to DOX (design of experiments) and its applications. Helps to establish a framework to identify, define, analyze and propose workable solutions to operating problems. Program fee.

### MOT 936 - Leadership and Team Management

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. Program fee.

### MOT 939 - Information Systems/Management of Enterprise Systems

Credits: 3.00

Develops an understanding of the importance of information systems in organizations and how to use it to support strategic decisions. Demonstrates computer based systems can assist in the management of projects and programs. Develops a framework to understand the unique MIS, EIS, and DSS information needs of projects and project managers. Will focus on Make vs. Buy (outsourcing) decision models and foster a better understanding of the detection and prevention of system security and emerging technologies. The critical issue of enterprise wide systems planning and implementation. Program fee.

### MOT 941 - Product Development and Marketing

Credits: 3.00

Examines the process of developing and commercializing a technology based product. Provides insight into how customer wants and needs are transformed into marketing strategies and tactics. Uses case

studies to introduce key marketing concepts and vocabulary and introduces the critical questions to ask in developing a marketing plan. Examines the importance of marketing information to the company and outlines steps in the marketing research process. Program fee.

#### 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. Program fee.

#### MOT 945 - Supply Chain Management and Procurement

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. Program fee.

#### 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. Program fee.

#### MOT 947 - Managing Emerging Technologies

Credits: 3.00

Explores several topics of importance to the management of technology. Three categories are explored: intellectual property, ethics, and public policy. Program fee.

#### MOT 948 - Business Planning and Program Management

Credits: 3.00

Introduces a variety of traditional and time proven market research concepts, techniques and tools. Explores new methodologies for conducting market research. Case studies explore interpreting market research data in an emerging technology environment. Understanding organizational change and transformation needed to successfully manage a project or program. Explores different change and transformation processes as well as the attributes and causes of both incremental (first order) and radical (second order) change. Will help identify agents of change and the sources of resistance in individual, group and institutions. Program fee.

## Materials Science

### MS 830 - Mechanical Behavior Materials

Credits: 4.00

Elastic and inelastic behavior of materials in terms of micro- and macro-mechanics. 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. 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. 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. Lab. Lab. (Also offered as OE 844.)

### MS 860 - Thermodynamics and Kinetics of Materials I

Credits: 3.00

Classical and statistical thermodynamics are used to establish the conditions of equilibrium for simple and multi-component, heterogeneous materials. Additionally, the thermodynamics of phase diagrams, miscibility, interfaces, and defects are explored. Examples and problems apply these concepts to various types of materials, including metals, ceramics, and polymers. Permission of instructor required.

### 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. Lab.

### MS 862 - Electronic Materials Science

Credits: 4.00

This course provides engineering and science students with a foundation in the materials science of modern electronic devices. Topics include bonding and structure of solids, electrical and thermal conduction, elements of quantum mechanics, band theory of electrons in solids, semiconductors, magnetism, dielectrics and superconductors. Examples of applications are taken primarily from the fields of semiconductor electronics and nanotechnology, and illustrate how the electrical and optical properties of

devices are obtained from their compositions, crystal structures and microstructures. Permission of instructor required.

#### 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. 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 stereo-chemical and catalytic polymerizations. Considerations of bulk, solution, and dispersion polymerization systems. Permission of instructor required.

#### MS 910 - Macromolecular Characterization

Credits: 3.00

Molecular characterization of synthetic and natural macromolecules in solution and in the solid state. Emphasis on the principles of various analytical techniques designed to provide information on the chemical composition, polymer chain size and structure in solution and in the dry state. Extension to methods that measure the interaction and association between polymer molecules. Interpretations of data from important characterization techniques including liquid chromatography (GPC), spectroscopy (FTIR, NMR, MS), microscopy (TEM, AFM, Confocal Raman), thermal analysis (DSC), light scattering, sedimentation, and x-ray diffraction. Permission of instructor required. (Also listed as BCHM 950).

#### MS 915 - Processing and Properties of Polymer Fluids and Solids

Credits: 3.00

Fundamentals of rheology of highly viscous, non-Newtonian polymer fluids with application to industrial forming operations. Multiphase (including particulate fillers) polymers and suspensions are treated in detail with an emphasis on the effect of the discontinuous phase on the flow field. Extension to reactive

processing (RIM). Treatments of the physical properties of simple and composite polymer solids are developed with an emphasis on the interdependencies of polymer glass transition temperature, polymer chain structure, and filler characteristics. Analysis of research articles and the completion of two major case studies. Permission of instructor required.

MS 961 - Thermodynamics and Kinetics of Materials II

Credits: 3.00

Introduction to diffusion and phase transformations in materials, and detailed descriptions of interfacial regions. Mechanisms of phase separation by spinodal decomposition and homogeneous nucleation. Kinetic processes leading to changes in phase structure driven by chemical reaction, temperature and diffusive processes (e.g. Ostwald ripening) are treated quantitatively. Applications to 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. May be repeated for a maximum of 12 credits. Special fee.

### MUSI 832 - Advanced Choral Conducting

Credits: 2.00

See description for MUSI 831.

### MUSI 836 - Graduate Early Wind Instruments

Credits: 1.00 to 4.00

Private instruction in Renaissance and Baroque wind instruments. May be repeated. Special fee.

MUSI 841 - Graduate Piano

Credits: 1.00 to 4.00

Private instruction in piano. May be repeated. Special fee for non-majors.

MUSI 845 - Graduate Voice

Credits: 1.00 to 4.00

Private instruction in voice. May be repeated. Special fee for non-majors.

MUSI 846 - Graduate Violin

Credits: 1.00 to 4.00

Private instruction in violin. May be repeated. Special fee for non-majors.

MUSI 847 - Graduate Viola

Credits: 1.00 to 4.00

Private instruction in viola. May be repeated. Special fee for non-majors.

MUSI 848 - Graduate Cello

Credits: 1.00 to 4.00

Private instruction in cello. May be repeated. Special fee for non-majors.

MUSI 849 - Graduate Bass

Credits: 1.00 to 4.00

Private instruction in bass. May be repeated. Special fee for non-majors.

MUSI 851 - Graduate Flute

Credits: 1.00 to 4.00

Private instruction in flute. May be repeated. Special fee for non-majors.

MUSI 852 - Graduate Clarinet

Credits: 1.00 to 4.00

Private instruction in clarinet. May be repeated. Special fee for non-majors.

MUSI 853 - Graduate Saxophone

Credits: 1.00 to 4.00

Private instruction in saxophone. May be repeated. Special fee for non-majors.

MUSI 854 - Graduate Oboe

Credits: 1.00 to 4.00

Private instruction in oboe. May be repeated. Special fee for non-majors.

MUSI 855 - Graduate Bassoon

Credits: 1.00 to 4.00

Private instruction in bassoon. May be repeated. Special fee for non-majors.

MUSI 856 - Graduate French Horn

Credits: 1.00 to 4.00

Private instruction in French horn. May be repeated. Special fee for non-majors.

MUSI 857 - Graduate Trumpet

Credits: 1.00 to 4.00

Private instruction in trumpet. May be repeated. Special fee for non-majors.

MUSI 858 - Graduate Trombone

Credits: 1.00 to 4.00

Private instruction in trombone. May be repeated. Special fee for non-majors.

MUSI 859 - Graduate Euphonium

Credits: 1.00 to 4.00

Private instruction in euphonium. May be repeated. Special fee for non-majors.

MUSI 860 - Graduate Tuba

Credits: 1.00 to 4.00

Private instruction in tuba. May be repeated. Special fee for non-majors.

MUSI 861 - Graduate Percussion

Credits: 1.00 to 4.00

Private instruction in percussion. May be repeated. Special fee for non-majors.

MUSI 862 - Graduate Keyboards

Credits: 1.00 to 4.00

Private instruction in jazz piano. May be repeated. Special fee for non-majors. Permission required.

MUSI 863 - Graduate Jazz Guitar

Credits: 1.00 to 4.00

Private instruction in jazz guitar. May be repeated. Special fee for non-majors.

MUSI 864 - Graduate Drum Set

Credits: 1.00 to 4.00

Private instruction in drum set. May be repeated. Special fee for non-majors.

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 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 801 - Ecological Sustainability and Values

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.

