AEROSPACE STUDIES

AS 1001. THE FOUNDATIONS OF THE UNITED STATES AIR FORCE I.
Cat. I (1/9 unit)
The AS 1001 sequence of courses are designed to introduce students to the United States Air Force and Air Force Reserve Officer Training Corps. Featured topics include mission and organization of the Air Force, officership and professionalism, Air Force officer opportunities, military customs and courtesies, and introduction to communication skills.

The first course focuses on the foundation of officership and customs and courtesies.

The course includes one hour of class work and two hours of mandatory leadership laboratory per week. The AS 100 Leadership Laboratory includes a study of Air Force customs and courtesies, drill and ceremonies, and military commands.

AS 1002. THE FOUNDATIONS OF THE UNITED STATES AIR FORCE II.
Cat. I (1/9 unit)
The AS 1002 sequence of courses are designed to introduce students to the United States Air Force and Air Force Reserve Officer Training Corps.

A continuation of AS 1001, the second course in this series emphasizes the communication skills needed in today’s Air Force. It describes the communication systems, discusses common barriers and enhancements to effective communications. The course includes numerous speaking and written exercises using current Air Force topics.

The course includes one hour of class work and two hours of mandatory leadership laboratory per week. The AS 100 Leadership Laboratory includes a study of Air Force customs and courtesies, drill and ceremonies, and military commands.

AS 1003. THE FOUNDATIONS OF THE UNITED STATES AIR FORCE III.
Cat. I (1/9 unit)
The AS 1003 sequence of courses are designed to introduce students to the United States Air Force and Air Force Reserve Officer Training Corps.

A continuation of AS 1002, the course outlines the origins of the Air Force and the organizational structure of the Air Force with a focus on the missions of select military organizations. The basic history of the United States military is studied in order to appreciate how military history impacts the Air Force today. Written and oral communication skills are practiced.

The course includes one hour of class work and two hours of mandatory leadership laboratory per week. The AS 100 Leadership Laboratory includes a study of Air Force customs and courtesies, drill and ceremonies, and military commands.

AS 1004. THE FOUNDATIONS OF THE UNITED STATES AIR FORCE IV.
Cat. I (1/9 unit)
The AS 1004 sequence of courses are designed to introduce students to the United States Air Force and Air Force Reserve Officer Training Corps.

The course includes one hour of class work and two hours of mandatory leadership laboratory per week. The AS 100 Leadership Laboratory includes a study of Air Force customs and courtesies, drill and ceremonies, and military commands.

Cat. I (1/9 unit)
The AS 2001 sequence of courses are designed to examine general aspects of air and space power through a historical perspective. Additionally, the course provides the student with a knowledge level understanding of the general elements and employment of air and space power from an institutional doctrinal and historical perspective. Historical examples are discussed to extrapolate the development of Air Force capabilities and missions to demonstrate the evolution of what has become today’s USAF air and space power. As a whole, the AS 2001 sequence of courses provides the student with a knowledge level understanding for the general element and employment of air and space power.

The course includes one hour of class work and two hours of mandatory leadership laboratory per week. The AS 200 Leadership Laboratory continues a study of Air Force customs and courtesies, drill and ceremonies, and military commands.

AS 2002. THE EVOLUTION OF USAF AIR AND SPACE POWER II.
Cat. I (1/9 unit)
The AS 2002 sequence of courses are designed to examine general aspects of air and space power through a historical perspective. The second course in the series continues with the development of air power from World War II through the development of the Intercontinental Ballistic Missile.

The course includes one hour of class work and two hours of mandatory leadership laboratory per week. The AS 200 Leadership Laboratory continues a study of Air Force customs and courtesies, drill and ceremonies, and military commands.

AS 2003. THE EVOLUTION OF USAF AIR AND SPACE POWER III.
Cat. I (1/9 unit)
The AS 2003 sequence of courses are designed to examine general aspects of air and space power through a historical perspective. The third course in the series begins with a study of air power in the Vietnam War through the Gulf War. Oral and written communications skills will be practiced.
The course includes one hour of class work and two hours of mandatory leadership laboratory per week. The AS 200 Leadership Laboratory continues a study of Air Force customs and courtesies, drill and ceremonies, and military commands.

**AS 3000. AIR FORCE LEADERSHIP STUDIES I.**

The AS 3000 sequence of courses are a study of leadership, management fundamentals, professional knowledge, Air Force personnel and evaluation systems, leadership ethics, and communication skills required of an Air Force senior officer. The second course studies various aspects of leadership, conflict management, counseling, and supervision. The course includes three hours of class work and three hours of mandatory leadership laboratory per week. The AS 300 Leadership Laboratory complements the class room work by providing advanced leadership experiences in officer-type activities and giving students the opportunity to apply leadership and management principles.

**AS 3002. AIR FORCE LEADERSHIP STUDIES II.**

The AS 3000 sequence of courses are a study of leadership, management fundamentals, professional knowledge, Air Force personnel and evaluation systems, leadership ethics, and communication skills required of an Air Force junior officer. The second course studies various aspects of leadership, conflict management, counseling, and supervision. The course includes three hours of class work and three hours of mandatory leadership laboratory per week. The AS 300 Leadership Laboratory complements the class room work by providing advanced leadership experiences in officer-type activities and giving students the opportunity to apply leadership and management principles.

**AS 3003. AIR FORCE LEADERSHIP STUDIES III.**

The AS 3000 sequence of courses are a study of leadership, management fundamentals, professional knowledge, Air Force personnel and evaluation systems, leadership ethics, and communication skills required of an Air Force junior officer. The final course explores teambuilding, improvement process, and military ethics. The course includes three hours of class work and three hours of mandatory leadership laboratory per week. The AS 300 Leadership Laboratory complements the class room work by providing advanced leadership experiences in officer-type activities and giving students the opportunity to apply leadership and management principles.

**AS 3004. AIR FORCE LEADERSHIP STUDIES IV.**

The AS 3000 sequence of courses are a study of leadership, management fundamentals, professional knowledge, Air Force personnel and evaluation systems, leadership ethics, and communication skills required of an Air Force junior officer. The final course explores officer professional development, and personnel and evaluation systems including practical exercises. The course includes three hours of class work and three hours of mandatory leadership laboratory per week. The AS 300 Leadership Laboratory complements the class room work by providing advanced leadership experiences in officer-type activities and giving students the opportunity to apply leadership and management principles.

**AS 4000. AIR FORCE LEADERSHIP STUDIES V.**

The AS 4000 sequence of courses examines the national security process, regional studies, advanced leadership ethics, and Air Force doctrine. The third course provides an extensive study of alliances and regional security issues, including international peacekeeping and terrorism. Continued attention is given to developing the research and communications skills required by junior officers. The course includes three hours of class work and three hours of mandatory leadership laboratory each week. The AS 401 Leadership Laboratory complements the classroom work by providing advanced leadership experiences in officer-type activities and giving the students the opportunity to apply leadership and management principles.

**AS 4002. NATIONAL SECURITY AFFAIRS II.**

The AS 4002 Leadership Laboratory provides a detailed examination of Air Force doctrine including a study of the joint doctrine and the roles of the other military services. The course includes three hours of class work and three hours of mandatory leadership laboratory each week. The AS 402 Leadership Laboratory complements the classroom work by providing advanced leadership experiences in officer-like activities and giving the students the opportunity to apply leadership and management principles.

**AS 4003. NATIONAL SECURITY AFFAIRS III.**

The AS 4003 sequence of courses examines the national security process, regional studies, advanced leadership ethics, and Air Force doctrine. The third course provides an extensive study of alliances and regional security issues, including international peacekeeping and terrorism. Continued attention is given to developing the research and communications skills required by junior officers. The course includes three hours of class work and three hours of mandatory leadership laboratory each week. The AS 403 Leadership Laboratory complements the classroom work by providing advanced leadership experiences in officer-type activities and giving the students the opportunity to apply leadership and management principles.

**AS 4004. PREPARATION FOR ACTIVE DUTY.**

The AS 4004 sequence of courses examines the national security process, regional studies, advanced leadership ethics, and Air Force doctrine. The final course in the series examines officership, the military justice system, social responsibilities, current issues affecting the military profession, and various factors that will facilitate a smooth transition from civilian to military life. The course includes three hours of class work and three hours of mandatory leadership laboratory each week. The AS 404 Leadership Laboratory complements the classroom work by providing advanced leadership experiences in officer-type activities and giving the students the opportunity to apply leadership and management principles.

**AS 4101. NATIONAL SECURITY AFFAIRS I.**

The AS 4101 Leadership Laboratory provides a detailed examination of Air Force doctrine including a study of the joint doctrine and the roles of the other military services. The course includes three hours of class work and three hours of mandatory leadership laboratory each week. The AS 4101 Leadership Laboratory complements the classroom work by providing advanced leadership experiences in officer-like activities and giving the students the opportunity to apply leadership and management principles.

**BB 1001. INTRODUCTION TO BIOLOGY.**

This course consists of an overview of the major concepts of Biology, including: cell theory, bioenergetics, molecular biology, reproduction, nutrition, growth, development, homeostatic controls, and ecological issues. This course is intended for students seeking a broad overview of contemporary Biology with emphasis on human issues and current topics.

Recommended background: high school or introductory college level chemistry.

**BB 1030. INTRODUCTION TO BIOLOGICAL MACROMOLECULES.**

This course is an introductory biology course for Biology and Biotechnology and health science pre-professional majors. The four classes of biologically important macromolecules (lipids, nucleic acids, proteins, and carbohydrates) will be studied, with particular reference to how their structure is appropriate to their function in cell metabolism and reproduction. Current topics in cell and molecular biology will be used as the basis for small group problem solving.

Recommended background: High School Biology, CH 1010 (concurrent).

**BB 1040. PLANT DIVERSITY.**

An introductory course stressing general concepts related to the vast array of plant species, taxonomic links, and uses of major plant phyla in both society and industry. Some emphasis will be given to economically important species chosen from agronomic and non-agronomic situations.

Recommended background: high school biology or equivalent.

Students may not receive credit for both BB 2030 and BB 1040.

**BB 1050. ZOOLOGY.**

This course is a survey of the animal kingdom with an emphasis on its history and organization. Particular attention is paid to special structures and mechanisms evolved by selected representatives of major phyla for solving problems of life in various environments.

Recommended background: BB 1001 and BB 1030.

Students may not receive credit for both BB 2020 and BB 1050.
BB 2002. MICROBIOLOGY.
Cat. I
The various organisms making up the protists and viruses, their taxonomy, morphology, and physiology are studied. Special attention will be given to those organisms which are of ecological concern or serve a useful industrial purpose. The importance of microbes in public health problems will be presented. This course is designed for all biology majors and for other students who seek a good general education in modern biology.
Recommended background: BB 2550 or equivalent. A basic understanding of elementary biochemical processes is desirable.

BB 2040. PRINCIPLES OF ECOLOGY.
Cat. I
This course is designed to give the student a basis for understanding the abundance and distribution of plants and animals from the level of the individual to that of the ecosystem. The course will focus on specific scientific examples of ecological research to elucidate general concepts. The basic concepts covered will be augmented with problem sets designed to get the student comfortable with the mathematics of ecology. The course format will include lectures and discussion sections and may include a field trip to a wildlife sanctuary.

BB 2130. ANATOMY.
Cat. I
The anatomy of the human body will be covered system by system, with histochimical highlights where relevant, e.g., skin, bone structure, smooth vs. skeletal muscle. Discussion will include, but not necessarily be limited to, the following systems: integumentary, nervous, musculoskeletal, circulatory, respiratory, reproductive, endocrine, urinary and digestive.
Recommended background: BB 1050 and BB 2550.
Students may not receive credit for both BB 3130 and BB 2130.

BB 2550. CELL BIOLOGY.
Cat. I
This entry level course, recommended for all BB, BC, and pre-professional majors, presents the fundamental aspects of cell structure and function, and is the foundation of all fields of modern biology.
Topics include: cell complexity and organizational hierarchy, evolution of the cell, cell surface, plasma membrane, single and double cytoplasmic membrane systems, nuclear fusion and hybridomas, cytoskeleton, cell growth, and differentiation.
Recommended background: BB 1001, BB 1030 or equivalent.

BB 2920. GENETICS.
Cat. I
This entry level course presents the principles and experimental evidence leading to our understanding of the gene concept and the role of DNA as genetic material. Patterns of inheritance, the relationship between genotype and phenotype, and transmission, coding, and expression of genetic information are considered in a variety of organisms. A quantitative, problem-solving approach and the use of genetic analysis as a tool to study biological phenomena are emphasized throughout the course. The course is designed for all biology and pre-professional majors.
Recommended background: BB 1030 or equivalent.

BB 2940. EXPERIMENTAL BIOLOGY I.
Cat. I
The lab exercises in this course have been selected to provide the skills needed to study living organisms at the cellular level, and to emphasize the basic principles of Biology. Students will gain experience with procedures, equipment and lab skills common to all Biology fields. Emphasis is on precise data collection, analysis and interpretation of biological data. This course is designed for Biology/Biotechnology majors and other life science preprofessionals. One lecture and lab per week for 2 terms (i.e. 1/3 unit per 14 weeks).
This course may not be taken for less than 1/3 unit of credit except with the prior approval of the instructor.
Recommended background: a college level course in general chemistry and biology, or its equivalent.

BB 2950 EXPERIMENTAL BIOLOGY II
Cat. I
A continuation of Experimental Biology I with lab exercises selected to emphasize the skills needed to study living organisms and their diversity. These exercises will emphasize the principles and techniques of genetics and microbiology, as well as the diversity of the biological flora and fauna. Unique aspects of living organisms will be featured as opportunities for use in Biotechnology. One lecture and lab per week for 2 terms (i.e. 1/3 unit per 14 weeks). This course may not be taken for less than 1/3 unit of credit except with the prior approval of the instructor.
Recommended background: BB 2940.
BB 3513. CELL CULTURE TECHNIQUES FOR ANIMAL CELLS.
Cat I (1/6 unit)
Basic laboratory skills in mammalian cell culture to include cell counting, freezing and thawing cell lines, culture of suspension and attached cells. Recommended background: BB 2940, BB 2550 and knowledge of aseptic techniques. Concurrent or prior registration in BB 4008 is recommended.

BB 3514. CIRCULATORY AND RESPIRATORY PHYSIOLOGY.
Cat I (1/6 unit)
Computer and laboratory studies of circulatory and respiratory physiology. Recommended background: BB 2940. Concurrent or prior registration in BB 3110 is recommended.

BB 3516. SEPARATION TECHNIQUES IN BIOTECHNOLOGY.
Cat I (1/6 unit)
A laboratory course in chromatographic and electrophoretic separation of proteins; plasmid isolation, restriction digestion and electrophoretic separation of DNA. Recommended background: BB 2940. Concurrent or prior registration in BB 3055 is suggested.

BB 3517. FERMENTATION.
Cat I (1/6 unit)
An introductory laboratory course in basic fermentation techniques. Recommended background: BB 2940, BB 2002, or knowledge of aseptic techniques. Concurrent or prior registration in BB 3055 is suggested. Recommended background: CH 4110 and CH 4120.

BB 3518. MOLECULAR BIOLOGY.
Cat I (1/6 unit)
A laboratory investigation in molecular aspects of cellular processes and components. Recommended background: BB 2940, BB 2550, CH 4110 and CH 4120. Concurrent, or prior registration in BB 4910/CH 4130 is recommended.

BB 3519. PROTEIN PURIFICATION.
Cat I (1/6 unit)
A laboratory course in protein purification techniques. Recommended background: BB 2940, CH 4110. Concurrent or prior registration in BB 4070 is recommended.

BB 3520. RECOMBINANT DNA TECHNOLOGY.
Cat I (1/6 unit)
A laboratory course in the construction, isolation and mapping of recombinants, and use of the polymerase chain reaction. Recommended background: BB 2940, BB 2550, CH 4110 and BB 4910/CH 4130. Concurrent or prior registration in BB 4955 is recommended.

BB 3620. DEVELOPMENTAL BIOLOGY.
Cat II
This advanced level course provides a detailed survey of the processes of animal development, including fertilization, cleavage, gastrulation, and organogenesis. These processes are examined in the context of concepts such as differentiation, determination, induction, intercellular signaling, morphogenesis, and pattern formation. Emphasis is placed on current techniques for studying development, such as genetic analysis of mutations, recombinant DNA technology, molecular probing of gene expression, and gene transfer. The experimental focus is on model organisms such as nematodes, fruit flies, frogs, and mice. Offered in 2000-01 and alternate years.
Recommended background: BB 2002, BB 2550, BB 2920.

BB 3920. IMMUNOLOGY.
Cat I
This is a survey course in immunology which assumes a background in cell biology, genetics and biochemistry. Topics to be covered will include cells of the immune system, antigen/antibody immunochemistry, immunogenetics and immune responses. Readings from research literature will be assigned. Recommended background: BB 2550, BB 2920, CH 4130, and CH 4120. Students may not receive credit for both BB 4920 and BB 3920.

BB 4008. CELL CULTURE THEORY AND APPLICATIONS.
Cat I
The use of cultured animal cell systems for research and production will be explored. Concepts, including media design, the effects of extracellular matrices, scaling up of cell cultures, and biochemical and morphologic assessment of cell function, will be discussed as a basis for readings from the literature. Recommended background: BB 2550, BB 2920, CH 4110, and CH 4120. Students who have received credit for BB 4007 may not take BB 4008 for credit.

BB 4010. ADVANCED MOLECULAR GENETICS.
Cat I
Topics in molecular genetics are presented using microbial systems as models. The structure, function and synthesis of DNA and the results of mutation, recombination and repair are emphasized. Simple bacteria and their plasmids, transposable elements and phages are discussed as experimental models. Recommended background: BB 2002, BB 2550, BB 2920, BB 4910.

BB 4020. COMPUTATIONAL BIOLOGY.
Cat II
This course will cover the use of mathematical and computational models to understand biological systems. Examples will be drawn from a number of different areas, including ecology, neurobiology, molecular biology, and fermentation. In each topic area, we will address the assumptions of the model, how much reality might deviate from the model, how the model can be used to determine optimum behavior of the system, and the stability of model parameters. No programming experience is necessary; students will use available computer software to explore these questions. Recommended background: MA 1021 and 1022, and any 3000 or 4000 level BB course. This course will be offered in 2000-01 and in alternating years thereafter.

BB 4040. EXPERIMENTAL DESIGN AND DATA ANALYSIS.
Cat II
This applied course introduces students to the design of experiments and analysis of data. We will cover a number of different experimental situations occurring frequently in biology, including testing the fit of data to theoretical distributions, comparisons of groups, and regression analysis. Emphasis will be placed on formulating the hypothesis of interest, designing experiments so that the subsequent analysis will have enough power to test the hypothesis, and choosing the appropriate analysis to perform. We will discuss the importance of pilot studies, and some of the most common errors made in choosing and performing statistical tests. Both parametric and non-parametric tests will be discussed. Students will use computer packages to analyze data from the literature and/or their own experimental data. Recommended background: MA 2611, and any 3000 or 4000 level BB course. This course will be offered in 2001-02 and in alternating years thereafter.

BB 4065. VIROLOGY.
Cat I
This advanced-level course uses a seminar format based on research articles to discuss current topics related to the molecular/cell biology of viral structure, function, and evolution. Particular emphasis is placed on pathological mechanisms of various human disorders, especially emerging diseases, and the use of viruses in research. Recommended background: BB 2550, BB 4910.

BB 4070. SEPARATION OF BIOLOGICAL MOLECULES.
Cat I
This course provides a detailed survey of state-of-the-art methods employed by the biotechnology industry for the purification of products, proteins in particular, from fermentation processes. Focus is on methods which offer the best potential for scale-up. Included are the theory of the design as well as the operation of these methods at the laboratory scale. It is intended for biology/biotechnology majors, chemical engineering and biochemistry students. Recommended background: knowledge of the topics in CH 4110 and CH 4120. Students who have received credit for BB 4060 may not take BB 4070 for credit.

BB 4140. ECOLOGICAL MANAGEMENT.
Cat II
We will take an in-depth look at the development of a management scheme for a natural area. The course focuses on the biological issues of ecological management rather than socio-economic ones. Format will vary from week to week and will include lectures, group discussions, workshops and field trips to a wildlife sanctuary with an established ecological management plan. Basic concepts of population ecology and field techniques of ecological research will be explored to give the student a working knowledge of the biological basis for ecological management. Recommended background: BB 1040, BB 1050 and BB 2040. This course will be offered in 2001-02 and in alternating years thereafter.

BB 4550. ADVANCED CELL BIOLOGY.
Cat I
This advanced-level course uses a seminar format based on research articles to discuss current topics related to the molecular biology of cellular function. Particular emphasis is placed on biological mechanisms of autoimmune disorders, cancer, Alzheimer’s disease, thrombosis, haemostasis, neurotropic factors, and gene therapy. Recommended background: BB 2550, BB 4910, CH 4110, CH 4120.

BB 4910/CH 4130. MOLECULAR BIOLOGY/BIOCHEMISTRY III.
Cat I
The structure, function, and biosynthesis of DNA, RNA and proteins are the chief topics of this course. Both prokaryotic and eukaryotic systems are examined. The nature of the genome and the genetic code, the structure and expression of selected genes and the regulation of genetic expression are emphasized. Recommended background: prior knowledge of BB 2550, BB 2920, and CH 4110, CH 4120.
BB 4955. RECOMBINANT DNA PRINCIPLES AND APPLICATIONS.

Cat. I

This course surveys both theory and applications in recombinant DNA methodology. Topics covered include enzymology of DNA manipulation; construction and isolation of recombinants; plasmid and bacteriophage vectors; structural analysis of cloned DNA.

Recommended background: prior knowledge of BB 2002, BB 2550, BB 2920, BB 4010, and BB 4910 will be assumed.

Students who have received credit for BB 4950 may not take BB 4955 for credit.

IS 4 BB. SPECIAL TOPICS.

Cat. I

Experimental courses, special conferences and seminars are offered by advance arrangement only.

Graduate Biology and Biotechnology Courses of Interest to Undergraduates

The following courses are open to advanced undergraduates with special written permission of the course instructor and department head.

BB 501. SEMINAR.

BB 502. TECHNIQUES IN ELECTRON MICROSCOPY.

This course presents the theory of operation, applications, and use of scanning and transmission electron microscopy in biology. Recent original articles from the biological literature illustrate the applications of these techniques to research. Students prepare specimens for both kinds of electron microscope and employ the standard preparative techniques including fixation, dehydration, staining, critical point drying, vacuum evaporation, embedding and sectioning. Associated photographic methods are also introduced.

BB 505. FERMENTATION BIOLOGY.

Focuses on biological (especially microbiological) systems by which materials and energy can be interconverted (e.g., waste products into useful chemicals or fuels). The processes are dealt with at the physiological and system level, with emphasis on the means by which useful conversions can be harnessed in a biologically intelligent way. The laboratory focuses on measurements of microbial physiology and on bench-scale process design.

BB 507. CELL CULTURE.

Techniques in animal cell and tissue culture from the excision of the original explant to hybridoma studies. The following topics are discussed: 1) initiation of primary cultures, their maintenance and subculture; 2) the initiation of suspension cultures, their maintenance and subculture; 3) organogenesis; 4) formation of protoplasts, their culture and fusion; and 5) cryopreservation and karyotyping.

BB 509. SCALE-UP OF BIOPROCESSING.

Strategies for optimization of bioprocesses for scale-up applications. In addition to the theory of scaling up unit operations in bioprocessing, students will scale-up a bench scale bioprocess (5 liters) including fermentation and downstream processing for 55 liters. Specific topics include: 1) mass transfer and bioreactor design, harvesting techniques including tangential flow filtration and centrifugation, and chromatography (open column and HPLC). Recommended courses include BB 3035 Microbial Physiology and BB 4070/560 Separations of Biological Molecules, as a working knowledge of the bench scale processes will be assumed. Otherwise, instructor permission is required.

BB 510. ADVANCED MICROBIAL GENETICS.

A study of modern molecular genetics as revealed by studies of microbial systems. This course covers detailed structure/function relationships in nucleic acids and proteins; molecular mechanisms of DNA replication and expression; mutagenesis, recombination, transposition, transformation, conjugation and repair; and molecular biology of plasmids and phages.

BB 520. IMMUNOLOGY.

This is a survey course in immunology which assumes a background in cell biology, genetics and biochemistry. Topics to be covered will include cells of the immune system, antigen/antibody interactions, immune genetics and immune responses. Readings from the research literature will be assigned.

BB 545. ADVANCED CELL BIOLOGY.

This advanced-level course uses a seminar format based on research articles to discuss current topics related to the molecular biology of cellular function. Particular emphasis is placed on biological mechanisms of autoimmune disorders, cancer, Alzheimers disease, thrombosis, haemostasis, neurotrophic factors, and gene therapy.

BB 549. MOLECULAR BIOLOGY.

Synthesis of biologically important macromolecules. Selected readings from the scientific literature are used to illustrate the milestones of molecular biology and the development of techniques and experiments. Protein synthesis and ribosome structure lead into a discussion of RNA and finally DNA synthesis, with the chemistry of DNA molecules receiving significant attention.

BB 550. RECOMBINANT DNA BIOCHEMISTRY.

This course presents both theory and laboratory experience in recombinant DNA methodology. Topics covered include enzymology of DNA manipulation; construction and isolation of recombinants; plasmid and bacteriophage vectors; structural analysis of cloned DNA.

BB 560. SEPARATION OF BIOLOGICAL MOLECULES.

This course provides a detailed hands-on survey of state-of-the-art methods employed by the biotechnology industry for the purification of products, proteins in particular, from fermentation processes. Focus is on methods which offer the best potential for scale-up. Included are the theory of the design as well as the operation of these methods both at the laboratory scale as well as scaled up. It is intended for biology, biotechnology, chemical engineering, and biochemistry students. A knowledge of basic biochemistry is assumed.

BB 565. VIROLOGY.

This advanced-level course uses a seminar format based on research articles to discuss current topics related to the molecular/cell biology of viral structure, function, and evolution. Particular emphasis is placed on pathological mechanisms of various human disorders, especially emerging diseases, and the use of viruses in research.

BB 570. SPECIAL TOPICS.

Specially subjects are offered using the research expertise of the department faculty. Content and format varies to suit the interest and needs of the faculty and students. This course may be repeated for different topics covered.

BB 580. NEUROBIOLOGY.

A survey of neurobiology, with emphasis on the cellular and molecular basis of neural development and function. Topics will range from electrical and biochemical signaling between neurons, to higher order functions of the nervous system, such as sensation, movement, and memory. Human neurological diseases and disorders will be discussed. Includes reas of original papers from the scientific literature.

BIOMEDICAL ENGINEERING

BE 1001. INTRODUCTION TO BIOMEDICAL ENGINEERING.

Cat. I

Lectures, group discussions, demonstrations, hands-on experimentation, and scientific literature readings in the major branches of biomedical engineering. A series of laboratory demonstration/experiments are utilized to complement key concepts covered in various lectures. Students will be expected to read, prepare reviews, and present summaries of critical papers from several branches of biomedical engineering. Introduction to biomedical engineering design.

BE 2300. BIOMEDICAL ENGINEERING DESIGN.

Cat. I

Students are guided through the open-ended, real-world, design process starting with the project definition, specification development, management, team interactions and communication, failure and safety criteria, progress reporting, marketing concepts, documentation and technical presentation of the final project outcome. The course will include a significant writing component, which will make use of computers, and hands-on design explorations.

BE 3011. BIOMEDICAL ENGINEERING DESIGN.

Cat. I

A survey of the basic principles of biomedical electronics and measurement with emphasis on the operational performance and selection of transducers, instruments and systems for biomedical data acquisition and processing. Biopotential electrode. Analysis and selection of physical, optical, electrical, mechanical, thermal transduction mechanisms which form the basis of the sensor design. Clinical laboratory instrumentation. Electrical safety problems in the clinical environment.

Recommended background: MA 2051, EE 3601, or equivalent.

BE 3101. BIOLOGICAL TRANSPORT PHENOMENA.

Cat. I

An introduction to modeling of complex biological systems using principles of transport phenomena. Quantitative description of momentum transport, mass transport and energy transport in living systems. Basic theories of transport phenomena are presented and applied to mammalian and cellular physiology as well as to the design of medical devices. Differential and integral balances; rheology of Newtonian and non-Newtonian fluids; steady and transient diffusion in reacting systems; dimensional analysis; homogeneous versus heterogeneous reaction systems.

Recommended background BB 3110, MA 2051, or equivalent.
BE 4101. BIOMEDICAL SIGNAL ANALYSIS.
Cat. II
Introduction to biomedical signal processing and analysis. Fundamental tech-
niques to analyze and process signals that originate from biological sources: ECGs, EMGs, EEGs, blood pressure signals, etc. Course integrates physiological knowledge with the information useful for physiologic investigation and medical diagnosis and processing. Biomedical signal characterization, time domain analysis techniques (transfer functions, convolution, auto- and cross-correlation), frequency domain (Fourier analysis), continuous and discrete signals, deterministic and stochastic signal analysis methods. Analog and digital filtering.
Recommended background: EE 2311, BE 3011, or equivalent.
This course will be offered in 2000-01, and in alternating years thereafter.

BE 401. BIOELECTROCHEMICAL PHENOMENA.
Cat. I
Recommended background: BE 3110, MA 2051.
This course will be offered in 2001-02, and in alternating years thereafter.