### 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 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 807 - Environmental Modeling

Credits: 4.00

Environmental Modeling introduces students to a range of key mathematical and computer modeling concepts and the ways they can be used to address important scientific questions. The course is divided into four topical sections: Population and Community Ecology, Hydrology, Biogeochemistry, and Ecosystems. In each section, modeling concepts and skills are presented together with environmental information to emphasize the linkage between quantitative methods and relevant scientific results. Prereq: MATH 425. (Also listed as EOS 807.)

### 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 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 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

Federal and state environmental statutory and administrative law, its application, strengths and weaknesses, and options for future amendment.

#### NR 819 - Wetlands Restoration and Mitigation

Credits: 3.00

Assesses the problems of wetlands loss and learning how to repair the damage. Asks what steps can be take. Does restoration work, can habitat value be replaced, what constitutes equivalent mitigation? Field experience and theoretical background in restoring marine and freshwater environments. 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 wetland issues. Prereq: NR 811 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

Students examine policies for managing human activities to sustain the health of regional ecosystems and planetary life-support systems. Selected problems of the international commons (oceans, marine resources, atmosphere, migratory species); global and regional carrying capacity (population, resource consumption), internationally shared ecosystems (trans-boundary watersheds, water-bodies, tropical forests); 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--Earth Summit Strategy to Save the Planet. Prereq: permission.

#### NR 824 - Resolving Environmental Conflicts

Credits: 4.00

Theories and practices of environmental dispute settlement. Roles of public, non-governmental and governmental organizations. Effectiveness of public participation initiatives in influencing public policy decisions and/or resolving environmental conflicts. Alternative approaches to consensus (policy dialogues, joint problem solving; strategic planning; negotiation, mediation) as well as litigation. Specific cases are critiqued and evaluated; conflict resolution skills are developed. Students observe and/or participate in ongoing local decision processes. Prereq: permission. Lab. Special fee.

### NR 829 - Silviculture

Credits: 4.00

The science and art of establishing, growing, and tending forests to meet multiple objectives. Basics of forest stand dynamics applied to the problems of timber management, wildlife habitat, water quality, and carbon sequestration. Prereq: NR 425 and NR 527 or permission. Special fee.

### NR 830 - Terrestrial Ecosystems

Credits: 4.00

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.

### NR 831 - Ecosystem Based Governance: Policies and Management Strategies

Credits: 4.00

Human stresses have and are taking their toll on the health and integrity of ecosystems worldwide. More and more commentators are stressing the need to switch from traditional top-down natural resource governance strategies to a broader ecosystem-based management (EBM) approach. This class will explore current strategies and trends, examine EBM in theory and practice, and ultimately put theory into practice with a collaborative effort to design an EBM governance strategy for a geographical region chosen by the class. Prereq: permission.

### 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 835 - Land Conservation Principles and Practices

Credits: 4.00

Students gain practical knowledge, understanding and experience in land conservation planning and implementation of options for land protection based on current practice in New Hampshire. By interacting with practitioners, students learn what it takes to implement successful land conservation projects, and conservation stewardship requirements and practices. Permission. Special fee. Lab.

### NR 838 - Wildlife Policy and Management

Credits: 4.00

Local, regional, and national issues and strategies in policy and administration. Contemporary issues including land management, commercialization of wildlife, overpopulation, endangered species, wildlife diseases, and professionalism. Prereq: permission. Special fee. Lab.

### NR 840 - Inventory and Monitoring of Ecological Communities

Credits: 4.00

Provides an introduction to the major concepts associated with monitoring change in ecological communities. Students develop an appreciation for such issues as: identification of appropriate baselines for comparison; use of indicator species; the tools used to inventory common, rare, and secretive species; how trend data are analyzed; and the implications of failing to detect an indicator species. Restricted to senior wildlife majors others by premission. Special fee. Lab.

### NR 841 - Demographic Methods in Conservation Biology and Wildlife Ecology

Credits: 2.00

A survey of quantitative methods used to characterize vertebrate populations. Emphasis placed on application rather than theory. Estimators of survival, responses to exploitation, and evaluation of physiological condition relative to carrying capacity are reviewed. Atudents are also introduced to computer models that are used to simulate age-, stage-, and spatially-structured populations, and how these models can be used to evaluate population viability. Prereq: concurrent or previous enrollment in a course in population ecology or conservation, one course in statistics. Lab. Special fee.

#### NR 844 - Biogeochemistry

Credits: 4.00

Examines the influence of biological and physical processes on elemental cycling and geochemical transformations from the molecular to the global scale, involving microorganisms, higher plants and animals and whole ecosystems; factors that regulate element cycles including soils, climate, disturbance and human activities; interactions among the biosphere, hydrosphere, lithosphere, and atmosphere; transformations of C, N, S, and trace elements. Prereq: one semester biology and two semesters chemistry or permission. (Also offered as EOS 844.)

#### 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 849 - Forest Inventory and Modeling

Credits: 4.00

Applied sampling and statistical techniques for assessing current forest conditions and predicting future growth, yield, and structure. Topics include plot and point sampling, ecological inventory, and evaluation of site quality and stand density. Prereq: MATH 420 and BIOL 528. Special fee.

#### NR 851 - Aquatic Ecosystems

Credits: 4.00

Energy flow and nutrient cycling in streams, rivers and lakes, with an emphasis on understanding the control of primary productivity, decomposition and community structure by both hydrologic and biotic drivers. Role of aquatic ecosystems in carbon and nitrogen budgets at watershed, regional, and global scales. Impacts of environmental changes such as global climate change and suburbanization on aquatic ecosystems. Prereq: General Ecology.

#### NR 857 - Photo Interpretation and Photogrammetry

Credits: 4.00

Practical and conceptual presentation of the use of remote sensing and other geospatial technologies for mapping and monitoring the environment. This course begins with the use of aerial photographs (photogrammerty, and photo interpretation) and includes measures of photo scale and area, parallax and stereo viewing, object heights, flight planning, photo geometry, the electromagnetic spectrum, camera systems and vegetation/land cover mapping. The course concludes with an introduction to other geospatial technologies including digital image analysis, global positioning (GPS), and geographic information systems (GIS). Conceptual lectures are augmented with practical homework assignments and hands-on lab exercises. Prereq: algebra. Special fee. Lab.

#### NR 859 - Digital Image Processing for Natural Resources

Credits: 4.00

Introduction to digital remote sensing, including multispectral 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

applications. Use of ERDAS image-processing software. Knowledge of PCs required. Prereq: NR 857 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 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. Lecture and discussion.

#### NR 867 - Earth System Science

Credits: 4.00

This course provides an introduction to the study of Earth as an integrated system. It investigates the major components (e.g. atmosphere, biosphere, cryosphere, hydrosphere, and lithosphere), dynamics (e.g., energy balance, water cycle, biogeochemical cycles), and changes within the earth system. Particular emphasis placed on the interactions and feedbacks within the system. The links between components will be presented by examining present day processes and selected events in Earth's history. The lab portion examines these concepts through the development and use of computer models of Earth system processes. Prereq: MATH 424B; MATH 425; or permission. Lab. (Also offered as EOS 867.)

#### NR 882 - Monitoring Forest Health

Credits: 4.00

Course provides the field and remote sensing tools and experience needed by students to assess forest conditions at the individual tree and stand levels, as well as to conduct independent research projects on specific topics of interest. Such topics may include assessing change-over-time, landscape-level impacts of urban development, severe weather events, and other natural and anthropogenic perturbations affecting the health of forests. Forest damage due to insects, air pollution (primarily ground-level ozone), drought, the 1998 ice storm, and others will be investigated. Lab. Special fee. 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: One course in ecology or environmental biology or permission. Special fee.

#### NR 884 - Sustainable Living

Credits: 4.00

Concepts of sustainability are explored in a learning-community format. The importance of human communication, sense of place and time, and the health and longevity of the human species as part of natural systems is emphasized. Students develop measures for sustainable living, including ecological foot-printing, and gain an understanding of system conditions necessary to move toward sustainable living.

Two required field trips. Special fee.

#### NR 885 - Systems Thinking for Sustainable Living

Credits: 4.00

Introduction to systems thinking from a sustainable living perspective. The course is a collaborative inquiry using a problem-solving approach. After studying 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?"

#### NR 897 - Special Topics

Credits: 1.00 to 4.00

An experimental course for the purpose of introducing a new course or teaching a special topic for a semester in an area of specialization in natural resources. 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 posed 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.

#### NR 903 - Approach to Research

Credits: 4.00

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.

#### 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 912 - 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 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. Cr/F.

### NR 965 - Community Ecology

Credits: 4.00

This course investigates how community properties -- species richness, and abundance distribution -- are influenced by evolutionary history, landscape phenomena such as dispersal and migration, and local factors such as the physical environment, disturbance, competition, predation, and positive interactions. Mechanistic models of community dynamics, including succession, are discussed. The influence of species diversity on ecosystem function is discussed, and all aspects of the course are related to conservation science.

### NR 993 - Natural and Environmental Resources Seminar

Credits: 1.00 or 2.00

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

An experimental course for the purpose of introducing a new course or teaching a special topic for a semester in an area of specialization in natural resources. Permission required. Special fee on some sections.

### NR 998 - Directed Research

Credits: 1.00 to 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). May be repeated up to a maximum of 4 credits.

## Natural Resrcs&EarthSystemsSci

NRES 995 - Independent Study  
Credits: 1.00 to 4.00

NRES 999 - Doctoral Research  
Credits:  
Cr/F.

## Nursing

### NURS 806 - Clinical Inquiry

Credits: 4.00

Theory course focuses on identifying problems and the role of the nurse in decision-making situations in nursing practice. Emphasizes using decision-making theories, patient education theories and practice, critical thinking, ethical concepts in decision-making, tools for organizing nursing information, and applying evidence based practice. In addition, learners are introduced to information management and nursing informatics as they apply to planning and delivery of nursing care. Special fee.

Co-requisites: NURS 807, NURS 813, NURS 825, NURS 900

### NURS 807 - Pathophysiology and Pharmacology

Credits: 4.00

Theory course focuses on concepts of human pathophysiology and pharmacology relevant to professional nursing practice. Physiologic response and manifestations of alterations in normal body functioning are analyzed. Pharmacological agents used for these alterations are examined. Application of concepts across the lifespan are incorporated through the discussion of pathophysiology and pharmacology. Provides the foundation for the clinical decision-making and management of care. In addition, learners are introduced to the professional nurse's responsibility for educating clients about basic pathophysiology and pharmacology issues.

Co-requisites: NURS 806, NURS 813, NURS 825, NURS 900

### 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 813 - Health Assessment and Clinical Nursing

Credits: 5.00

Clinical course provides student with evidence-based knowledge related to acquiring the psychomotor and assessment skills required for the safe delivery of nursing care across the lifespan. Students develop foundational skills applicable to achieving program outcomes. Focuses on developing beginning health assessment and clinical nursing skills while implementing critical thinking and application of the nursing process to highlight fundamental nursing concepts as they pertain to providing and improving client care. Special fee.

Co-requisites: NURS 806, NURS 807, NURS 825, NURS 900

### NURS 825 - Collaborative Care I: Care of Older Adult

Credits: 3.00

Theory course focuses on care outcomes for major functional and health transitions of older adults across health settings. Emphasizes nurse's advocacy in facilitating care collaboration based on informed practice utilizing current research and best practice models of care. Learners incorporate theories from nursing and other disciplines to achieve a broad perspective and understanding of the aging experience and cultural implications for nursing practice.

Co-requisites: NURS 806, NURS 807, NURS 813, NURS 900

### NURS 826 - Caring for People with Severe and Persistent Mental Illness

Credits: 4.00

This theory and clinical course is designed to provide an understanding of the neurobiological and psychosocial concepts of mental health and illness, factors influencing human behavior and interaction, current somatherapies, and the role of the psychiatric nurse as part of the interdisciplinary team. Previous course knowledge and communication skills provide a theoretical foundation in explaining, guiding, and predicting nursing action. During the clinical experience, students are responsible for collaborative and interdependent health care relationships with professional and paraprofessional mental health partners. A special focus is placed on the integration of personal knowledge, therapeutic use of self, and professional communication skills inherent in nurse-client relationships. Emphasis placed on the practice of mental health nursing as being supported by the Scope and Standards of Psychiatric and Mental Health Nursing Practice to frame care plan implementation. Through a variety of clinical experience, the student assumes a leadership role within the interdisciplinary practice team of a designated mental health care delivery system. Prereq: NURS 806, NURS 807, NURS 813, NURS 825, NURS 900.

Co-requisites: NURS 827

NURS 827 - Collaborative Care II: Managing Acute and Complex Care of Individuals

Credits: 6.00

In this combined theory and clinical course students develop the knowledge base to refine their clinical judgment and decision-making skills in care of individuals from diverse populations with acute, critical, and chronic illnesses. Focuses on illness management, health restoration, and risk reduction in prototypic health care problems. Focuses on nurses' ability to use leadership skills and concepts of care collaboration with clients, families, peers, and members of the health care team to maximize client outcomes. Care experiences primarily center on the acute care environment. Prereq: NURS 806, NURS 807, NURS 813, NURS 825, NURS 900.

Co-requisites: NURS 826

NURS 828 - Public Health Nursing

Credits: 5.00

This theory and clinical course prepares the student for community and population focused practice. Emphasis placed on the synthesis of concepts, theories, knowledge and practice from nursing, and public health sciences. The concepts of community assessment, health promotion, health protection, illness prevention, and vulnerability are examined from a public health nursing perspective. Prereq: NURS 826, NURS 827, NURS 901. Special fee.

Co-requisites: NURS 905, NURS 908

NURS 829A - Collaborative Care III: Childbearing Families

Credits: 2.00

This theory course focuses on providing competent nursing care for young families throughout the childbearing period. Healthy transitions and physical alterations occurring during the childbearing period are examined. The health needs of the young family are discussed in terms of major morbidity/mortality and contemporary issues. This experience integrates experience in the discipline that builds on theories of growth and development, pathophysiology and use of decision making models to provide opportunities for the development of the nurse generalist role. Prereq: NURS 826, NURS 827, NURS 901.

Co-requisites: NURS 828, NURS 829B, NURS 829C, NURS 905, NURS 908

NURS 829B - Collaborative Care III: Childrearing Families

Credits: 2.00

This theory focuses on providing competent nursing care for young families throughout the child-rearing periods. Healthy transitions and physical alterations occurring from infancy through adolescence are examined. The health needs of the young family are discussed in terms of major morbidity/mortality and contemporary issues. This experience integrates in the discipline through seminars that build on theories of

growth and development, pathophysiology and use of decision making models to provide opportunities for the development of the nurse generalist role. Prereq: NURS 826, NURS 827, NURS 901.

Co-requisites: NURS 828, NURS 829A, NURS 829C, NURS 905, NURS 908

#### NURS 829C - Collaborative Care III: Clinical

Credits: 2.00

This clinical course focuses on providing competent nursing care for 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. This experience integrates real-world experience in the discipline through clinical opportunities in a variety of acute and community clinical settings that build on theories of growth and development, pathophysiology and use of decision making models to provide opportunities for the development of the nurse generalist role. Prereq: NURS 826, NURS 827, NURS 901. Special fee.

Co-requisites: NURS 828, NURS 829A, NURS 829B, NURS 905, NURS 908

#### 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. Special fee on some sections.

#### NURS 899 - Master's Thesis

Credits: 1.00 to 6.00

Prereq: permission. May be repeated up to a maximum of 6 credits. 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 - Advanced 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 - Advanced 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 - Advanced 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 925 - Health Care Systems and Leadership

Credits: 3.00

This theory course emphasizes the use of systems thinking and systems theory as a guide for analyzing and improving health systems. Careful consideration is given to the complex challenges of achieving quality care delivery and quality health outcomes for aggregates within specific environments. Course contents include systems theory, health systems analysis, shaping care delivery, research utilization, ethics, and leadership. Course fosters student integration of knowledge in preparation for clinical nursing leadership responsibilities. Prereq: NURS 900, NURS 905, NURS 908.

### NURS 935 - Primary Care Families I

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 908; 909. Pre- or Co-req: NURS 907; 936 Special fee.

### NURS 936 - Practicum in the Primary Care Families I

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 Families II

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 935; 936.

Co-requisites: NURS 938

### NURS 938 - Practicum in the Primary Care of Families II

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 935; 936.

Co-requisites: NURS 937

### NURS 939 - Seminar and Practicum in the Primary Care of Families III

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.