BE 402. BIOMEDICAL IMAGING.
Cat. II
This course is a practical introduction to biomedical image processing using examples from various branches of medical imaging. Topics include: point operations, filtering in the image and Fourier domains, image reconstruction in computed tomography and magnetic resonance imaging, and data analysis using image segmentation. Review of linear-systems theory and the relevant principles of physics. Course work uses examples from microscopy, computed tomography, X-ray radiography, and magnetic resonance imaging. A working knowledge of undergraduate signal analysis and linear algebra is desirable. Facility with a high-level programming language is recommended.
The course will be offered in 2000-01, and in alternating years thereafter.

BE/ME 4504. BIOMECHANICS.
Cat. II
This course emphasizes the applications of mechanics to describe the material properties of living tissues. It is concerned with the description and measurement of these properties as related to their physiological functions. Emphasis on the interrelationship between biomechanics and physiology in medicine, surgery, body injury and prosthesis. Topics covered include: Review of basic mechanics, stress, strain, constitutive equations and the field equations, viscoelastic behavior, and models of material behavior. The measurement and characterization of properties of tendons, skin, muscles and bone. Biomechanics as related to body injury and the design of prosthetic devices.
Recommended background: Mechanics (ES 2051, ES 2052, ME 3501), Mathematics (MA 2051).
This course will be offered in 2001-02, and in alternating years thereafter.

BE 4541. BIOLOGICAL SYSTEMS.
Cat. II
Review of control theory with applications to biological control systems. Analysis and modeling of physiological systems. Physiological systems identification. Formulation of mathematical models of biological systems and the application of computer techniques in the simulation of these systems. Recommended background: Laplace transforms, transient response, frequency response and system stability analysis.
The course will be offered in 2000-01, and in alternating years thereafter.

BE 595C/ME 554. COMPOSITES WITH BIOMEDICAL AND MATERIALS APPLICATIONS.
Introduction to fiber/particulate reinforced, engineered and biologic materials. This course focuses on the elastic description and application of materials that are made up of a combination of submaterials, i.e., composites. Emphasis will be placed on the development of constitutive equations that define the mechanical behavior of a number of applications including: biomaterial, tissue, and materials science. (Prerequisite: Understanding of stress analysis and basic continuum mechanics.)
BE 595/ME 550. TISSUE ENGINEERING.
This biomaterials course focuses on the selection, processing, testing and performance of materials used in biomedical applications with special emphasis upon tissue engineering. Topics include: material selection and processing, mechanisms and kinetics of material degradation, cell-material interactions and interfaces; effect of construct architecture on tissue growth; and transport through engineered tissues. Examples of engineering tissues for replacing cartilage, bone, tendons, ligaments, skin and liver will be presented. (Recommended preparation: A first course in biomaterials equivalent to ME/BE 4814 and a basic understanding of physiology and cell biology.)

CHEMICAL ENGINEERING

CM 2001. INDUSTRIAL CHEMICAL CALCULATIONS.  Cat. I
First course in chemical engineering designed to give the student an acquaintance with the techniques and problems of the chemical engineer.
Pressure-volume-temperature relationships for ideal and nonideal pure gases and gas mixtures; equations of state and compressibility factors; material and energy balances; introduction to use of computers.
The student should have a background in elementary college chemistry and introductory calculus and the basics of computer programming.

CM 2002. INTRODUCTION TO CHEMICAL ENGINEERING.  Cat. I
Material and energy balance calculations for steady state design of important separation systems. Emphasis is on staged processes, such as distillation, extraction and washing. Discussion and application of physical equilibria. Computer solution of staged process problems.
The student should have some knowledge of computer programming, in addition to CM 2001.

CM 2102. CHEMICAL ENGINEERING THERMODYNAMICS.  Cat. I
This course is primarily for chemical engineers and is the basis for future study in chemical engineering. Problems are based on industrial operations dealing with mixing, and physical and chemical equilibrium.
Topics covered: thermodynamics of nonreacting mixtures, partial molal properties, heats of mixing; thermodynamics of reacting mixtures (thermochemistry); equilibria in reacting multicomponent systems, ideal solution at low and high pressures, fugacities; phase equilibria in nonideal systems, Gibb-Duhem Equation and its integrated forms, stated equilibrium processes; equilibria in chemically reacting systems—pressure, temperature and composition effects; independence of intensive variables, Gibbs Phase Rule; complex reaction equilibria, simultaneous and consecutive reactions.
Background: familiarity with basic thermodynamic relationships (CH 3510, ES 3000) and calculus (MA 1021 - MA 2005) is assumed.

CM 3201. KINETICS AND REACTOR DESIGN.  Cat. I
Techniques for experimentally determining rate laws for simple and complex chemical reactions, and the kinetics and theories of chemical reactions, the function of catalysts, and the design of isothermal, adiabatic, batch and flow reactors. The course is intended to provide chemists and chemical engineers with the conceptual base needed to study reactions and perform in the design and analysis of reactors.
Background should include differential equations, thermodynamics and some organic chemistry. Suitable for third- or fourth-year students.

CM 3501. APPLIED MATHEMATICS IN CHEMICAL ENGINEERING.  Cat. I
The consolidation of the methods of mathematics into a form that can be used for setting up and solving chemical engineering problems. Mathematical formulation of problems corresponding to specific physical situations such as momentum, energy and mass transfer, and chemical reactions. Analytical and numerical techniques for handling the resulting ordinary and partial differential equations and finite difference equations.
Intended for third- and fourth-year students majoring in chemical engineering. Basic knowledge of ordinary and partial differential equations, vectors, matrices and some knowledge of numerical analysis will be helpful. Background in simple computer programming is assumed. The course also may be elected by students from other disciplines with fundamental background in momentum, heat and mass transfer.

CM 3601. CHEMICAL MATERIALS ENGINEERING.  Cat. II
This course is designed to provide a working knowledge in the solving of materials problems encountered by chemical engineers and in the engineering of new and improved materials used in chemical processes. The approach used is the correlation of engineering properties with atomic and microstructures, utilizing the diagnostic techniques of X-ray diffraction and spectrometry, microscopy, and phase relationships.
Topics include surface active materials such as catalysts, sorbents, filtering and separation agents, corrosion resistant materials, metals, refractories and polymers used in construction materials, particularly for pollution control.
Background: basic knowledge of chemistry.

CM 3910. CHEMICAL AND ENVIRONMENTAL TECHNOLOGY.  Cat. II
Day trips to industrial plants provide an insight into the real world of the chemical industry. Advanced technologies for commercially producing major organic chemicals and the monomers and polymers derived from them are described. Petroleum refining, catalytic and thermal petrochemical processes, soaps and detergents, specialty chemicals, and antibiotic production processes are presented at the industrial level. Large scale unit operations and processes are seen on the plant trips. Students see how plant layout is integrated with process and product control and environmental protection at each facility.
Particular attention is paid to plant scale processes and equipment for control of chemical spills, hazards, and environmental pollution, for safety and accident prevention, and for compliance with local and national laws.
A general understanding of Organic Chemistry and Material Balances is assumed.

CM 3920. AIR QUALITY MANAGEMENT.  Cat. II
This course discusses the sources, sinks, ambient concentrations and effects of major gaseous and particulate air pollutants. The course is problem oriented and applied engineering methods to develop strategies for managing air quality on a local, regional and global scale. Topics include: indoor air quality, regional air shed modelling, global atmospheric change and design and efficiencies of air pollution control devices.
Students are expected to have a knowledge of chemistry, mathematics and engineering principals.

CM 4401. UNIT OPERATIONS OF CHEMICAL ENGINEERING I.  Cat. I
Laboratory-application of fundamental theories to practical chemical engineering operations. Emphasis is on building the student’s understanding and ability to approach the problems of design and operations of large scale chemical processing equipment.
The course is a combination of lectures and laboratory projects in the area of unit operations. Laboratory projects include experiments in fluid-flow phenomena through various media such as: friction in conduits, filtration, pressure drop in packed towers, fluidization of solids, and spray drying.
Students are expected to carry out the planning and execution of experimental work as well as the analysis and reporting of experimental results in both written and oral format.
Students are expected to have a knowledge of chemistry, mathematics and engineering principles.

CM 4402. UNIT OPERATIONS OF CHEMICAL ENGINEERING II.  Cat. I
Overall format and procedure are essentially the same as in Unit Operations of Chemical Engineering I.
Laboratory projects include experiments in heat and mass transfer such as: heat transfer in two heaters and a cooler, climbing film evaporation, multiple effect evaporation, absorption, extraction, distillation and rotary drying of solids.
Familiarity with techniques and procedures emphasized in CM 4401 will be assumed.

CM 4403. CHEMICAL ENGINEERING DESIGN.  Cat. I
Design of equipment, systems and plants; discussion of factors important in chemical plant design such as: economics, cost estimation, profitability, process selection, materials of construction, process control, plant location and safety.
Introduction to optimization and computer-aided design. Principles are illustrated with short industrial-type problems.
Background is expected in thermodynamics, heat, mass and momentum transfer; inorganic and organic chemistry; chemical kinetics and reactor design.

CM 4404. CHEMICAL PLANT DESIGN PROJECT.  Cat. I
Application of principles learned in CM 4403 to the design of a major chemical plant. Students work in groups to produce a preliminary practical process flowsheet, equipment and plant design, and economic analysis.

CM 4405. CHEMICAL PROCESS DYNAMICS AND CONTROL LABORATORY.  Cat. I
This course is intended to provide laboratory application of fundamental principles of chemical process dynamics and control feedback. This includes open-loop dynamics of typical chemical engineering processes such as distillation, fluid flow, chemical reactors and heated stirred tanks. Closed-loop experiments will involve control loop design, controller tuning, multivariable, and computer control.
Students will be required to design and execute their own experiments based on supplied objectives. Analysis and presentation of the results will be done through oral and written reports.
The recommended background is third- and fourth-year chemical engineering students.
CM 504. MATHEMATICS ANALYSIS IN CHEMICAL ENGINEERING. Methods of mathematical analysis selected from such topics as vector analysis, matrices, complex variables, Eigenvalue problems, Fourier analysis, Fourier transforms, Laplace transformation, solution of ordinary and partial differential equations, integral equations, calculus of variations, perturbation and asymptotic methods and numerical analysis. Emphasis on application to the solution of chemical engineering problems.

CM 505. GAS Dynamics AND FLOW MECHANICS. Advanced treatment of heat and mass transfer. Topics from: forced and natural convection; high-speed and rarefied gas flows; film and dropwise condensation, spray cooling, boiling and two-phase flow; packed and fluidized bed heat and mass transfer; the heat pipe; radiant transfer within enclosures, including radiation from gases and flames; ionic transport and electrochemical systems; combustion and mass transfer; drying and diffusion in porous materials, mass transfer; adsorption; design of heat and mass transfer equipment.

CM 506. KINETICS AND CATALYSIS. Theories of reaction kinetics and heterogeneous catalysis are developed for both simple and complex reactions. The kinetics and mechanisms of both catalyzed and uncatalyzed reactions are explored, as well as the effects of bulk and pore diffusion. Techniques for experimentation, reaction data treatment, and catalyst preparation and characterization are related to developing a sound approach to studying a chemical reaction.

CM 507. CHEMICAL REACTOR DESIGN. A review of the design of ideal reactors. Main course topics include: deviations from ideal reactor behavior; transport effects in reacting systems; steady state multiplicity and stability analysis; optimization of reactors; analysis of heterogeneous reactors.

CM 508. CATALYSIS AND SURFACE SCIENCE OF MATERIALS. The major factors which distinguished catalytic processes for chemicals and fuels from one another are the structure and composition of the materials used as catalysts.

CM 510. DYNAMICS OF PARTICULATE SYSTEMS. Systems of discrete particles which grow in size or some other characteristic variable (e.g., age, molecular weight, etc.) are analyzed. Both reaction engineering and population balance analyses are introduced for batch and continuous systems. Steady state and transient system dynamics are explored.

CM 521. BIOCHEMICAL ENGINEERING. The course emphasizes the basic concepts of biological systems which are relevant to study by chemical engineers. Topics covered include ligand binding and membrane transport processes; growth kinetics of microorganisms; kinetics of interacting multiple populations; biological reactor design and analysis; soluble and immobilized enzyme kinetics; optimization and control of fermentation; and biological product recovery and separation.

CM 543. MOLECULAR SIEVES. The structure, natural occurrence, synthesis, properties, and uses of the microporous crystals known as molecular sieves are examined. Emphasis is placed on understanding the relationship of their internal structures and their use as absorbents and catalysts.

CM 551. STRUCTURE AND PROPERTIES OF POLYMERIC MATERIALS. The course will acquaint the chemical engineering student with the fundamental properties of polymeric materials, both natural and synthetic. Topics covered include determination of polymer molecular weight, thermodynamics; polymer physics; mechanical properties of polymers; and an introduction to rheology.

CM 561. ADVANCED THERMODYNAMICS. An examination of the fundamental concepts of classical thermodynamics and presentation of existence theorems for the thermodynamic properties with study of relations among them. The inequality of Clausius as a criterion for equilibrium in both chemical and physical systems. Examination of thermodynamic equilibrium for a variety of restraining conditions. Applications to fluid mechanics, process systems and chemical systems. Computation of complex equilibria.

CM 571. INTERMEDIATE TRANSPORT PHENOMENA. Mass, momentum and energy transport; analytic and approximate solutions of the equations of change. Special flow problems such as creeping, potential and laminar boundary-layer flows. Heat and mass transfer in multi-component systems. Estimation of heat and mass transfer rates. Transport with chemical reaction.

CM 572. MASS AND ENERGY TRANSFER. Advanced treatment of heat and mass transfer. Topics from: forced and natural convection; high-speed and rarefied gas flows; film and dropwise condensation, spray cooling, boiling and two-phase flow; packed and fluidized bed heat and mass transfer; the heat pipe; radiant transfer within enclosures, including radiation from gases and flames; ionic transport and electrochemical systems; combustion and mass transfer; drying and diffusion in porous materials, mass transfer; adsorption; design of heat and mass transfer equipment.

CM 573. SEPARATION PROCESSES. Thermodynamics of equilibrium separation processes such as distillation, absorption, adsorption and extraction. Multi-staged separations. Principles and processes of some of the less common separations.

CM 574. FLUID MECHANICS. Advanced treatment of fluid kinematics and dynamics. Stress and strain rate analysis using vectors and tensors as tools. Incompressible and compressible, one-dimensional flows in channels, ducts and nozzles. Nonviscous and viscous flow fields. Boundary layers and turbulence. Flow through porous media such as fixed and fluidized beds. Two-phase flows with drops, bubbles and/or boiling. Introduction to non-Newtonian flows.

CM 580. SPECIAL TOPICS. Course content and schedule by arrangement.

CHEMISTRY AND BIOCHEMISTRY COURSES

CHEMISTRY AND BIOCHEMISTRY

GENERAL CHEMISTRY SEQUENCE. The general chemistry sequence, CH 1010—1040, is a unified course in which areas of major importance in chemistry are treated in depth from both the empirical and theoretical viewpoints. Emphasis in the first two terms is on the behavior of matter at the macroscopic level. The principles developed therein are then blended with a treatment of the microscopic aspects of matter, during the third and fourth terms of the sequence, to provide a unified understanding of the behavior of chemical systems. The sequence is designed for science and engineering majors.

The format of each of these terms will include three lectures, one hour of conference and a three-hour laboratory per week. For reasons of safety, contact lenses may not be worn in the chemical laboratories. Individuals who normally wear contact lenses should also have prescription glasses available for use in the laboratory when taking these courses. Prescription glasses meeting ANSI standard Z87.1 will be accepted as affording adequate eye protection in the laboratory. Otherwise, goggles meeting these standards must be used in the laboratory at all times.

CH 1010. CHEMISTRY I. Cat. 1
This course begins with a brief review of the fundamentals of chemistry (chemical formulas, the mole concept, chemical equations, stoichiometric calculations and the “language” of chemistry). The next topic is the important and timely subject, nuclear chemistry. Following this is some fundamental inorganic reaction chemistry and then a discussion of the three phases of matter, gases, solids and liquids, and the changes that occur between phases. Recommended background: one year of high school chemistry, one year of physics, trigonometry, and analytic geometry at high school level.

CH 1020. CHEMISTRY II. Cat. 1
The discussion of liquids in CH 1010 is extended to the study of solutions. This is followed by a discussion of chemical equilibrium and its relationship to chemical thermodynamics. The aim of this area of study is to be able to predict what chemical processes are spontaneous. This is then used to understand the chemistry of sparingly soluble salts and acids and bases.

CH 1030. CHEMISTRY III. Cat. 1
Having completed a thorough treatment of the macroscopic properties of matter in CH 1010 and CH 1020, we now turn to a study of matter at the microscopic (atomic and molecular) level. CH 1030 begins with the modern quantum mechanical theory of the electronic structure of atoms and organization of the modern periodic table of the elements. This section is aimed at giving an in-depth look at chemical bonding in both ionic and covalent compounds and molecular electronic structure/stereochemistry. The course concludes with the development of an understanding of intra- and intermolecular forces and their effects on physical and chemical properties.
EXPERIMENTAL CHEMISTRY SEQUENCE

The following four courses provide a full-year laboratory program. The purpose of this sequence is to train students in the most essential laboratory techniques, procedures and instrumentation of experimental chemistry. It aims to develop the skills needed for effective work on future chemical laboratory projects such as the Major Qualifying Project. The work of the year develops sequentially.

CH 2640. EXPERIMENTAL CHEMISTRY I.
Cat. 1
Emphasis is on quantitative laboratory techniques and manipulations, as exemplified by quantitative analysis. Gravimetric and volumetric procedures, and elementary glass blowing. Completion of the introductory chemistry sequence is recommended.

CH 2650. EXPERIMENTAL CHEMISTRY II.
Cat. 1
The experiments to be performed this term have been chosen to illustrate important principles and experimental techniques of physical chemistry. Students will gain experience with many of the instruments that they are likely to use in any chemical laboratory setting. These include optical spectrometers, vacuum lines, electrochemical cells and the bomb calometer. Mastery of the techniques and manipulations emphasized in CH 2640 will be assessed.

CH 2660. EXPERIMENTAL CHEMISTRY III.
Cat. 1
The emphasis in CH 2660 is on basic techniques essential for the synthesis, isolation, and characterization of inorganic and organic compounds. These include isolation and purification by solvent extraction, crystallization, distillation, and chromatographic techniques, followed by the determination of physical properties and characterization by infrared and nuclear magnetic resonance spectroscopy. Micro-synthetic procedures are introduced. Mastery of the techniques and manipulations emphasized in CH 2640 and CH 2650 would be advantageous.

CH 2670. EXPERIMENTAL CHEMISTRY IV.
Cat. 1
The synthesis, isolation, and characterization of inorganic compounds are emphasized. Syntheses of main group compounds, classical transition metal complexes, and organotransition metal compounds are included. In addition to reinforcing and building on standard techniques of synthesis and characterization, several new techniques are introduced: synthesis under inert atmosphere, measurement of magnetic susceptibility by NMR, and cyclic voltammetry. Some exposure to 13C NMR is also provided. The final experiment of the course requires the student to design a synthesis for a compound selected from a list provided, based on strategies learned in the course.
CH 4130/BB 4910. BIOCHEMISTRY III/MOLECULAR BIOLOGY.

Cat. I

The structure, function and biosynthesis of DNA, RNA and proteins are the chief topics of this course. Both prokaryotic and eukaryotic systems are examined. The nature of the genome and the genetic code, the structure and expression of selected genes and the regulation of genetic expression are emphasized.

Recommended background: prior knowledge of Cell Biology (BB 2530), Genetics (BB 2920), and Biochemistry (CH 4110, CH 4120).

CH 4150. EXPERIMENTAL BIOCHEMISTRY.

Cat. I

The experiments in this laboratory course have been designed to acquaint the students with the basic skills necessary to perform biochemical studies. The course will cover, for instance, protein purification from different biological sources, subcellular fractionation, enzyme kinetics (Km, Vmax, Hill coefficient; specific activity, effector-protein interaction, etc.), exclusion and ion exchange chromatography, electrophoresis and immunodetection.

Recommended background: CH 4120.

CH 4190. REGULATION OF GENE EXPRESSION.

Cat. I

This course will cover the biochemical mechanisms involved in regulation of gene expression: modifications of DNA structures that influence transcription rates, transcriptional regulation by protein binding, post-transcriptional modifications of RNA including splicing and editing, regulation of translation including ribosome binding and initiation of translation, and factors that control the half-lives of both mRNA and protein. During the course, common experimental methods will be explored, including a discussion of the information available from each method.

Recommended background: CH 4110, CH 4120, CH 4130, BB 4010.

CH 4330. ORGANIC SYNTHESIS.

Cat. II

A discussion of selected modern synthetic methods including additions, condensations and cyclizations. Emphasis is placed on the logic and strategy of organic synthesis. This course is intended to follow CH 2530 and competence in elementary organic synthesis is assumed.

This course will be offered in 2000-01 and in alternate years thereafter.

CH 4420. INORGANIC CHEMISTRY II.

Cat. II

Complexes of the transition metals are discussed. Covered are the electronic structures of transition metal atoms and ions, and the topological and electronic structures of their complexes. Symmetry concepts are developed early in the course and used throughout to simplify treatments of electronic structure. The molecular orbital approach to bonding, first used in CH 3410, is emphasized. The pivotal area of organotransition metal chemistry is introduced, with focus on complexes of carbon monoxide, metal-metal interactions in clusters, and catalysis by metal complexes.

Knowledge of the material in CH 1010 - CH 1040, CH 2640 - CH 2670, CH 3410, CH 3530, and CH 3550 is recommended.

This course will be offered in 2000-01 and in alternate years thereafter.

CH 4520. CHEMICAL STATISTICAL MECHANICS.

Cat. II

This course deals with how the electronic, translational, rotational and vibrational energy levels of individual molecules, or of macromolecular systems, are statistically related to the energy, entropy, and free energy of macroscopic systems, taking into account the quantum mechanical properties of the component particles. Ensembles, partition functions, and Boltzmann, Fermi-Dirac, and Bose-Einstein statistics are used. A wealth of physical chemical phenomena, including material related to solids, liquids, gases, spectroscopy and chemical reactions are made understandable by the concepts learned in this course.

Recommended background: CH 3510 and CH 3530, or equivalent, and mathematics through differential and integral calculus.

This course will be offered in 2000-01 and in alternate years thereafter.

CH 4550. POLYMER CHEMISTRY.

Cat. II


Fundamentals of polymer science and technology based on organic polymers.

Recommended background: prior knowledge of Cell Biology (BB 2530), Genetics (BB 2920), and Biochemistry (CH 4110, CH 4120).

CH 516. CHEMICAL SPECTROSCOPY.

This graduate course addresses current topics in bioinorganic chemistry, with emphasis on the structure and function of metalloenzymes of d-block metal ions. Active site structures of myoglobin and hemoglobin, blue copper proteins and hemocyanin, iron-sulfur cluster proteins, and the nitrogendase enzyme are discussed. The applications of a variety of physical methods (including electronic absorption spectroscopy, FTIR, multinuclear NMR, EPR, Resonance Raman spectroscopy, EXAFS, and electrochemical methods) to the elucidation of metalloprotein structure/function are discussed.

Knowledge of the fundamental theories of d-metal chemistry and of various spectroscopic methods is assumed.

CH 534. ORGANIC PHOTOCHEMISTRY.

Mechanisms of representative organic reactions, and the methods used for their evaluation. Structural, electronic, and stereochemical influences on reaction mechanisms.

CH 535. PHYSICAL ORGANIC CHEMISTRY.

Introduction to the photophysical and photochemical consequences of light absorption by molecules. Experimental techniques, excited state description, photochemical kinetics and energy transfer are among the topics discussed in relation to the primary photochemical reactions in simple and complex molecules.

CH 538. MEDICINAL CHEMISTRY.

This course will focus on the medicinal chemistry aspects of drug discovery from an industrial pharmaceutical Research and Development perspective. Topics will include Chemotherapeutic Agents (such as antibacterial, antiviral and antitumor agents) and Pharmacodynamic Agents (such as antihypertensive, antiinflammatory, antitumor and CNS agents). Prospective students should have a good foundation in organic chemistry (e.g., CH 2310 Organic Chemistry I and CH 2320 Organic Chemistry II).

CH 539. MOLECULAR PHARMACOLOGY.

The course will begin with a review of human physiology emphasizing the endocrine, nervous, and lymphatic systems, and including a discussion of the psychoneuroimmunology controversy. Understanding communication between cells requires study of the variety of chemical messengers, their storage, release, action on their target receptors, and eventual fate. This study will include discussion of the location and nature of the variety of receptors. Understanding the effects of messengers necessitates a detailed study of the molecular structure and function of ion channels which will include an application to the nerve impulse. Intercellular and intracellular communication are brought together by a discussion of the molecular mechanisms of receptor-effector coupling. The molecular structures of the acetylcholine receptor and of rhodopsin will be used as illustrations. The concepts of agonist and antagonist will be reinforced by a discussion of selected drugs. Nonreceptor blocking will be illustrated in a study of local anesthetics. Study of the neuroactive peptides will lead to a discussion of drug addiction and alcoholism as receptor mediated pathologies. A segment on the role ion cotransport systems play in bodily regulation will include an analysis of the molecular action of the loop diuretics as another example of nonreceptor blockers. This course is designed to compliment the "Medicinal Chemistry" course and will emphasize general principles and the underlying molecular structures. A knowledge of the material covered in one of the following is recommended: (a) CH 4110 and CH 4120, or (b) BB 3100, or (c) CH 538 plus an understanding of protein and membrane structures.

CH 552. STATISTICAL MECHANICS.

Application of the laws of the quantum theory to achieve an atomistic physical understanding of the properties of physical systems. The treatment of thermodynamic variables, Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein distribution functions are discussed using the concepts of phase space and the exclusion principle, and the thermodynamic functions are developed in terms of the distribution functions. Application of the partition function and the theory of fluctuations to common physical systems.
CH 554. MOLECULAR MODELING.
This course is intended to train students in the area of molecular modeling using a variety of quantum mechanical and force field methods. The approach will be towards practical chemists who want to answer specific questions about molecular geometry, transition states, reaction paths, and photo-excited states. No experience in programming is necessary; however, a background at the introductory level in quantum mechanics is highly desirable. Methods to be explored include Extended Hückel Theory, Molecular Mechanics, Semiempirical Molecular Orbital Methods, Ab initio Methods, Graphical Display of Molecules.

CH 555. ADVANCED TOPICS
A course of advanced study in selected areas whose content and format to suit the interest and needs of faculty and students.

CH 556. EXPERIMENTAL PHOTOCHEMISTRY.
This course has been designed to illustrate how modern spectroscopic techniques can be utilized to learn more about the photo-induced chemistry of organic materials. The principles of time-resolved and steady-state spectroscopic methods will be described in lectures and then applied in the laboratory to a variety of chemical systems. The aim will be to show how it is possible to fully describe the photo-induced chemistry of an electronically excited molecule using these techniques. Aspects of the following techniques will be covered:

Florescence emission spectroscopy, including solvent effects, quantum yields, quenching behavior, singlet lifetime determinant, excited singlet state energies and the origin of temperature dependence.

Phosphorescene emission spectroscopy, including triplet state energies, distinguishing between π and π* excited states.

Fluorescence emission spectroscopy, including triplet state energies, including triplet state energies, distinguishing between π and π* excited states.

Fluorescence emission spectroscopy, including triplet state energies, distinguishing between π and π* excited states.

Steady-state irradiation coupled with end product analysis and how these studies compliment time-resolved measurement.

Students will gain hands-on experience with the use of UV-visible absorption and fluorescence emission spectrometers as well as the laser flash photolysis research facility. Also, as part of the course, students will submit a short research proposal based on one or more of the techniques used. Although there is no formal requirement for this course, some background and an interest in photochemistry would be an asset.

CH 560. CURRENT TOPICS IN BIOCHEMISTRY.
In this course, students will acquire experience and the skills necessary in reading, analyzing and presenting specific papers, while learning recent developments in key areas of biochemical research. The course is presented in a seminar format where students and faculty present and debate scientific publications. Active participation in the discussions is required. Topics to be covered in different years are, for example, gene regulation and expression, protein structure-function, regulation by phosphates and protein kinases.

CIVIL AND ENVIRONMENTAL ENGINEERING

CE 1030. CIVIL ENGINEERING AND COMPUTER FUNDAMENTALS.
Cat. I
This course introduces students to basic fundamentals of civil engineering, group dynamics, oral presentation skills, engineering report writing techniques, and uses of the computer. Basics of structural engineering, geotechnical engineering, environmental engineering, surveying, materials, and construction engineering and management are presented in this course through a collaborative group teaching approach. Background is provided to gain competence in operating systems, editors, spreadsheets, data base software packages, and rule based programming packages. Student groups complete weekly computer laboratory projects and develop oral presentations and written reports. No previous computer use skills are required or assumed. This course is recommended for freshmen or sophomores students.

CE 2000. ANALYTICAL MECHANICS I.
Cat. I
This fundamental civil engineering course provides an introduction to the analysis of structures in static equilibrium. The focus of this course is a classical analysis of concurrent and non-concurrent equilibrium. A variety of engineering problems including trusses, machines, beams, rigid frames, and hydraulic structures involving concentrated and distributed loading systems are analyzed for external reactions and internal forces.

CE 2001. ANALYTICAL MECHANICS II.
Cat. I
This course provides an introduction to the relationship between analysis, design, and the behavior of materials under load. Theory and applications are developed that utilize simple and combined stress-strain behavior of materials subjected to axial, torsional, and flexural loadings, with applications to beams, trusses, rigid frames, shafts, and tension and compression structures.