Co-requisites:

### NURS 942 - Advanced Evidence in Complex Health Challenges

Credits: 3.00

This course critically appraises current best evidence to develop effective advanced practice nursing interventions for chronic and complex illness as experienced by individuals, families and populations. In-depth case care model used to explore common complex health challenges such as, but not limited to, diabetes, heart failure, respiratory disorders such as asthma and chronic lung obstructive, and pathogenic as well as normal aging related problems.

### 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. Prereq: NURS 905.

### 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. May be repeated up to a maximum of 8 credits. Pre- or Coreq: NURS 900, 901, 905.

#### NURS 951 - Clinical Epidemiology and Decision Analysis

Credits: 3.00

This theory course provides an in-depth study and application of methods and tools used to guide clinical nursing leader's decision-making under conditions of uncertainty.

#### NURS 952 - Clinical Nursing Leadership I

Credits: 8.00 or 10.00

This clinical and seminar course focuses on the integration of systems thinking when engaging in clinical nursing leadership and the application of systems theory in analyzing dynamic health systems.

Emphasizes the developing leadership role at the micro-system level and with an aggregate focus (e.g., long term care; community/public health agencies; ambulatory care clinics; health centers; schools; and acute care settings). Seminars focus student reflection on leadership experiences and emerging issues in health systems, professional development and collegiality. Prereq: NURS 900, NURS 905, NURS 908.

Special fee.

#### NURS 953 - Promoting Quality Management

Credits: 2.00

In this seminar course, students work with agency preceptor and faculty mentor to develop a proposal for a quality improvement project. Concepts of clinical micro-systems are explored. Prereq: NURS 900, NURS 905, NURS 908.

#### NURS 954 - Clinical Nursing Leadership II

Credits: 3.00

In this clinical course students assume increasing independence in identifying problems requiring quality management techniques and skills. Students work with preceptor and/or members of a project team to define and/or implement strategies that will address/resolve identified problems that will improve nursing practice or enhance outcomes of a patient aggregate. Prereq: Must hold RN license in state of clinical and project. Prereq: NURS 952. Special fee. Cr/F.

Co-requisites: NURS 956

#### NURS 955 - Practicum in Advanced Nursing Practice

Credits: 3.00 to 12.00

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. Must hold RN license in state of practicum. Special fee.

Co-requisites: NURS 956

#### NURS 956 - Capstone Project Seminar

Credits: 3.00

This seminar course requires students to focus on nursing practice issues and to work as individuals or groups to develop solutions. As the capstone course for the clinical nurse leader and evidence-based nursing tracks, the students are required to complete this scholarship project under the direction of a faculty member. Must hold RN license in state of project. Prereq: NURS 905 Pre- or Coreq: NURS 901.

Coreq; NURS 954 or 955.

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.

## Nutrition

### NUTR 811 - Lipid Metabolism

Credits: 4.00

Structure, metabolism, and function of lipids and their impact on health and disease. Prereq: NUTR 400 and a biochemistry course.

### 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: NUTR 400.

### 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 851 - Nutritional Biochemistry of Micronutrients

Credits: 4.00

Investigation of the biochemical and clinical aspects of micronutrient metabolism. All of the essential vitamins and minerals are explored in depth. Some representative phyto-nutrients and quasi-nutrients are also explored. The nutrients are examined for their molecular, cellular, and biomedical functions and intermediary metabolism, as well as the biochemical and clinical consequences of their deficiency or excess. Prereq: Nutritional biochemistry (NUTR 750/850 or equivalent.) Spring semester only.

### NUTR 855 - Treatment of Adult Obesity

Credits: 4.00

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. Special fee.

### NUTR 870 - Nutrition and Gender Based Health Concerns

Credits: 2.00

Offers a comprehensive review of the health issues facing adult men and women today. Students read and evaluate the current literature and document their reactions to group discussion in reaction papers on the topic. Students also present a topic of interest to the class.

### 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, anatomy and physiology, and biochemistry. Nutrition majors only or by permission. (Fall semester only.)

Co-requisites:

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 895 - Investigations

Credits: 1.00 to 4.00

Prereq: permission.

NUTR 898 - Nutrition Research Experience

Credits: 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. May be repeated up to a maximum of 4 credits.

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 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 - Dietetics: Principles and Practices

Credits: 4.00

Course provides 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. Permission required. Special fee.

### NUTR 930 - Dietetics: Foodservice, Community and Research

Credits: 4.00

This course is designed to enhance pre-professional work experiences with continued examination and application of theory and practice in the dietetic profession. Rotations with local foodservice operations and community nutrition agencies will provide students with supervised practical experience while exploring the application of food and nutritional science principles within these settings. Foodservice management topics to be examined include, but are not limited to, facility and human resources management, translation of nutrition into foods/menus, procurement, distribution and service within delivery systems, and food safety and sanitation. Community nutrition topics include: nutrition screening and assessment, nutrition counseling and education, and program development and evaluation. In addition, weekly seminars, assignments and supplemental readings will reinforce practicum experiences. Permission required. Special fee.

### NUTR 931 - Dietetics: Clinical Theory and Practice

Credits: 4.00

This course is designed to enhance the clinical experiences of dietetic interns through continued examination and application of theory and practice via dietetic internship field placements. Clinical rotations provide interns with the opportunity to explore the application of nutritional science principles and practices within inpatient and outpatient environments. Topics to be examined include, but are not limited to, general medicine, diabetes, cardiology, oncology, orthopedics, neurology, rehabilitation medicine, nephrology, maternity, surgery, intensive care, nutrition support and psychiatric medicine. Students have the opportunity to work in a variety of clinical settings. In addition, weekly seminars, assignments and supplemental readings will reinforce practicum experiences. (Course restricted to dietetic internship students.) Permission required. Special fee.

### NUTR 955 - Topics in Human Obesity

Credits: 4.00

Various topics related to obesity are discussed from year to year. Topics include: neuregulatory and hormonal mechanisms; role of diet, exercise and energy metabolism, fat as an endocrine organ; obesity, immune function and chronic disease.

### 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.) Lab.

### OE 845 - Environmental Acoustics I: Air and Water

Credits: 4.00

Sound and vibration; simple harmonic oscillators; characteristics and measurements of sound sources and receivers; acoustic wave equation (1D, 2D, 3D); sound reflection, transmission, refraction, and absorption in various media; room acoustics; basic sonar equation. Prereq: Physics II; Differential Equations w/Linear Algebra; Engineering Analysis, or permission. Lab. (Also listed as ECE 845.)

### 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 - Fundamentals of 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: 4.00

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 885 - Environmental Acoustics II: Air and Water

Credits: 4.00

General sonar equation: active, passive; sound generation, source level, directivity, calibration methods; sound propagation, rays and normal modes, acoustic waveguides; transmission loss, reverberation, scattering; ambient noise characteristics and measurements; sound reception and processing. Prereq: Environmental Acoustics I: Air and Water or permission. Lab. (Also listed as ECE 885.)

#### OE 895 - Special Topics

Credits: 1.00 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

May be repeated up to a maximum of 6 credits. Cr/F.

#### 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 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: Fundamentals of Ocean Mapping, Geodesy and Positioning for Ocean Mapping; or permission. (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, multi-beam and interferometric sonars) and optical (video and laser line-scanner) 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 810 - OT Practice and Professional Roles

Credits: 3.00

Students are introduced to foundation knowledge, values and philosophy of occupational therapy practice. Students learn skills to apply professional behaviors and skills required to be ethical practitioners. They learn about various practice settings and systems within which occupational therapists practice to prepare them to begin to make decisions regarding their fieldwork site selections. They are introduced to models of OT practice. Special fee.

### OT 822 - Introduction to 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 830 - Assistive Technology for Enhancing Occupational Performance

Credits: 3.00

This course provides instruction on how occupational therapy practitioners use and apply assistive technology in the context of client evaluation and intervention, to improve quality of life and functional capacities. Students learn and apply clinical reasoning skills related to the selection, procurement, modification and training in the use of assistive technology solutions.

Co-requisites: OT 830L

### OT 830L - Assistive Technology for Enhancing Occupational Performance Lab

Credits: 2.00

Co-Requisite Laboratory for OT 730/830 Assistive Technology for Enhancing Occupational Performance. Students are provided hands-on learning experiences regarding the fabrication, identification, adaptation and training in the use of assistive technology for individuals with functional problems associated with disability or impairment. OT evaluation and interventions related to the application of assistive technology are addressed.

Co-requisites: OT 830

### OT 841 - Human Occupation

Credits: 4.00

This course introduces students to the broad concept of occupation by exploring ways people acquire skills for occupational performance. Students develop an understanding of the relations between health and occupation, disability and occupation, and explore how humans find meaning in their lives, through occupational engagement. This course is writing intensive.

#### OT 845 - Administration and Policy for Occupational Therapy Practice

Credits: 3.00

This course aims to increase the student's understanding of systems of practice, and to business fundamentals associated with occupational therapy service delivery. Specific topics covered include and analysis of practice settings, reimbursement, supervision of professional and non-professional staff, program evaluation methods, ethics, OT management practices, marketing, health policy including medicare, Human Rights and Education Legislation, and the impact of policy decisions for the delivery of OT services.

#### OT 846 - Transitions: Student to Professional

Credits: 2.00

This course is designed to help occupational therapy students explore role changes involved in leaving the academic world and entering the larger realm of professional and practice settings. Research on professional development indicates this transition is easier when students are prepared in both personal and institutional domains. Through lecture, presentations, small group work, readings, and written assignments students are given opportunities to analyze factors that contribute to successful professional development and ethical practice. Students use the results of their analyses to plan their individual transitions to fieldwork and entry-level practice. Prereq: OT 892; second semester standing in first year of MS program.

#### OT 851 - Mind Body Systems/Neurologically-based Function and Dysfunction

Credits: 3.00

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 and Environmental Effects on Everyday Occupations

Credits: 3.00

Students will integrate their 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.

Co-requisites: OT 852L

#### OT 852L - Human Movement and Environmental Effects on Everyday Occupations Lab

Credits: 1.00

Lab. Special fee. Co-requisites: OT 852

#### OT 854 - Level II Fieldwork, I

Credits: 8.00

This course is a 12-week, full-time internship that takes place after completion of the first graduate year,

either in the summer or the fall. 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.

Co-requisites: OT 855

OT 855 - Level II Fieldwork, I Online Discussion

Credits: 1.00

OT 855 Level II Fieldwork, I, online discussion is a co-requisite course that accompanies OT 854 and 856: Level II Fieldwork. Students respond to instructor-lead discussion prompts as well as to postings of their classmates. The online discussion provides the opportunity for students to relate fieldwork experiential learning to all areas of UNH coursework including: mind-body systems, health-and-human systems of care; assessment; intervention; documentation; evidence-based practice; client-centered and occupation-centered practice; and application of research to practice. Students engage in on-going discussion about professional identity and the transition from student to professional as they describe and discuss fieldwork challenges and successes across a variety of practice settings. Cr/F.

Co-requisites: OT 854

OT 856 - Level II Fieldwork, II

Credits: 8.00

This course is the second 12-week, full-time internship. It takes place after two semesters in the second graduate year. OT 856 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 857 - Level II Fieldwork, II Online Discussion

Credits: 1.00

OT 857: Level II Fieldwork, II, online discussion is a co-requisite course that accompanies OT 856: Level II Fieldwork, II. Students respond to instructor-lead discussion prompts as well as to postings of their classmates. The online discussion provides the opportunity for students to relate fieldwork experiential learning to all areas of UNH coursework including: mind-body systems, health-and-human systems of care; assessment; intervention; documentation; evidence-based practice; client-centered and occupation-centered practice; and application of research to practice. Students engage in on-going discussion about professional identity and the transition from student to professional as they describe and discuss fieldwork challenges and successes across a variety of practice settings. Cr/F.

Co-requisites: OT 856

OT 860 - Psychosocial Evaluation and Intervention

Credits: 3.00

Examines the evaluation of psychosocial and psycho-emotional areas of occupational performance and the planning and implementation of occupation-based interventions across domains of practice and client populations. Course addresses developing a client's occupational profile, narrative reasoning and therapeutic use of self, behavioral change, illness representation, and adjustment to chronic disorders. A specific focus of the course is evaluation of and intervention for clients' presenting with mental health disorders. Open to OT majors only.

Co-requisites: OT 860L

OT 860L - Psychosocial Evaluation and Intervention Lab

Credits: 1.00

This is the co-requisite lab for OT 860. Lab provides hands-on experiences regarding the evaluation and

intervention of psychological and psycho-emotional areas of occupational performance. Course focuses on the evaluation and intervention for clients presenting with mental health disorders and also addresses narrative reasoning, therapeutic use of self, behavioral change, illness representation and adjustment to chronic disorders. Special fee.

Co-requisites: OT 860

OT 862 - OT Evaluation and Intervention for Children

Credits: 4.00

Students will gain foundation knowledge of OT evaluation intervention process. Students apply the clinical reasoning process for the evaluation and treatment of children with various conditions, and across age groups. Students learn common assessment tools used by occupational therapists, and how to select and critique evaluation methods. Select cases will be used for the application of knowledge, interventions, and frames of reference used with children. Special fee.

Co-requisites: OT 863

OT 863 - Occupational Therapy Intervention

Credits: 3.00

Students gain foundation knowledge of the OT evaluation and intervention process with adults with neurological and orthopedic conditions. Students apply the clinical reasoning process to clinical practice with adults with various types of medical conditions. Students learn about common assessment tools available to occupational therapists for adults, where, when, and how to apply them. Students develop technical skills in administering selected evaluation tools, in integrating assessment data, and demonstrate clinical decisions about intervention planning and implementation. Selected cases are used for application of knowledge, and the course covers the application of common intervention strategies used by occupational therapists with adults.

Co-requisites: OT 862

OT 864 - Occupational Therapy Intervention Lab

Credits: 2.00

Pre- or co-requisite OT 863. Special fee.

OT 865 - Occupational Therapy Practice and Professional Reasoning

Credits: 3.00

Develops professional reasoning by building upon level II fieldwork experiences. Students develop a population-based intervention plan, explore occupational therapy in an emerging or specialized practice setting, and implement a plan for continuing professional development. Students prepare for their OT board certification examination, and complete a culminating capstone experience.

OT 871 - Enabling Participation in Community Groups

Credits: 3.00

Students will work in a community 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.

Co-requisites: OT 871L

OT 871L - Enabling Participation in Community Groups Lab

Credits: 2.00

The lab portion serves as a Level 1 fieldwork placement and involves working in a community setting on a weekly basis.

Co-requisites: OT 871

OT 875 - Leadership in Occupational Therapy Systems of Practice

Credits: 3.00

Students will integrate 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 health care industry are emphasized.

OT 885 - Research Methods and Application to Practice

Credits: 3.00

Students engage in activities of systematic inquiry. Research methods from qualitative, quantitative, and mixed perspectives are introduced and applied to relevant research questions in occupational therapy. Students critically analyze research articles, bodies of evidence, and are expected to synthesize information for practical application and evidence-based OT practice.

OT 892 - Level I Fieldwork

Credits: 1.00

During a two-week fieldwork, students observe an occupational therapist and participate in the planning and implementation of the occupational therapy evaluation and intervention process for a client. The Level I Fieldwork placement is scheduled between fall and spring of their first graduate year. 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 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 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

May be repeated up to a maximum of 6 credits. Prereq: permission. Cr/F.

## 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 817 - Lake Ecology

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 biology. (Also offered as ZOOL 817.)

### PBIO 819 - Field Studies in Lake Ecology

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. Prereq: CHEM 403-404; PBIO 701 or permission. 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.) 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 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 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 847 - Aquatic Plants in Conservation

Credits: 4.00

A field-intensive class focusing upon freshwater and marine vascular plants with an emphasis on species commonly associated with ecological restoration, the identification and conservation of rare species, and the adaptations and management of invasive species of aquatic habitats in New England. Field trips emphasize the flora of various wetland habitats, including open water and vegetated fresh water wetlands, as well as coastal and estuarine habitats. Lectures and readings examine the current trends in research and management focusing upon specific taxa and pertinent facets of their taxonomy, physiology, and natural history. Prereq: PBIO 566 or permission.

#### 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 sub-culturing, 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 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 860 - Insect Pest Management

Credits: 4.00

Students learn the principles of integrated pest management, as they apply to insects (and some other arthropods). Additionally, they learn to recognize the major orders of insects, and some insect families that are important as natural enemies of pests. Course incorporates a significant amount of writing, plus learning to search the scientific literature. Prereq: BIOL 411 and BIOL 412 or equivalent.