Knowledge of the subject matter in CE 2000 is a necessary background for this course.

CE 2002. INTRODUCTION TO ANALYSIS AND DESIGN.
Cat. I
This course develops an understanding of classical and modern structural analysis. Topics include loading systems, and the analysis of statically determinate and statically indeterminate systems. The course will include advanced methods of analysis for beams, structures, and structural floor systems for buildings, bridges, and other structural assemblies.

Knowledge of the subject matter in CE 2000 and CE 2001 is a necessary background for this course.

CE 2020. SURVEYING.
Cat. I
This course deals with measuring and fundamental skills in the theoretical and practical aspects of plane surveying through the use and care of modern instruments and the associated computations. Topics include the calculation of errors incurred in observed field data and necessary correction applications, the use and care of surveying equipment, traversing, differential leveling, stadia and mapping, and electronic data transfer. Computer applications are used where appropriate.

CE 3006. DESIGN OF STEEL STRUCTURES.
Cat. I
This course covers the theory and practice of structural steel design. The structural design process for beams, columns, trusses, frames, and connections is based on Load and Resistance Factor Design (LRFD) specifications of the American Institute of Steel Construction.

Knowledge of the subject matter in CE 2002 and CE 3010 is a necessary background for this course.

CE 3008. DESIGN OF REINFORCED CONCRETE STRUCTURES.
Cat. I
This course covers the theory and practice of reinforced concrete design. The structural design process for beams, columns, slabs, frames, flat slabs, footings, and retaining walls uses the ultimate strength design codes of the American Concrete Institute.

Knowledge of the subject matter in CE 2002 and CE 3010 is a necessary background for this course.

Knowledge of the subject matter in CE 2000, CE 2001, and CE 2002 is a necessary background for this course.

CE 3010. STRUCTURAL ENGINEERING.
Cat. I
This course provides an understanding of the practice of structural engineering. It builds upon the fundamental skills developed in CE 2000, CE 2001, and CE 2002 to present the principles of structures and their elements. The course provides a perspective for dealing with the issues of strength, stiffness, and stability. Although wood is the principle material used to develop the study of the interrelationship between analysis and design of structural systems, structural steel and reinforced concrete systems are also discussed. It also introduces students to the use of building codes for design criteria. The role of the structural engineer in the design process and cost factors are also discussed.

Knowledge of the subject matter in CE 2000, CE 2001, and CE 2002 is a necessary background for this course.

Knowledge of the subject matter in CE 2000, CE 2001, and CE 2002 is a necessary background for this course.

CE 3020. PROJECT MANAGEMENT.
Cat. I
This course presents the fundamental concepts and process of project management applied to public and private works. The principle focus of the course is the management of civil engineering projects including planning, scheduling, organization and control, as well as management concepts of leadership, motivation, trust, project team development, division of work, and conflict resolution. Ancillary engineering and construction practices involving financial management and contracting strategies is also covered.

Knowledge of the subject matter in CE 2000, CE 2001, and CE 2002 is a necessary background for this course.

CE 3021. COST ESTIMATING, SCHEDULING AND PROJECT CONTROL.
Cat. II
This course presents the fundamental concepts and processes by which the cost and time of execution of civil engineering projects are established. It emphasizes the importance of decisions made at the early stages of design on final project cost. The relationship between time and cost is examined in detail. Topics include: construction methods, quantity surveying, resource pricing, activity

152 CHEMISTRY AND BIOCHEMISTRY COURSES
planning, resource allocation, financial analysis, bidding, job cost accounting and cost control with extensions to operating and maintenance costs. Commercial software for project scheduling, cost estimating, and cost control is used in this course.

Knowledge of the subject matter in CE 1030 and CE 3020 is necessary background for this course.

Offered in 2000-01 and in alternating years thereafter.

CE 3022. LEGAL ASPECTS IN DESIGN AND CONSTRUCTION.
Cat II
This course addresses legal aspects that underpin the planning, design and construction of a project. The principle focus is the contracts, laws, specifications, and design documents needed to conduct civil engineering practice in the United States. Labor, safety, and environmental laws are reviewed, as well as the role of ethics and professional relationships with the client, other professional organizations and groups, the public, and the regulatory system.

Knowledge of the subject matter in CE 3020 is necessary background for this course.

Offered in 2001-02 and in alternating years thereafter.

CE 3023. ARCHITECTURAL ENGINEERING SYSTEMS.
Cat I
This course introduces the fundamental concepts associated with the design and construction of a building. Major building components, such as foundations, structures, envelopes and environmental systems are presented as subsystems to be integrated. The systems approach is utilized to describe the functional interdependence of building components and the interdisciplinary nature of the design of contemporary buildings. Building components are analyzed in terms of design details and constructability implications. AutoCAD representation and building design exercises as well as case studies are used to illustrate the topic.

CE 3024. CONTROL SURVEYING.
Cat II
This course presents the principles and field procedures required in the design of vertical and horizontal control networks for large building and construction projects.

A knowledge of the subject matter in CE 2020 is necessary background for this course.

Offered in 2000-01 and in alternating years thereafter.

CE 3026. MATERIALS OF CONSTRUCTION.
Cat I
This course provides an understanding of the use and acquisition of engineering properties of construction materials. Topics include relationships between the structure of materials, their engineering properties, and the selection of suitable materials for applications involving strength, durability, and serviceability. Experimental laboratory procedures including design of experiments, data collection, analysis, and representation, and report writing are an integral part of the work.

Knowledge of the subject matter in CE 3020 is necessary background for this course.

CE 3030. FUNDAMENTALS OF CIVIL ENGINEERING AUTOCAD.
Cat I
This course introduces Civil Engineering students to fundamental uses of the AutoCAD software package. Basic two dimensional drawing techniques are covered. Advanced topics that may be covered include three dimensional drawing, rendering and animation. Students are required to become familiar with AutoCAD on the DOS, and Windows platforms.

Knowledge of the subject matter in at least two civil engineering design courses is expected background for this course.

CE 3041. SOIL MECHANICS.
Cat I
This is an introductory course dealing with the science and technology of earth materials with an emphasis on fundamental concepts of particulate mechanics. The topics which are discussed include fluid flow through porous media, deformation and shear characteristics of soil, consolidation, lateral earth pressure, and slope stability.

Knowledge of the subject matter in CE 2000 and CE 2001 is a necessary background for this course. Knowledge of the subject matter in GE 2341 is a useful background for this course.

CE 3044. FOUNDATION ENGINEERING.
Cat I
Foundation engineering is a study of the applications of the principles of soil mechanics and structural theory to the analysis, design and construction of foundations for engineering works with the emphasis on the soil engineering aspects of soil structure interaction. Subsurface exploration techniques, design of rigid and flexible retaining structures, and design of, shallow and deep foundations are considered. Although the course deals mainly with aspects of the design of buildings and bridges, certain parts of the course (design of temporary trench bracing, for example) are very relevant to construction engineering.

Knowledge of the subject matter in CE 3041 is a necessary background for this course. Knowledge of the subject matter in CE 3008 is helpful.

CE 3050. HIGHWAY ENGINEERING AND PLANNING.
Cat I
This course provides an in-depth coverage of the design and planning of highways. Topics covered include the geometric design of highways, design of surface drainage systems, earthwork calculations and transportation planning methodology and models.

Knowledge of the subject matter in CE 2020 Surveying is helpful.

CE 3051. TRANSPORTATION SYSTEMS.
Cat I
This course provides an introduction to the planning and design of highways, railroads, airports, and water ports. Coverage includes methods for the analysis of safe and orderly flow of traffic on streets and highways, as well as evaluating traffic operations and capacity flow.

CE 3059. ENVIRONMENTAL ENGINEERING.
Cat I
This is an introductory course in the area of environmental engineering. The course should also be of interest to students who require an overall understanding of environmental engineering problems. Topics covered include: environmental impact of population growth and energy demand, water resources, water chemistry, water quality standards, environmental microbiology, wastewater characteristics, receiving water quality and dissolved oxygen budgets, water pollution abatement, sludge management, solids and hazardous waste management, and an introduction of air and noise pollution.

Knowledge of the subject matter in CH 1010 and CH 1020 is a necessary background for this course.

CE 3060. WATER TREATMENT.
Cat I
This course provides in-depth coverage of processes used in wastewater treatment. Topics include: review of water chemistry and drinking water standards, impurities in natural waters, aeration, water softening coagulation, flocculation, sedimentation, filtration, disinfection, taste and odor control, corrosion control, and iron and manganese removal.

Knowledge of the subject matter in CE 3059 and ES 3004 is a necessary background for this course.

CE 3061. WASTE WATER TREATMENT.
Cat I
This course provides in-depth coverage of processes used in wastewater treatment. Topics include: review of water quality standards, wastewater characteristics, application of biochemical oxygen demand, sources and effects of pollution, physical, chemical, and biological wastewater treatment processes, and waste sludge management.

Knowledge of the subject matter in CE 3059 and ES 3004 is a necessary background for this course.

CE 3062. HYDRAULICS IN CIVIL ENGINEERING.
Cat I
This course provides a basic background for designing hydraulic systems used in water supply and wastewater transport systems. It is a basic course for students in the sanitary engineering and water resources area. Topics include open channel flow, pipe flow, pumps, sewer design and water supply network design.

Knowledge of the subject matter in ES 3004 is a necessary background for this course.

CE 3070. URBAN AND ENVIRONMENTAL PLANNING.
Cat I
This course introduces to the student the social, economic, political, and environmental factors that affect the population growth and distribution patterns, and the impact of such patterns to the natural environment. By using the principles and procedures of planning, the optimal growth pattern may be examined, and the infrastructure (roads, water supply systems, waste-water treatment systems, shopping malls, etc.) necessary to support present and future growth patterns may be determined.

The information necessary in planning, which involves conscious procedures of analysis, formulation of alternative solutions, rational assessment and deliberate choice in accordance with evaluation criteria, is obtained through extensive reading. As such the course introduces a variety of topics of concern to engineers and environmentalists. The course is intended not only for civil engineering majors, but also for students preparing for an IQP in areas of urban or environmental concerns.

CE 3074. ENVIRONMENTAL ANALYSIS.
Cat II
This course provides a background in the principles and techniques of assessing areas of natural environment and the application of this assessment to evaluate the inherent suitability for urban and resource based uses and facilities. The techniques developed in this course will be useful for land use planning, site design, and the impact of engineering projects on the environment.

Knowledge of the subject matter in CE 3070 will be helpful.

Offered in 2000-01 and in alternating years thereafter.
CE 4007. MATRIX ANALYSIS OF STRUCTURES.  
Cat. I  
This course presents the principles of matrix analysis of structural elements and systems; fundamentals of matrix algebra, solution of simultaneous equations, matrix inversion; analysis of plane trusses, method of joints; displacement method, principle of virtual work, analysis of continuous beams, analysis of plane frames, plane trusses, analysis of building frames and bridges; computer aided structural analysis and principles of software development.  
Knowledge of the subject matter in CE 2002 is a necessary background for this course.

CE 4017. PRESTRESSED CONCRETE DESIGN.  
Cat. I  
This course covers analysis and design aspects of prestressed concrete structural elements and systems: principles of prestressing, materials for prestressing, high strength steel, flexural analysis and design methods; allowable stress and strength design methods; design of beams, load balancing, partial prestressing and cracking moment; design for shear, partial loss of prestress; deflections of prestressed concrete and precast construction; connections.  
Knowledge of the subject matter in CE 2002 and CE 3026 is a necessary background for this course. A knowledge of the subject matter in CE 3008 is helpful.

CE 4024. REAL ESTATE DEVELOPMENT.  
Cat. II  
This course introduces real estate development with an emphasis on the decision-making process from initial concept to final acceptance; organizations, and professions in the development process; time frame for development; capital and operating budget construction; debt and equity finance; principle of planning, scheduling and managing the process.  
Knowledge of the subject matter in CE 2002 and CE 3026 is a necessary background for this course.  
Offered in 2001-02 and in alternating years thereafter.

CE 4046. EXPERIMENTAL SOIL MECHANICS.  
Cat. II  
The standard laboratory soil testing procedures generally encountered in civil engineering are introduced in this course. It further includes a limited discussion of soil behavior primarily based on the effect of soil’s physical and chemical properties on laboratory test results. The tests which are performed include: grain size analysis, Atterberg limits, specific gravity, permeability, compaction, compression and consolidation, and direct and triaxial shear. The student’s results of the various tests are integrated within an engineering problem.  
Knowledge of the subject matter in CE 3041 is a necessary background for this course.  
Offered in 2000-01 and in alternating years thereafter.

CE 4048. EARTH STRUCTURES.  
Cat. II  
This course provides in-depth study of the geotechnical principles applied to design earth structures including earth dams, waste containment facilities, soil slopes, highway cuts and embankments, and slurry trenches. It includes fundamentals of analysis of flow through porous media by graphical and digital techniques, slope stability, use of geosynthetics, soil stabilization and the design of preload and drain installations.  
Knowledge of the subject matter in CE 3041 is a necessary background for this course.  
Offered in 2001-02 and in alternating years thereafter.

CE 4060. ENVIRONMENTAL ENGINEERING LABORATORY.  
Cat. I  
This course familiarizes students with the laboratory studies used to obtain the design parameters for water and wastewater treatment systems. The topics include laboratory experiments dealing with physical, chemical, and biological treatment systems.  
Knowledge of the subject matter in CE 3060 and CE 3061 is a necessary background for this course.

CE 4061. HYDROLOGY.  
Cat. I  
This course provides a quantitative description of the rainfall and runoff process for use in design of water resource related projects. Topics include: the review of the hydrologic cycle, precipitation, evaporation, transpiration, infiltration, stream flow measurements, flow routing, runoff analysis, show hydrology and development of drainage estimates for development plans. The course involves a stream measurement laboratory and application of model for hydrological and hydraulic engineering applications.  
Knowledge of the subject matter in ES 3004 is a necessary background for this course.

CE 4071. LAND USE DEVELOPMENT AND CONTROLS.  
Cat. I  
The purpose of this course is to provide an understanding of how land use controls may be used to effectively shape our physical, social, and economic development. The quality of our environment depends upon the development which is permitted to take place and the controls which direct that development

Through this course, the student will learn the principles, methods, and techniques which a planner may use to plan the uses and development of land. In particular, the use and limits of zoning, special permits, hammerhead lots, subdivision control, comprehensive permits, and other tools with which a developer of planner board member should be familiar will be examined in detail.