#### PBIO 899 - Master's Thesis

Credits: 1.00 to 10.00

May be repeated up to a maximum of 10 credits. 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. Unlike other core courses in the MPH Program which are 8 weeks in length, this course is 16 weeks in length.

### 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 learn through classroom instruction, lab instruction and exercises, a variety of statistical methods in public health. Students review measures of central tendency, rates, and standardization, probability, sampling, hypothesis testing, comparisons, and simple, multiple and logistic regression techniques. Unlike other core courses in the MPH Program which are 8 weeks in length, this course is 16 weeks in length.

### 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 focuses on public health managers, organizational culture, management process, management functions and 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 specific public health policy in-depth.

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, 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 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 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 928 - Principles of Toxicology

Credits: 3.00

This special topics lecture course in public health ecology is an introduction to the science of toxicology. Students gain an understanding of broad toxicological principles and their application to current public health issues. In general, the course provides a mechanistic basis for how substances initiate toxicity, the major environmental determinants of risk, and the risk assessment framework. Examples of toxicants to be examined include the following: drugs, pesticides, food additives and contaminants, environmental pollutants, natural and household products.

#### 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 964 - Applied Epidemiology

Credits: 3.00

Course provides a thorough understanding of essential statistical and epidemiological concepts and their effective application in everyday public health practice. Students are given numerous real-life examples to demonstrate the theory in practice. Prereq: PHP 901 and instructor permission.

### PHP 966 - Health Information Systems and Technology

Credits: 3.00

Course provides a graduate level perspective of the use of information technology to improve clinical and operation performance of a variety of health care settings. Topics such as: data collection and storage, enterprise applications, data warehousing, analytics, health information exchange, patient privacy and security, and Geographic Information Systems (GIS) are discussed. Students gain insight as to the extent of the role of information systems play in our health care system.

### 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. May be repeated up to a maximum of 3 credits. 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. May be repeated up to a maximum of 3 credits. Prereq: permission.

### PHP 990 - Field Study

Credits: 3.00

This course provides a 16-week long opportunity for students to synthesize, integrate, and apply the skills and competencies they have acquired during enrollment in the MPH Program and apply them to a public health problem or project in a professional public health practice setting. Students are expected to spend a minimum of 40 hours in the organization (not including preparation time) exploring how that organization deals with a particular public health issue and working on a project for that organization. In addition, students present the findings of their work in a poster session following the conclusion of the course. This public health experience is conducted under the direction of a faculty member and a community public health mentor. This class meets one hour prior to the regularly scheduled core and elective courses in the MPH Program. Prereq: Completion of core courses and permission of course instructor and MPH Program Director.

### PHP 995 - Independent Study

Credits: 1.00 to 3.00

Directed readings and other activities to explore a specific topic related to public health. May be repeated up to a maximum of 3 credits. Prereq: Permission of faculty member and MPH Program Director.

### PHP 996 - Applied Topics in the Essentials of Public Health

Credits: 3.00

This course will require students to attend at least six approved workshops on concepts related to the Ten Essential Services of Public Health. After attending the required workshops, a student will write an integrating paper summarizing what s/he has learned across these workshops at it relates to the Ten Essential Services and identify the types of skills s/he will need to be more effective as a public health professional.

### PHP 998 - Integrating Seminar

Credits: 3.00

This final course in the MPH curriculum serves as the capstone to the MPH degree and provides the opportunity for students to work in teams, bringing both their individual and joint perspectives and expertise, to address a particular public health problem for a New Hampshire-based public health entity. This course incorporates substantive, analytical, administrative, and policy perspectives. Students make a formal presentation of recommendations at the conclusion of the course. This class meets one hour prior to the regularly scheduled core and elective courses in the MPH Program. Prereq: Completion of core

courses and permission of course instructor and MPH Program Director.

## 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 806 - Introduction to Physics Research

Credits: 1.00

Introduction to research in physics including research currently conducted at UNH, library resources, responsible conduct in research, how research differs from coursework, and how research results are presented in the research community. Cr/F.

### PHYS 808 - Optics

Credits: 4.00

Geometrical optics, electromagnetic theory of light, interference, diffraction, polarization, related phenomena and nonlinear optics. (Alternate years only.)

### 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 - Introduction to Space Plasma Physics

Credits: 4.00

Introduction to the subject of space plasma physics including solar physics, heliospheric physics, magnetospheric physics, and ionospheric physics. The course provides an overview of the basic phenomena and processes (e.g. particle acceleration and transport, shock formation, magnetic structures and reconnection, wave propagation, wave-particle interactions, instabilities), theoretical techniques (e.g. single-particle orbits, kinetic and fluid descriptions), and experimental techniques. (Also offered as EOS 812.) (Alternate years only.)

### 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 864 - General Relativity and Cosmology

Credits: 4.00

Review of special relativity, and the motivation for considering gravity in terms of curvature of space time. Introduction to Riemannian geometry, general relativity and Einstein's equations. Application of general relativity in the study of black holes, gravitational waves, cosmology, as well as recent results on inflation and quantum gravity. (Alternate years only.)

### 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

May be repeated up to a maximum of 6 credits. Cr/F.

### PHYS 900 - Introduction to Physics Research and Teaching I

Credits: 1.00

Introduction to teaching/research in physics including responsibilities and methods for teaching assistants, research currently conducted at UNH, library sources, responsible conduct in research, how research differs from coursework, how research results are presented in the research community, and readings from physics education research literature. Cr/F.

### PHYS 901 - Introduction to Physics Research and Teaching II

Credits: 1.00

Introduction to teaching/research in physics including responsibilities and methods for teaching assistants, research currently conducted at UNH, library sources, responsible conduct in research, how research differs from coursework, how research results are presented in the research community, and readings from physics education research literature. 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 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 - Classical Mechanics

Credits: 3.00

Newtonian, Lagrangian, and Hamiltonian formulation of the classical mechanics of particles and rigid bodies. Topics that serve as background for the study of modern physical theories are emphasized.

### PHYS 941 - Electromagnetic Theory I

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 II

Credits: 3.00

See description for PHYS 941.

### PHYS 943 - Quantum Mechanics I

Credits: 3.00

Introduces non-relativistic 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 II

Credits: 3.00

See description for PHYS 943.

### PHYS 951 - Plasma Physics

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 953 - Magnetohydrodynamics of the Heliosphere

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 - Heliospheric Physics

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 #961 - Advanced Quantum Mechanics I

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 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 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 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: 3.00

Impact of judicial decisions on public policy and influences on judicial decision making at the federal, state, and local levels.

### POLT 804 - Policy and Program Evaluation

Credits: 3.00

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 806 - State and Local Government

Credits: 3.00

Advanced study of powers, politics, political cultures, and constitutional settings of American state and local government.

### POLT 808 - Administrative Law

Credits: 3.00

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 811 - Public Opinion and Survey Research

Credits: 3.00

Examination of the role of public opinion in democracy. Research, design, implementation and analysis of a public opinion survey.

### POLT 812 - Leadership Theory and Practice

Credits: 3.00

Exploration of the major theoretical approaches to leadership, including students' and others' leadership skills, styles, roles, and practices. Students will refine their own conceptual and practical approaches to leadership in a variety of settings.

### POLT 815 - Art of Negotiation

Credits: 3.00

Identification, analysis, evaluation and application of effective communication and negotiation skills. Course will include case studies, and simulation/role-playing exercises.

### POLT 818 - Special Topics - Public Administration

Credits: 1.00

Selected topics in public administration, emphasis on specific aspects of management in public and non-profit sectors.

### POLT 821 - Feminist Political Theory

Credits: 3.00

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 825 - Politics and Literature

Credits: 3.00

Seminar: Advanced work in exploring classical and contemporary works of literature to illustrate perennial issues in political philosophy.

#### POLT 840 - States and Societies in the Middle East

Credits: 3.00

Exploration of changing relationships between states and societies in the Middle East and North Africa from WWII to the present. Analyzes the creation of states and markets, the origins of authoritarian and democratic rule, the politics of environment and development, and the evolution of Islamist movements. Country and case studies vary. Previous coursework in comparative politics (POLT 540-559) or history is strongly recommended.