##### COMPUTER SCIENCE

CS 1001. INTRODUCTION TO COMPUTERS.  
Cat. I  
This course introduces computer systems to students who may need to write or use computer programs in their undergraduate engineering, science, or management courses.  
Topics include problem-solving and algorithm development, the program development cycle, structured programming design, coding, debugging and documentation.  
Students will be expected to implement a variety of programs using the FORTRAN programming language.  
Intended audience: noncomputer science majors desiring a practical introduction to programming. This course is not sufficient background for MQPs or IQPs involving extensive programming or most advanced computer science or computer engineering courses. Such background may be obtained by taking CS 1005 or CS 1006 followed by CS 2005.  
Recommended background: none.

CS 1005. INTRODUCTION TO PROGRAMMING.  
Cat. I  
This course introduces structured programming with emphasis on modular design and functional decomposition.  
Topics include problem solving and algorithm development, the syntax and semantics of sequential, iterative, and conditional control structures, functions, arrays, pointers, and simple I/O.  
Students will be expected to design and implement programs in C++.  
Intended audience: computer science and computer engineering students and those students desiring a background in computer programming.  
Recommended background: none.

CS 1006. OBJECT-ORIENTED INTRODUCTION TO PROGRAMMING.  
Cat. I  
This course introduces computer programming, with emphasis on object-oriented programs.  
Topics include: Problem solving, algorithm development, and debugging; the syntax and semantics of sequential, iterative, conditional, and recursive control structures; primitive and complex data types; and simple I/O.  
Outcomes: Students will be expected to design and implement programs as applications and applets in an object-oriented programming language, such as Java.  
Intended audience: All students with little or no programming experience who desire to learn an object-oriented programming language.  
Recommended background: None.  
Note: Either CS 1005 or CS 1006 will provide sufficient background for further study in Computer Science, including CS 2005 Techniques of Programming.

CS 2005. DATA STRUCTURES AND PROGRAMMING TECHNIQUES.  
Cat. I  
This course continues the development of discipline in programming design, style and expression, and debugging and testing. It provides sufficient programming background for other 2000, 3000, and 4000 level computer science courses.  
Topics include complex data types, indirect addressing, file I/O, dynamic memory allocation, elementary data structures, algorithm analysis, recursion, internal sort/search methods, and step-wise refinement of both procedures and data. Object-oriented concepts will be discussed as time allows.  
Students will be expected to design and implement reasonably large and complex programs in C++. Differences between C and C++ programming languages will be examined as appropriate. Students will learn how to use appropriate high-level tools for program development.  
Intended audience: computer science majors who do not have a strong background in these topics and noncomputer science majors who desire further programming experience or who intend to pursue upper-level computer science courses.  
Recommended background: CS 1005 or CS 1006 or its equivalent.

CS 2011. INTRODUCTION TO MACHINE ORGANIZATION AND ASSEMBLY LANGUAGE.  
Cat. I  
This course introduces students to the structure and behavior of digital computers at several levels of abstraction. Starting with a high-level view of functional components, the course progresses through the system from the point of view of assembly language programming, microprogramming, and logic circuits.
Topics include the functional organization of computer hardware, the functions of assemblers, linkers, and loaders, representations of numbers in computers, basic assembly language instruction sets, addressing modes, stacks and procedures, low-level I/O, concepts and examples of microprogramming, and logic circuits.

Students will be expected to write programs in an assembly language.

Intended audience: computer science and computer engineering students, and those desiring a deeper understanding of the low-level functionality of a computer.

Recommended background: CS 2005.

CS 2022/MA 2201. DISCRETE MATHEMATICS.

Cat. I

This course serves as an introduction to some of the more important concepts, techniques, and structures of discrete mathematics, providing a bridge between computer science and mathematics.

Topics include functions and relations, sets, countability, groups, graphs, propositional and predicate calculus, and permutations and combinations.

Students will be expected to develop simple proofs for problems drawn primarily from computer science and applied mathematics.

Intended audience: computer science and mathematical sciences majors.

Undergraduate credit may not be earned both for this course and for CS 501.

Recommended background: none.

CS 2135. PROGRAMMING LANGUAGE CONCEPTS.

Cat. I

This course introduces the student to the fundamental concepts of programming languages, models of programming languages, and the basic concepts of language translation.

Topics include syntactic structure, binding, scope, parameter passing, control structures, and run-time environments. Imperative and functional programming languages will be contrasted. Different programming languages will be examined to illustrate these principles.

Students will be expected to acquire competence in functional programming.

Intended audience: computer science and computer engineering students, and those desiring a deeper understanding of computer programming.

Recommended background: CS 2005.

CS 2136. PARADIGMS OF COMPUTATION.

Cat. I

This course introduces students to advanced concepts in computational systems and programming languages and builds upon the functional approach to programming acquired in CS 2135.

Topics covered include object-oriented programming, logic programming, stream programming, and parallel systems and programming.

Students will be expected to write programs in object-oriented and logic-based programming languages.

Intended audience: computer science and computer engineering students, and those desiring a deeper understanding of advanced computational paradigms.

Recommended background: CS 2135.

CS 2223. ALGORITHMS.

Cat. I

Building on a fundamental knowledge of data structures, data abstraction techniques, and mathematical tools, a number of examples of algorithm design and analysis, worst case and average case, will be developed.

Topics include greedy algorithms, divide-and-conquer, dynamic programming, heuristics, and probabilistic algorithms. Problems will be drawn from areas such as sorting, graph theory, and string processing. The influence of the computational model on algorithm design will be discussed.

Students will be expected to perform analysis on a variety of algorithms.

Intended audience: computer science and computer engineering students, and those desiring a deeper understanding of algorithm design and analysis.

Undergraduate credit may not be earned both for this course and for CS 507.

Recommended background: CS 2005 and CS 2022.

CS 3013. OPERATING SYSTEMS.

Cat. I

This course provides the student with an understanding of the basic components of a general-purpose operating system.

Topics include processes, process management, synchronization, input/output devices and their programming, interrupts, memory management, resource allocation, and an introduction to file systems.

Students will be expected to design and implement a large piece of system software.

Intended audience: computer science majors and others interested in studying the software and hardware components of computer systems.

Undergraduate credit may not be earned both for this course and for CS 502.

Recommended background: CS 2005 and CS 2111.

CS 3041. HUMAN-COMPUTER INTERACTION.

Cat. I

This course develops in the student an understanding of the nature and importance of the problems concerning the efficiency and effectiveness of human interaction with computer-based systems.

Topics include the design and evaluation of interactive computer systems, basic psychological considerations of interaction, interactive language design, interactive hardware design, and special input/output techniques.

Students will be expected to complete two projects. A project might be a software evaluation, interface development, or an experiment.

Intended audience: computer science majors, especially juniors.

Recommended background: CS 2005.

CS 3043. SOCIAL IMPLICATIONS OF INFORMATION PROCESSING.

Cat. I

This course makes the student aware of the social, moral, ethical, and philosophical impact of computers and computer-based systems on society, both now and in the future.

Topics include major computer-based applications and their impact, human-machine relationships, and the major problems of controlling the use of computers.

Students will be expected to contribute to classroom discussions and to complete a number of writing assignments.

Intended audience: students interested in the impact of a computer-oriented technology on his or her future way of life and well-being. This course is highly recommended for juniors.

Undergraduate credit may not be earned both for this course and for CS 505.

Recommended background: a general knowledge of computers and computer systems.

CS 3133. FOUNDATIONS OF COMPUTER SCIENCE.

Cat. I

This course introduces the theoretical foundations of computer science. These form the basis for a more complete understanding of the proficiency in computer science.

Topics include computational models, formal languages, parsing, and an introduction to compatibility and complexity theory, including NP-completeness.

Students will be expected to complete a variety of exercises and proofs.

Intended audience: computer science majors and others desiring an understanding of the theoretical foundations of computer science.

Undergraduate credit may not be earned both for this course or for CS 503.

Recommended Background: CS 2002 and CS 2223.

Students who have credit for CS 4121 cannot receive credit for CS 3133.

Students graduating under the pre-1996 distribution requirements may satisfy the Theory area requirement by taking this course, although it does not count as a 4000-level course.

CS 3733. SOFTWARE ENGINEERING.

Cat. I

This course introduces software design topics pertinent to the waterfall life cycle model.

Topics include requirements analysis and specification, architectural design, module testing, and system integration.

Student groups will be expected to specify, design, partially implement and test a project.

Intended audience: computer science majors and others who expect to design software systems. This course should be taken before any course requiring a large programming project.

Undergraduate credit may not be earned both for this course and for CS 509.

Recommended background: CS 2005.

CS 4031/MA 3255. NUMERICAL ANALYSIS I.

Cat. I

Topics include: solution of nonlinear equations, finding roots of polynomials, interpolation and polynomial approximation, approximation theory, numerical differentiation and integration. Numerical linear algebra and numerical solution of differential equations will not be studied: see MA 4235 and MA 4411 for these materials.

A knowledge of MA 2051 or of MA 2071 and the ability to write programs in a scientific language is assumed. Computer programming will be necessary to utilize existing scientific subroutines for case studies, but the details of programming will not be emphasized.

Undergraduate credit may not be earned both for this course and for CS 552.

CS 4120. ANALYSIS OF ALGORITHMS.

Cat. II

This course develops the skill of analyzing the behavior of algorithms.

Topics include the analysis, with respect to average and worst case behavior and correctness, of algorithms for internal sorting, pattern matching on strings, graph algorithms, and methods such as recursion elimination, dynamic programming, and program profiling.

Students will be expected to write and analyze programs.

Intended audience: computer science majors.

Undergraduate credit may not be earned both for this course and for CS 504.

Recommended background: CS 2223 and some knowledge of probability.

This course will be offered in 2000-01 and in alternate years thereafter.
CS 4123. THEORY OF COMPUTATION.

Building on the theoretical foundations from CS 3133, this course addresses the fundamental question of what it means to be "computable," including different characterization of computable sets and functions.

Topics include the halting program, the Church-Turing thesis, primitive recursive functions, recursive sets, recursively enumerable sets, NP-completeness, and reducibilities.

Students will be expected to complete a variety of exercises and proofs.

Intended audience: computer science majors and others desiring an understanding of the nature of computation.

Undergraduate credit may not be earned both for this course and for CS 553.

Recommended Background: CS 3133.

This course will be offered in 2001-02 and in alternate years thereafter.

CS 4233. OBJECT-ORIENTED ANALYSIS AND DESIGN.

This Software Engineering course will focus on the process of Object-Oriented Analysis and Design. Students will be expected to complete a large number of exercises in Domain Modeling, Use Case Analysis, and Object-Oriented Design.

In addition, the course will investigate Design Patterns, which are elements of reusable object-oriented software designs. This course will survey a set of design patterns and consider how these patterns are described and used to solve design problems.

Recommended Background: CS 3733.

This course will be offered in 2000-01 and in alternate years thereafter.

CS 4241. WEBARE: COMPUTATIONAL TECHNOLOGY FOR NETWORK INFORMATION SYSTEMS.

This course explores the computational aspects of network information systems as embodied by the World Wide Web (WWW). Topics include: languages for document design, programming languages for executable content, scripting languages, design of WWW based human/computer interfaces, client/server network architecture models, high level network protocols (e.g., http), WWW network resource discovery and network security issues.

Students in this course will be expected to complete a substantial software project (e.g., Java based user interface, HTML/CGI based information system, WWW search mechanisms, etc.).

Recommended background: CS 2005.

Suggested background: CS 2316 or CS 3041.

CS 4341. INTRODUCTION TO ARTIFICIAL INTELLIGENCE.

This course studies the problem of making computers act in ways which we call "intelligent".

Topics include major theories, tools and applications of artificial intelligence, aspects of knowledge representation, natural language understanding, searching and planning.

Students will be expected to complete projects which express problems in terms of their state spaces, transitions, goal and initial states, and to propose appropriate methods for solving the problems.

Intended audience: computer science majors.

Undergraduate credit may not be earned both for this course and for CS 534.

Recommended background: CS 2136 and CS 2223. CS 3133.

Suggested background: CS 3133.

This course will be offered in 2000-01 and in alternate years thereafter.

CS 4431. DATABASE SYSTEMS I.

This course introduces the student to the design, use, and application of database management systems.

Topics include: the rational data model, relational query languages, design theory, and conceptual data design and modeling for relational database design. Techniques that provide for data independence, minimal redundancy, good user interfaces, protection from data loss, and growth problems will be discussed.

Outcome: Students will be expected to design and implement database system applications.

Intended audience: computer science majors and others interested in studying the development of software applications with large data management requirements.

Undergraduate credit may not be earned both for this course and for CS 542.

Recommended background: CS 2005 and CS 2022.

CS 4432. DATABASE SYSTEMS II.

This course concentrates on the study of the internals of database management systems.

Topics include: principles and theories of physical storage management, advanced query languages, query processing and optimization, index structures for relational databases, transaction processing, concurrency control, distributed databases, and database recovery, security, client server and transaction processing systems.

Outcome: Students may be expected to design and implement software components that make up modern database systems.

Intended audience: computer science and computer engineering majors.

Undergraduate credit may not be earned both for this course and CS 542.

Recommended background: CS 4431 and knowledge of software engineering, such as CS 3733.

This course will be offered in 2000-01 and in alternate years thereafter.

CS 4513. DISTRIBUTED COMPUTER SYSTEMS.

This course extends the study of the design and implementation of operating systems begun in CS 3013 to distributed and advanced computer systems.

Topics include principles and theories of resource allocation, file systems, protection schemes, and performance evaluation as they relate to distributed and advanced computer systems.

Students may be expected to design and implement programs that emphasize the concepts of file systems and distributed computing systems using current tools and languages.

Intended audience: computer science and computer engineering majors.

Recommended background: CS 3013 and a knowledge of probability, such as provided by MA 3613.

CS 4514. COMPUTER NETWORKS: ARCHITECTURE AND IMPLEMENTATION.

This course introduces principles and current trends in computer networks. The ISO Reference Model will be used as the framework with the course progressing through the physical, data link, network, transport, session, and presentation layers with specific examples and standards cited throughout for point-to-point, satellite, packet-radio, and local area networks.

Topics include motivation and objectives of computer networks, overview of network architectures, layered architectures, performance analysis, virtual circuits, datagrams, routing flow control, local area networks, internetworking, end-to-end communication, virtual terminal, file transfer protocols, and client-server programming.

Students will be expected to design and implement projects such as simulation of the network/transport layer functions, routing, congestion control, an Ethernet controller, applications using TCP/IP or remote procedure calls.

Intended audience: computer science and computer engineering majors.

Undergraduate credit may not be earned both for this course and for CS 513.

Recommended background: CS 3013 and some knowledge of probability.

This course will be offered in 2000-01 and in alternate years thereafter.

CS 4515. COMPUTER ARCHITECTURE.

This course explores modern computer architectures in terms of instruction sets and the organization of processors, controllers, memories, devices, and communication links.

Topics include an overview of computer systems, theoretical foundations, modern computer system components, pipelining of instruction sets, multifunction pipelines, parallel computer organization.

Students will be expected to design and implement programs which simulate significant components of modern computer architectures.

Intended audience: computer science and computer engineering majors.

Recommended background: CS 2011 EE 3801 and either CS 3013 or EE 3808.

This course will be offered in 2001-02.

CS 4533. TECHNIQUES OF PROGRAMMING LANGUAGE TRANSLATION.

This course studies the compiling process for high-level languages.

Topics include lexical analysis, syntax analysis, semantic analysis, symbol tables, intermediate languages, optimization, code generation and run-time systems.

Students will be expected to use compiler tools to implement the front end, and to write a program to implement the back end, of a compiler for a recursive programming language.

Intended Audience: computer science and computer engineering majors.

Recommended Background: CS 2136 and CS 3133.

This course will be offered in 2000-01 and in alternate years thereafter.

CS 4731. COMPUTER GRAPHICS.

This course studies the use of the computer to model and graphically render two- and three-dimensional structures.

Topics include graphics devices and languages, 2- and 3-D object representation, and various aspects of rendering realistic images.

Students will be expected to implement programs which span all stages of the 3-D graphics pipeline, including clipping, projection, arbitrary viewing, hidden surface removal and shading.

Intended audience: computer science majors.

Undergraduate credit may not be earned both for this course and for CS 543.

Recommended background: CS 2223 and MA 2071.

This course will be offered in 2000-01 and in alternate years thereafter.
CS 4732. COMPUTER ANIMATION.
Cat. II
This course provides an in-depth examination of the algorithms, data structures, and techniques used in modeling and rendering dynamic scenes. Topics include animation hardware and software, parametric blending techniques, modeling physical and articulated objects, forward and inverse kinematics, key-frame, procedural, and behavioral animation, and tree-form deformation.

EE 2022. INTRODUCTION TO DIGITAL CIRCUITS AND COMPUTER ENGINEERING.
Cat. I
The objective of this course is to expose new electrical engineering students (including first year students) to the broad field of electrical engineering, introducing basic concepts of circuits and systems and their applications. Experiments based on practical devices are used to reinforce basic concepts and develop laboratory skills, as well as to provide system-level understanding. The use of circuit simulation tools for analysis and design is introduced.

EE 2112. ELECTROMAGNETIC FIELDS.
Cat. I
The object of this course is a comprehensive treatment of electromagnetic engineering principles covering the entire application spectrum from static to dynamic field phenomena.

EE 2201. MICROELECTRONIC CIRCUITS I.
Cat. I
This course is the first of a two-course sequence in electronic circuit design. It begins with a substantive treatment of the fundamental behavior of semiconductor materials and moves on to the semiconductor diode, the bipolar transistor, and the field-effect transistor. Laboratory exercises are provided to reinforce the theoretical operation of these devices. Numerous circuit applications are considered, including: power supplies, transistor amplifiers, and FET switches.

EE 2311. CONTINUOUS-TIME SIGNAL AND SYSTEM ANALYSIS.
Cat. I
This course provides an introduction to time and frequency-domain analysis of continuous time signals and linear systems. Topics include signal characterization and operations; singularity functions; impulse response and convolution; Fourier series; the Fourier transform and its applications; frequency-domain characterization of linear, time-invariant systems such as filters; and the Laplace transform and its applications.

EE 2425. COMPUTER ANIMATION.
This course will be offered in 2001-02 and in alternate years thereafter.

EE 2799. ELECTRICAL AND COMPUTER ENGINEERING DESIGN.
Cat. I
The goal of this course is to provide experience with the design of a system, component, or process. Basic sciences, mathematics, and engineering sciences are applied to convert resources into a stated objective. Fundamental steps of the design process are practiced, including the establishment of objectives and criteria, synthesis, analysis, manufacturability, testing, and evaluation. Students work in small teams and are encouraged to use creativity to solve specific but open-ended problems, and then present their results.

EE 2801. FOUNDATIONS OF EMBEDDED COMPUTER SYSTEMS.
Cat. I
This course introduces the assembly language programming concepts that are needed to develop microprocessor and microcontroller-based computer systems. Beginning with the fundamentals of computer architecture and organization, students learn assembly language and how assembly language programs running on microprocessors are used to solve problems that require interactions between a computer and the physical world. Students in this course will also learn about the hardware architecture of a modern computer system and how hardware, software, and the passage of time must be managed in an embedded system design. Other issues that will be addressed as appropriate include overall embedded system development, software maintenance, and programming for reliability, and product safety.

Recommended background: CS 4731.

This course will be offered in 2001-02 and in alternate years thereafter.

ELECTRICAL ENGINEERING COURSES

The second digit in electrical engineering course numbers is coded as follows:

0 — Circuits
1 — Fields
2 — Electronic Circuits and Systems
3 — Signals and Communication Systems
4 — Available for Future Use
5 — Machines, Power Systems
6 — Professional and Miscellaneous
7 — Projects, Laboratory, Independent Study
8 — Computers
9 — Electronic Devices

EE 2111. INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING.
Cat. I
The objective of this course is to expose new electrical engineering students (including first year students) to basic concepts that underlie computer engineering while continuing an introduction to basic concepts of circuits and systems in a hands-on environment. Experiments representing practical devices introduce basic electrical engineering concepts and skills which typify the study and practice of electrical and computer engineering. In the laboratory, the students construct, troubleshoot, and test analog and digital circuits that they have designed. They will also be introduced to the nature of the interface between hardware and software in a typical microprocessor-based computer.

Topics: Boolean algebra, digital switching logic, the transistor as amplifier and switch, circuit design of logic gates, design of combinational logic circuits, software and hardware interfacing including analog/digital and digital/analog conversion.

Recommended background: high school physics.

EE 2211. FUNDAMENTALS OF ELECTRICAL ENGINEERING.
Cat. I
In this course students will learn the practical aspects of electromagnetics and their relation to basic DC and AC circuit theory.

The meaning of the electric and magnetic field concepts is explained and placed in context with capacitive and inductive circuits. Exploiting these concepts leads to a host of practical devices such as transformers, motors, and generators. In addition, measures to minimize the influence of stray electric and magnetic fields are analyzed as part of various shielding and grounding strategies.

The electric and magnetic circuit aspects are then presented as linear first order systems in the time and frequency domains. Issues such as time consultants, impedance, and superposition are explained in detail. Building upon these basic concepts, second order systems consisting of mixed capacitive and inductive systems are analyzed in terms of their resonance effects. The second order system description will then be applied to develop the basic transmission line theory as required in high-speed digital design.

Recommended background: EE 2011 introductory physics courses such as PH 1120 or PH 1121, MA 1024, MA 2051 (concurrent).
Lab exercises: Design and implementation of assembly language programs for embedded applications such as real-time controllers, burglar alarms, and signal processing.

Recommended background: EE 2022 (for ECE students, CS 2011 is acceptable for CS students), MA 1022, and an introductory physics course such as PH 1110 or PH 1111.

EE 3113. INTRODUCTION TO RF CIRCUIT DESIGN. Cat. I

This course is designed to provide students with the basic principles of radio frequency (RF) circuit design. It concentrates on topics such as designing tuning and matching networks for analog and digital communication, satellite navigation, and radar systems.

After reviewing equivalent circuit representations for RF diodes, transistors, FETs, and their input/output impedance behavior, the course examines the difference between lumped and distributed parameter systems. Characteristics impedance system design and operation, reflection coefficients, insertion loss, and group delay of RF circuits will be explained.

Within the context of Maxwell’s theory the course will then focus on the graphical display of the reflection coefficient (Smith Chart) and its importance in designing matching circuits. Students will learn the difference between SPICE and monolithic and microwave integrated circuit analysis, and design (MMICAD) modeling. Basing and matching networks for single and multistage amplifiers in the 900 to 2,000 MHz range are analyzed and optimized in terms of input/output impedance matching, insertion loss, and group delays.

Recommended background: EE 2111, EE 3204.
Suggested background: EE 2112.

EE 3204. MICROELECTRONIC CIRCUITS II. Cat. I

This course is the second of a two-course sequence in electronic circuit design. More complex circuits are analyzed and the effects of frequency and feedback are considered in detail. The course provides a comprehensive treatment of operational amplifiers and linear systems analysis. The use of Bode plots to describe the amplitude and phase response of circuits as a function of frequency is also presented. In addition, the concepts of analog signal sampling, analog-to-digital conversion and digital-to-analog conversion are presented along with techniques for interfacing analog and digital circuits. Laboratory exercises are provided to reinforce student facility with the application of these concepts to the design of practical circuits.

Topics include: transducers; differential amplifiers, inverting/non-inverting amplifiers, summers, dividers, integrators, passive and active filters, the Schmitt trigger, monostable and astable oscillators, timers, sample-and-hold circuits, A/D converters, and D/A converters.

Recommended background: Introductory electronic-circuit design and analog signal analysis as found in EE 2201 and EE 2311.

EE 3305. AEROSPACE AVIONICS SYSTEMS. Cat. I

This course is intended for students interested in obtaining a systems-level perspective of modern aerospace communications, navigation, and radar systems. The fundamental theory of operation of these systems is presented along with current-day applications of them.

Topics: Functionalizing principles and techniques of communications, navigation (including GPS) and radar systems; performance expectations for antenna, transmitter, receiver, and transmission-line components; error sources and their effect in combination on both individual component and aggregated system performance; earth-shape approximations and their influence on satellite design and operation; tropospheric and ionospheric effects of radio-wave propagation; and achievable overall system accuracies.

Recommended background: MA 1022 and PH 1120 or equivalent, and EE 2311. With extra work, this course can be successfully completed by non-EE students. The basic concepts of electromagnetic-wave propagation and antennas will be introduced as needed.

EE 3306. AUDIO ENGINEERING. Cat. I

Intended to provide an advanced student a thorough understanding of the theory and practice of electronic systems used for the recording and reproduction of speech and music, and of the nature and control of acoustic noise.


Recommended background: EE 2201, EE 2311, EE 3204 or equivalent.

EE 3311. PRINCIPLES OF COMMUNICATION. Cat. I

This course provides an introduction to analog and digital communications systems. Bandpass transmission of analog data is motivated and typical systems are analyzed with respect to bandwidth considerations and implementation techniques. Baseband and passband digital transmission systems are introduced and investigated. Pulse shaping and intersymbol interference criteria are developed in relation to the pulse rate transmission limits of bandlimited channels. Finally, digital carrier systems and line coding are introduced in conjunction with applications to modern modem transmission schemes.

Recommended background: EE 2311 and EE 2312.
EE 4304. COMMUNICATION SYSTEMS ENGINEERING.
Cat. I.
This course introduces the theory and performance analysis of communication in noise. The mathematical treatment of noise as a random process is developed in the context of baseband and passband transmission systems. The performance of analog transmission systems is developed and the tradeoff between bandwidth and performance is exposed. The optimum PCM receiver is derived and introduces the general concept of decision theory and signal space representation of decision systems. A treatment of coding theory for error detection, correction and compression leads to the development of Shannon’s information theory and the ultimate performance of digital transmission systems. Finally, concepts that underly modern digital data computer network systems are introduced.
Recommended background: EE 3311 and MA 3613.

EE 4502. ANALYSIS OF LARGE SCALE ELECTRIC POWER SYSTEMS.
Cat. I.
This course is designed to provide an introduction to network analysis and optimization techniques that are used in operation and planning for electric power systems.
Students may not receive credit for both EE 4501 and EE 4502.
Recommended background: EE 3501.

EE 4801. ADVANCED COMPUTER SYSTEM DESIGN.
Cat. I.
This course continues the development of microprocessor and microcontroller-based systems. This course focuses on the design of standalone embedded and high-performance microprocessor systems. Students are introduced to advanced concepts in microprocessor architecture and will design, implement, and program a complete embedded computer system. The importance of designing a system suitable for production will be covered, including issues such as Design for Manufacturability (DFM), design for test, reliability, and regulatory compliance including product safety. Topics: advanced microprocessor architecture, microprocessor timing, microcontrollers, embedded systems, interrupts, DMA, CACHE and memory system controllers, real-time system design issues, high-performance system and peripheral buses, DFM, reliability.
Laboratory exercises: Design of a complete, standalone microcontroller based-system, mixed language programming, embedded system debugging, design of systems with real-time requirements.
Recommended background: EE 3803 or equivalent.

EE 4902. ANALOG INTEGRATED CIRCUIT DESIGN.
Cat. I.
This course introduces students to the design and analysis of analog integrated circuits such as operational amplifiers, phase-locked loops, and analog multipliers. Topics: integrated circuit building blocks: current mirrors and sources, differential amplifiers, voltage references and multipliers, output circuits. Computer-aided simulation of circuits. Layout of integrated circuits. Design and analysis of such circuits as operational amplifiers, phase-locked loops, FM detectors, and analog multiplexers. Laboratory exercises.
Recommended background: familiarity with the analysis of linear circuits and with the theory of bipolar and MOSFET transistors. Such skills are typically acquired in EE 3204 and EE 3901.

ENGINEERING SCIENCE INTERDISCIPLINARY

ES 1020. INTRODUCTION TO ENGINEERING.
Cat. I.
Students gain actual engineering experience by working on an engineering problem which has been selected from a professional work experience. Student teams are formed and are assigned the entire problem or a segment of the problem. Students are taught a general problem solving methodology and techniques of library research and creative thinking. They gain experience in planning, questioning, decision making and produce written and oral reports.
The course is primarily for first-year students.

ES 1310. INTRODUCTION TO COMPUTER AIDED DESIGN.
Cat. I.
This basic course in engineering graphical communications provides a background for all engineering disciplines. The ability to create and interpret standard, well-integrated detail and assembly drawings is a necessity for engineers to communicate ideas. Computer Aided Design software will be used as a tool for creating these engineering design drawings. Multiview and pictorial graphics techniques are integrated with standards for dimensioning, sectioning, and generating detailed engineering drawings. Emphasis is placed on relating drawings to the required manufacturing processes. The design process and aids to creativity are combined with graphics procedures to incorporate functional design requirements in the geometric model.
No prior engineering graphics or software knowledge is assumed.

ES 2001. INTRODUCTION TO MATERIAL SCIENCE.
Cat. I.
A beginning course in understanding the structures and properties of metals, ceramics and plastics, in the selection and in the working and heat treating of materials. A course of interest to any engineer, scientist or person involved with materials.
The underlying fundamental theme of materials science is structure-property relationship. Structures covered range from the subatomic, or atomic level, through the microscopic world to the macroscopic, or gross point of view. Properties investigated may be chemical, mechanical, thermal, nuclear, electrical or optical. The selection, working and thermal treatments of materials are also related to structural changes and thus property alterations. No formal laboratory, but ample opportunity exists for the student to experiment with the fundamentals presented on a voluntary basis. A prior knowledge of college-level chemistry is assumed.