#### POLT #843 - Comparative Political Economy

Credits: 3.00

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 851 - Comparative Environmental Politics and Policy

Credits: 3.00

Environmental politics and policy across national boundaries and at different levels of governance. Comparisons of the U.S. and European Union environmental policies to build a foundation for comparisons across national boundaries and sub-national authorities. Students improve their understanding of how and why comparative methods are used to gain insight into politics and policymaking. Central concepts and debates addressed include the roles of expertise, sustainability, precautionary principle, the use of market mechanisms in policy, environmental justice, policy devolution and flexibility, environmental performance assessment, NGO roles, activism, and social movements. A range of theoretical approaches and historical and contemporary events and case studies, evaluating the claims and explanatory power of various concepts and theories. Includes ethical issues emerging from the theory and practice of environmental politics.

#### POLT 860 - Theories of International Relations

Credits: 3.00

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: 3.00

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: 3.00

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: 3.00

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: 3.00

Advanced analysis and individual research.

POLT 897C - Seminar in Comparative Politics

Credits: 3.00

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: 3.00

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: 3.00

Advanced analysis and individual research, including opportunities for direct observation of governmental administration.

POLT 897I - Seminar in Political Thought

Credits: 3.00

Advanced treatment and individual research.

POLT 898B - Seminar in American Politics

Credits: 3.00

Advanced analysis and individual research.

POLT 898C - Seminar in Comparative Politics

Credits: 3.00

See description for POLT 897C.

POLT 898E - Seminar in International Politics

Credits: 3.00

See description for POLT 897E.

POLT 898F - Seminar in Public Administration

Credits: 3.00

Advanced analysis and individual research, including opportunities for direct observation of governmental administration.

POLT 898I - Seminar in Political Thought

Credits: 3.00

Advanced treatment and individual research.

POLT 899 - Master's Thesis

Credits: 3.00 to 6.00

Each student carries out original research that culminates in a master's thesis. Permission Required. Cr/F.

POLT 900 - Political Science Pro-Seminar

Credits: 3.00

Familiarizes students with political science as a profession. Briefly surveys the scope of the discipline in terms of the substantive fields and methodological approaches. Examines the logic of research design and explores diverse methods of inquiry (i.e., archival, experimental, case study, comparative analysis, field study, survey, etc.), including the process of generating a presentable research paper.

POLT 905 - Introduction to Statistical Analysis

Credits: 3.00

Quantitative research, design and analysis methodology and techniques for political science and public policy and administration.

POLT 906 - Foundations and Theories of Public Administration

Credits: 3.00

Introduction to essential aspects of public and non-profit administration. Critical concepts and theoretical bases; operational nature of public and non-profit administration; contributions of key scholars and practitioners to the study and understanding of public and non-profit administration.

POLT 907 - Legal and Policy-Making Environment on Public and Non-Profit Sectors

Credits: 3.00

Though the use of case studies, analysis and assessment of legal, institutional, social, political and economic settings within public and non-profit sectors.

POLT 908A - Capstone in Public Administration

Credits: 3.00

In-Service.

POLT 908B - Capstone in Public Administration

Credits: 6.00

Pre-Service.

POLT 909 - Organization and Management in Public and Non-profit Sectors

Credits: 3.00

Introduction to key actors, theories and concepts in the fields of organizational theory and behavior.

POLT 911 - Public Management Techniques

Credits: 3.00

Introduction to analytic decision-making and planning techniques applicable to public sector management.

POLT 912 - Human Resource Management in Public and Non-profit Sectors

Credits: 3.00

Examination of the administration, politics, and strategies of effective public human resource management.

POLT 914 - Financial Management and Budgeting in Public and Non-profit Sectors

Credits: 3.00

Analysis, goal setting, and strategic planning in a governmental setting, with particular emphasis on budgetary processes as a means for controlling policy effectiveness.

POLT 915 - Collective Bargaining and Labor Relations

Credits: 3.00

Introduction to theory and practice of labor relations and collective bargaining. Emphasis is on the public sector, although elements of private sector bargaining are included.

POLT 918 - Non-Profit Management

Credits: 3.00

Introduction to governance and management in the non-profit sector: finance, development, personnel management, strategic planning, and risk management.

POLT 995 - Reading and Research

Credits: 1.00 to 3.00

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 3.00

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 Pro-seminar

Credits:

Students and graduate faculty in psychology meet periodically for a mutual exchange on current issues in psychology. Cr/F.

### PSYC 902 - Graduate Pro-seminar

Credits:

See description for PSYC 901. Cr/F.

### PSYC 904 - First-year Graduate Seminar

Credits: 4.00

Coverage of fields of psychology represented in the department's graduate program and taught in the department's introductory psychology course that psychology graduate students teach during their third year in the program. Course is focused on providing common background among students when they enroll in advanced graduate seminars and on assuring they have certain foundational knowledge when they begin to teach the introductory psychology course. Course is required of all first-year psychology graduate students in fall semester. Taught in seminar format.

### 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 T2 multivariate analysis of variance, path analysis, discriminant functions, canonical correlation, factor analysis.

#### PSYC 908 - Mathematical Methods and Behavioral Models

Credits: 4.00

Equations, transformations, and graphs; fundamentals of differential equations; stochastic processes and probability distributions other than Gaussian; applications to selected models of behavior. Prereq: PSYC 906 or permission.

#### 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, para-linguistics 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 820 - Community-Based Natural Resource Management: Lessons from the Field

Credits: 3.00

Guest lectures by extension agents and practitioners from a variety of natural resource-based fields, including: agriculture, forestry, marine resources, planning, and community/economic development. The goal is to expose students to the theoretical and practical aspects of community outreach in the natural resources arena. Prereq: CD 415, EREC 411, NR 401 or permission from instructor. Participation in outreach project is required.

### 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: CEP 614 or permission. (Also offered as CEP 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

May be repeated for a maximum of 10 credits. 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 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 993 - Natural and Environmental Resources Seminar

Credits: 2.00

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 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 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

May be repeated for a maximum of 10 credits. Cr/F.

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 843 - Cultural Environmental Interpretation

Credits: 3.00

This course focuses on the communication processes and practices used by parks and recreation professionals to explain and interpret the special characteristics of cultural and environmental resource sites for visitors. Conceptual principles for planning, interpretive programs as well as techniques for analyzing and disseminating information and entertainment through various media (personal interactions, verbal presentations, exhibits, publications, and other programs) will be discussed. Delivery of interpretive messages across a variety of audiences, strategies for programming interpretative services, and the administration and evaluation of interpretive services in recreation settings will be examined.

### 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 #875 - Entrepreneurial and Commercial Recreation

Credits: 3.00

Principles of business planning and development as applied to the private sector leisure services industry. Emphasizes knowledge of key commercial leisure services profiles and their intersection with allied professions such as hospitality and tourism. Course topics include entrepreneurship, business planning, needs assessment, product development, selling, financing, legal designations, and business operations leading to the development of a business plan for a new entrepreneurial recreation enterprise.

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. May be repeated for a maximum of 6 credits. 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: 1.00 to 3.00

Prereq: RMP 800 and 805 or 806, permission. May be repeated for a maximum of 6 credits.

#### 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.

#### RMP 998 - Special Topics

Credits: 2.00 to 4.00

## 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 825 - Social Demography

Credits: 4.00

Social demography examines the linkages between changes in the size, composition and distribution of the population and changes in social, environmental, economic and political factors. The course examines demographic methods and the materials and the analytical techniques used by demographers to analyze population redistribution, fertility, work, marriage, migration and mortality. The policy implications of demographic change will be examined with attention to the U.S. as well as the developed and developing world.

### SOC 830 - Communities and the Environment

Credits: 4.00

People and the natural environments in which they live fundamentally structure communities around the globe. Economic change, expanding development, and human migration are transforming social and environmental conditions in both rural and urban settings, altering the identities of many communities as well as their relationships with the natural world. The importance of these emerging social and environmental issues has made them a focus for social science inquiry. This course exposes students to a range of sociological concepts, theories, and research approaches related to the study of communities and environmental issues. Some of the substantive themes that are covered include: population dynamics and environmental change; social capital and social networks; political economy and community development; collective action and social movements; science, technology, and environmental risks; and environmental racism and justice. The principal assignment for the course will be a research project where students investigate a community or environmental issue of their own interest.

### SOC 835 - Sociology of Community

Credits: 4.00

This course analyzes "community" from a sociological perspective. Community is one of the fundamental concepts in the sociological literature; this course covers those aspects of the concept that are concerned with geographic communities: neighborhoods, communities, cities, etc. It considers how American communities have changed over time and what the current characteristics are, and how these characteristics are related to the "quality of life" in the communities. Students study theoretical and empirical approaches to studying communities, particularly but not exclusively American communities.

Among specific areas of community research covered are: spatial inequality and concentrated poverty; what housing research shows about the importance of community to outcomes for families and children; the impact of community on health; and community development as a strategy for community change.

#### 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 842 - 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 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 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 876 - Family Violence Research Seminar

Credits: 4.00

Analysis of abusive relationships within the family, especially physical and sexual abuse of children and spouses. Each student designs and conducts an empirical study to test a theory purporting to explain intra-family violence, the consequences of violence for families and society, or a study of what might prevent family violence. Permission required.

#### 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 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 - Pro-seminar

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 classical 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 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 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.

### 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 #871 - Latin American Drama

Credits: 3.00

Topic varies from year to year. Examples: 20th-century Latin American drama; Latin American one-act plays; Theater of protest in Latin America. Prereq: SPAN 650, 654, or equivalent. 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 874 - Major Latin American Authors

Credits: 3.00

Special fee. (Not offered every year.)

### SPAN 881 - Summer Study Abroad in Mexico

Credits: 8.00

Six-week summer immersion program for graduate students. (There are two sessions; one for home-stay and one for dorm). Special fee. Cr/F.

### SPAN 882 - Summer Seminar for Spanish Teachers

Credits: 3.00

Two-week summer seminar for Spanish teachers for K-12 teachers and graduate students. (only one session--home-stay). Special fee. Cr/F.

### 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 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; E) Other. Specialized courses covering topics not normally presented in regular course offerings. Barring duplication of content, Topic E may be repeated for credit. Prereq: permission of major supervisor. Special fee.

#### SPAN 901 - Bibliography and Methods of Research

Credits: 3.00

Required of all graduate students, to be taken concurrently with all graduate work from first to last semester during the program of study. An introduction to standard bibliographical techniques and to form and style in the preparation and writing of research findings. Preparation bibliographical essay is the final requirement for graduation. IA (continuous grading).

#### SPAN 903 - Applied Linguistics

Credits: 3.00

Required of all graduate assistants teaching in the departmental program. Discussion of current methodology and linguistic approaches to the teaching of Spanish. Instruction in the use of media, technology and the Language Resource Center. Readings, discussion, class observation and teaching portfolio. IA (continuous grading).

#### 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.

## 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 and Adolescent Risks and Resiliency: Program, Policy 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 812 - Understanding 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, Bisexual, and Transgender People

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.

Co-requisites: SW 880

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.

Co-requisites: SW 881

SW 840 - Implications of Race, Culture, and Oppression for Social Work Practice

Credits: 3.00

This foundation course is designed to increase students awareness of historical, social, political, economic and cultural aspects of micro- and macro-level oppression directed at minorities. Course materials focus on insidious societal forces that shape and profoundly alter life experiences of large numbers of people, with special attention to social relationships that promote the welfare of some, while limiting opportunities and choices for others, including racial and ethnic minorities, children, women, the poor, the handicapped, GLBTQ individuals, and others. Students consider practice issues in multicultural SW.

SW 850 - Human Behavior and the Social Environment I

Credits: 3.00

SW 850 is the first half of a two-semester sequence in which students learn about human behavior and development and it's context across the life cycle. This semester addresses growth and development from the prenatal period through adolescence using social systems theory/person-in-the-environment as a conceptual framework. The macrosystems that impact individual development, including family, community and larger systems, are examined. Societal forces that are often invisible shape and profoundly alter life experiences of larger numbers of people. HBSE I pays special attention to social relationships that promote the welfare of some while limiting opportunities and choices for others during the first half of the lifecycle. Human worth and social justice themes permeate course materials, class discussions and activities.

SW 851 - Human Behavior and the Social Environment II

Credits: 3.00

SW 851 is the second half of a two-semester sequence in which students learn about human behavior and development and it's context across the life cycle. This semester addresses growth and development from adolescence through old age using social systems theory/person-in-the-environment as a conceptual framework. The macrosystems that impact individual development, including family, community and larger systems, are examined. Societal forces that are often invisible shape and profoundly alter life experiences of larger numbers of people. HBSE II pays special attention to social relationships that promote the welfare of some while limiting opportunities and choices for others during the first half of the lifecycle. Human worth and societal justice themes permeate course materials, class discussions and activities.

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.

Co-requisites: SW 830

#### 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.

Co-requisites: SW 831

#### SW 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. (Also listed as KIN 882.)

#### SW 885 - Study Abroad: 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) Drugs and Chemical Dependency; B) Intimate Partner Violence C) Social Action in Education Settings D) Social Action in the Dominican Republic. May be repeated for different topics. Special fee for course trip.

#### 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 incorporates a focus on the conscious and purposeful use of self as a therapeutic or change agent. Differential assessment is featured through the application of the scientific method and a bio-psycho-social perspective. Several frameworks for assessment and intervention are explored including: psychodynamic, systemic, cognitive-behavioral, family, group and community/organizational frameworks. Prereq: SW 831.

Co-requisites: SW 982

### SW 933 - Direct Practice IV: Advanced Clinical Assessment and Intervention

Credits: 3.00

This course marks the end of MSW preparation for entering the field and, as such, focuses on professional identity development and positioning. Critical thinking and conscious, purposeful and differential use of self as a therapeutic or change agent are emphasized. Advanced assessment using cognitive, psychodynamic, social constructionist and systemic frameworks is offered with a focus each week on role-plays and presentations of case material from field experiences that help to integrate theory with practice. Prereq: SW 932.

Co-requisites: SW 983

### SW 936 - Community and Administrative Practice III: Community Organization and Political Strategies

Credits: 3.00

Provides students with the knowledge base and skills in the areas of: community assessment, intervention, planning, budgeting, and developing organizational change and political strategies. Students learn to use strategies of cultivation, mobilization and sustaining support that empowers underserved constituent groups. Course provides both historical and current contexts for change efforts across organizational and community systems. Course is required of students in the community and administrative practice concentration, but also open as an elective to any M.S.W. student who has completed first-year practice courses

Co-requisites: SW 982

### 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 performing managerial functions in public and private human service settings, including those that serve diverse constituent groups. Focuses on the concepts, principles, values, and strategies that inform administrative practice, including policy formulation and program planning. Emphasis on the integration of organizational theory, managerial roles, and a systems knowledge base. 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. Coreq: SW 983 if CAP concentration.

### SW 952 - Human Behavior and the Social Environment III

Credits: 3.00

Designed to acquaint master's degree students with the epidemiology, classification, and etiology of the major mental illnesses; with a primary objective to develop the student's diagnostic skills in the field of psychopathology. Students become familiar with historical and current mental health policy issues. At course conclusion students have an effective working knowledge of the bio-psycho-social basis of the major mental disorders, the behavioral symptomology that characterizes them, the use of psychotropic medication in treatment, and their classification according to the current DSM system. Prereq: SW 850 and 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 human service agencies. Basic principles of administrative, supportive and educational supervision are reviewed and related to the student's own experiences in supervision or as a supervisor. This elective course is open to both direct practice and community and administrative practice students.

### SW 975 - Theory and Practice of Family Therapy

Credits: 3.00

This course is designed to provide students with an introduction to the theory and practice of family therapy. Major approaches to be examined include structural, strategic, systemic, brief, narrative family therapy, and social constructionism. Students have an opportunity to present cases they are currently working with in their internships and are able to practice family therapy techniques with the use of a team coaching them from behind a one-way mirror.

### 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. Coreq: SW 932 or SW 936. 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 workshop-style 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. Coreq: SW 933 or SW 937. Cr/F.

#### 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 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 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 biology. (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.) 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 817 - Lake Ecology

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 biology. (Also offered as P BIO 817.)

### ZOOL 819 - Field Studies in Lake Ecology

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 PBIO 819.) Special fee. Lab.

#### 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 PBIO 825.) Special fee. (Not offered every year.)

#### 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 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 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 899 - Master's Thesis

Credits: 1.00 to 10.00

Prereq: permission of department chairperson and prospective supervisor. May be repeated up to a maximum of 10 credits. 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 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.