ES/NE 2011. INTRODUCTION TO NUCLEAR TECHNOLOGY.
Cat. I.
Overview of the basic phenomena which form the foundation of the field of nuclear engineering, including radiosotope production and utilization, and controlled chain reactions. Familiarization with nuclear laboratory techniques and instrumentation is emphasized.
Topics covered include: structure of the atom and nucleus, decay laws, properties of decay emanations, and nuclear interactions.
Recommended preparation: Differential and Integral Calculus (MA 1022).
ES 2501. INTRODUCTION TO STATIC SYSTEMS.
Cat. 1
This is an introductory course in the engineering mechanics sequence that serves as a foundation for other courses in mechanical engineering. In this course, students will learn to solve for forces and couples in systems that are not accelerating and which are statically determinate. They will also learn to draw shear and bending moment diagrams for beams and how to calculate the centroid and the moment of inertia for areas.
This course qualifies as one of the three courses that mechanical engineering students must complete in the mechanical systems stem.
Topics normally covered include: forces, moments of forces and couples; free body diagrams; equilibrium; friction; distributed loadings; pin trusses; beams and beam loading; suspended cables; first and second moment of area. Force analysis of submerged bodies is addressed in this course.
Recommended preparation: Differential and Integral Calculus (MA 1022) and elementary vector algebra.

ES 2502. STRESS ANALYSIS.
Cat. 1
The first course in engineering mechanics that addresses stress analysis of mechanical and structural elements.
Topics covered include: stresses, strains and deformations in bars, beams, and torsional elements; principal stresses, transverse shear stresses, buckling.
Recommended preparation: Statistics (ES 2501) and elementary vector algebra.

ES 2503. INTRODUCTION TO DYNAMIC SYSTEMS.
Cat. 1
Engineers should be able to formulate and solve problems that involve forces that act on bodies which are moving. This course deals with the kinematics and dynamics of particles and rigid bodies which move in a plane.
Topics covered will include: kinematics of particles and rigid bodies, equations of motion, work-energy methods, and impulse and momentum. In this course a basic introduction to mechanical vibration is also discussed. Basic equations will be developed with respect to translating and rotating coordinate systems.
Recommended preparation: Statistics (ES 2501 or CE 2000).

ES 3000. CLASSICAL THERMODYNAMICS.
Cat. 1
This course presents the background for all work in energy conversion from the classical, macroscopic approach to thermodynamics. The emphasis is on the First and Second Laws of Thermodynamics and on the various relationships between the thermodynamic properties of substances.
Topics include: fundamental physical concepts; systems of units; properties of pure substances; processes; work and heat, first law of thermodynamics, the system and control volume; second law, Carnot Principle, entropy, reversibility and irreversibility; availability of systems and energy, second law analysis of systems; property relationships, Maxwell relations, equations of state; generalized property charts; cycle analysis and mixtures.
Background: general first year in science and engineering and Chemical Thermodynamics (CH 3510).

ES 3001. INTRODUCTION TO THERMODYNAMICS.
Cat. 1
This course emphasizes system and control volume modeling using the First and Second Laws of Thermodynamics.
Topics include: properties of simple substances, an introduction to availability, cycle analysis.
Recommended preparation: Introductory Thermofluids (ME 2434).

ES 3002. MASS TRANSFER.
Cat. 1
This course introduces the student to the phenomena of diffusion and mass transfer. These occur in processes during which a change in chemical composition of one or more phases occurs. Diffusion and mass transfer can take place in living systems, in the environment, and in chemical processes. This course will show how to handle quantitative calculations involving diffusion and/or mass transfer, including design of process equipment.
Topics may include: fundamentals of diffusional transport, diffusion in thin films, unsteady diffusion; diffusion in solids; convective mass transfer; dispersion; transport in membranes; diffusion with chemical reaction; simultaneous heat and mass transfer; selected mass transfer operations such as absorption, drying, humidification, extraction, crystallization, adsorption, etc.
Recommended background: fundamentals of chemical thermodynamics, fluid flow and heat transfer; ordinary differential equations (MA 2051 or equivalent).

ES 3003. HEAT TRANSFER.
Cat. 1
To provide an understanding of fundamental concepts of heat fluxes, to develop understanding of the coupling of fluid mechanics and thermodynamics, and to provide experience in modeling engineering systems and predicting their behavior.
Topics covered include: steady-state and transient conduction exemplified by heat transfer to and from buried pipes, heat losses through furnace walls, response of a fluid as it is heated, and the effects required to increase heat transfer rates. Contact resistance. Natural and forced convection. Heat exchanger analysis and design. Convection accompanied by boiling and condensation. Blackbody radiation. Thermal radiation within an enclosure including diffuse and gray surfaces. Radiation accompanied by conduction and with motion.
Recommended preparation: Ordinary Differential Equations (MA 2051).

ES 3004. FLUID MECHANICS.
Cat. 1
A study of the fundamental laws of statics, kinematics and dynamics applied to fluid mechanics. The course will include fluid properties, conservation of mass, momentum and energy as applied to real and ideal fluids. Laminar and turbulent flows, fluid resistance and basic boundary layer theory will also be considered.
The course is recommended for third-year students having a background of basic physics, basic differential equations and vectors.

ES 3011. CONTROL ENGINEERING I.
Cat. 1
This sequence of courses in the field of control engineering (ES 3011 and ES 4012) is generally available to all juniors and seniors regardless of department. A good background in mathematics is required; familiarity with Laplace transforms, complex variables and matrices is desirable but not mandatory. All students taking Control Engineering I should have an understanding of ordinary differential equations (MA 2051 or equivalent) and basic physics through electricity and magnetism (PH 1120/1121). Control Engineering I may be considered a terminal course, or it may be the first course for those students wishing to do extensive work in this field. Students taking the sequence of two courses will be prepared for graduate work in the field.
Recommended preparation: Ordinary Differential Equations (MA 2051) and Electricity and Magnetism (PH 1120, PH 1121).
Suggested preparation: Background in Laplace transforms, complex variables and matrices.

ES 3323. ADVANCED COMPUTER AIDED DESIGN.
Cat. 1
This course exposes the student to computer aided engineering design and geometric modeling using Unix based graphic workstations. The use of geometric models for applications in computer aided mechanical design, engineering analysis and manufacturing is emphasized. Topics may include mechanical design, solid and feature based modeling, variational and parametric design, physical properties, assembly modeling, numerical control, mechanisms, and other analytical methods in engineering design.
Recommended preparation: familiarity with drafting standards (ES 1310), mechanical systems (ES 2501 or CE 2000, ES 2503) and kinematics (ME 3310) is assumed. Additional background in strength of materials (ES 2502 or CE 2001), machine design (ME 2300, ME 3320), machining and manufacturing methods (ME 1800) and higher level programming capability (CS 1001 or CS 1005) is helpful.

ES 4012. CONTROL ENGINEERING II.
Cat. 1
This course applies state-space analysis and design techniques to continuous and discrete-time systems.
Topics covered include: multiple-input, multiple-output, state models; controllability, observability and stability concepts; solution of state equations; computer-control design techniques and computer effects in physical systems; computer simulation.
Recommended background: linear algebra (MA 2071 or equivalent) and an understanding of control systems as found in an introductory course such as ES 3011.
FIRE PROTECTION
ENGINEERING

FP 3070. FUNDAMENTALS OF FIRESAFETY ANALYSIS.
Cat. I
This course introduces students of different technical disciplines to analytical methods and techniques to address problems of fire, explosions, or hazardous incidents. Emphasis will be placed on understanding the physical concepts of the problem and their interactions. Quantification will adapt existing procedures to appropriate levels of theoretical and empirical methods in the field of fire science and engineering. Computer applications will be incorporated.

Recommended background: mathematics through differential equations; engineering science; fluid mechanics.

Graduate Fire Protection Engineering Courses of Interest to Undergraduates

FPE 510. FLAMMABILITY TESTS, CODES AND STANDARDS.
Cat. II
(Prerequisite: FPE 521 or special permission of the instructor.) Advanced fire dynamics, combustion and compartment fire behavior will be discussed within a framework of modeling fire and its effects. Topics include computer modeling of pre-flashover and post-flashover compartment fires, burning characteristics of polymers and other fuels, the effect of fire retardants, products of combustion generation, flame spread models, plume and ceiling jet models and overall toxicity assessment. Some familiarity with computer programming is recommended.
Offered 2001-02 and alternating years thereafter.

FPE 520. FIRE DYNAMICS II.
Cat. I
(Prerequisites: Undergraduate chemistry, thermodynamics [or physical chemistry], fluid mechanics and heat transfer.) This course introduces students to fundamentals of fire and combustion and is intended to serve as the first exposure to fire and combustion phenomena. The course includes fundamental topics in fire and combustion such as thermodynamics of combustion, fire chemistry, premixed and diffusion flames, solid and liquid burning, ignition, plumes and ceiling jets. These topics are then used to develop the basic for introducing compartment fire behavior, pre and post-flashover conditions and smoke movement.

FPE 553. FIRE PROTECTION SYSTEMS.
Cat. I
(Prerequisites: Undergraduate courses in chemistry, fluid mechanics and either thermodynamics or physical chemistry.) This course provides an introduction to automatically activated fire suppression and detection systems. A general overview is presented of relevant physical and chemical phenomena and commonly used hardware in automatic sprinkler, gaseous agent, foam and dry chemical systems. Typical contemporary installations and current installation and approval standards are reviewed.

FPE 554. ADVANCED FIRE SUPPRESSION.
Cat. II
(Prerequisite: FPE 553 or special permission of instructor.) Advanced topics in suppression systems analysis and design are discussed with an aim toward developing a performance based understanding of suppression technology. Automatic sprinkler systems are covered from the standpoint of predicting actuation times, reviewing numerical methods for hydraulic analyses of pipe flow networks and understanding the phenomenology involved in water spray suppression. Special suppression systems are covered from the standpoint of two phase and non-Newtonian pipe flow and simulations of suppression agent discharge and mixing in an enclosure.
Offered 2000-01 and alternating years thereafter.

FPE 555. DETECTION, ALARM AND SMOKE CONTROL.
Cat. II
(Prerequisites: FPE 553. Also FPE 521 and FPE 571 which can be taken concurrently.) Principles of fire detection and using flame, heat and smoke detectors are described. Fire alarm technology and the electrical interface with fire/smoke detectors are reviewed in the context of contemporary equipment and installation standards. Smoke control systems based on buoyancy and HVAC principles are studied in the context of building smoke control for survivability and safe egress.
Offered 2001-02 and alternating years thereafter.

FPE 563 (MG 527). RISK MANAGEMENT.
Cat. I
Risk Management is highly interdisciplinary drawing upon systems engineering and managerial decision making and finance. The basics of risk management including hazard analysis, risk assessment, risk control and risk financing are covered. The course is self-contained and includes material from engineering economy, risk assessment and decision analysis. Group projects can draw from fire protection engineering, hazardous waste management and product liability. The projects serve to emphasize important techniques for quantifying risk and the challenge of integrating risk assessment with managerial decision making.

FPE 565. FIRESAFETY ENGINEERING EVALUATION.
Cat. II
(Prerequisites: FPE 521, FPE 553 and FPE 570.) This course develops techniques to evaluate the firesafety performance of a variety of facilities in the built environment and to produce management plans for decision making. The framework for this course is a firesaftey engineering method which decomposes the firesafety system into discrete elements that can be used for quantitative evaluation using a variety of fire protection engineering and fire science materials. Offered 2001-02 and alternating years thereafter.

FPE 570. BUILDING FIRESAFETY I.
Cat. I
This course focuses on the presentation of qualitative and quantitative means for firesafety analysis in buildings. Fire test methods, fire and building codes and standards of practice are reviewed in the context of a systematic review of firesafety in proposed and existing structures.

FPE 571. BUILDING FIRESAFETY II.
Cat. I
(Prerequisites: FPE 553, FPE 521 and FPE 570 or special permission of instructor.) This course covers practical applications of fire protection engineering principles to the design of buildings. Both compartmented and non-compartmented buildings will be designed for criteria of life safety, property protection, continuity of operations, operational management and cost. Modern analytical tools as well as traditional codes and standards are utilized. Interaction with architects, code officials and an awareness of other factors in the building design process are incorporated through exercises and a design studio.

FPE 572. FAILURE ANALYSIS.
Cat. I
(Prerequisites: FPE 570, FPE 553 or special permission of instructor.) This course develops fire investigation and reconstruction as a basis for evaluating, and improving firesafety design. Accident investigation theory and failure analysis techniques such as fault trees and event sequences are presented. Fire dynamics and computer modeling are applied to assess possible fire scenarios and the effectiveness of fire protection measures. The products liability aspects of failure analysis are presented. Topics include products liability law, use of standard test methods, warnings and safe product design. Application of course materials is developed through projects involving actual case studies.

FPE 573. INDUSTRIAL FIRESAFETY.
Cat. I
(Prerequisites: FPE 553, FPE 521 or special permission of instructor.) Principles of fire dynamics, heat transfer and thermodynamics are combined with a general overview of automatic detection and suppression systems in analyzing fire protection requirements for generic industrial hazards. Topics covered include safe separation distances, plant layout, hazard isolation, smoke control, warehouse storage and flammable liquid processing and storage. Historical industrial fires influencing current practice on these topics are also discussed.

FPE 574 (CM 594). PROCESS SAFETY MANAGEMENT.
Cat. II
(Prerequisite: An undergraduate engineering or physical science background.) This course provides basic skills in state-of-the-art process safety management and hazard analysis techniques including Hazard and Operability Studies (HAZOP), Logic Trees, Failure Modes and Effects Analysis (FMEA) and Consequence Analysis. Both qualitative and quantitative evaluation methods will be utilized. Following a case study format, these techniques along with current regulatory requirements will be applied through class projects addressing environmental health, industrial hygiene, hazardous materials, fire or explosion hazards scenarios.
Offered 2000-01 and alternating years thereafter.
at the Worcester Art Museum, the student will survey the major developments in
How do we understand a work of art? Through readings and the study of objects

AR 1111. INTRODUCTION TO ART HISTORY.
Cat. 1
How do we understand a work of art? Through readings and the study of objects
at the Worcester Art Museum, the student will survey the major developments in
world art and be introduced to various critical perspectives in art history. Stu-
dents will learn how art historians work with primary materials and formulate
arguments. No previous knowledge of art is required. (Formerly HU 1014.)

AR 2111. MODERN ART.
Cat. 1
The successive phases of modern art, especially painting, are examined in light
of the late-19th-century break with the 600-year old tradition of representation.
Topics covered include: non-objective art and abstraction—theory and prac-
tice, primitivism in modern art, surrealism and the irrational, the impact of
photography on modern painting, cubism and collage, regionalism and abstract
expressionism as American art forms, Pop art and popular culture, and the
problem of concept versus representation in art. (Formerly AR 2300.)

EN 1221. INTRODUCTION TO DRAMA:
THEATRE ON THE PAGE AND ON THE STAGE.
Cat. 1
The plays studied will give the student an understanding of the forms of drama,
the styles of theatre performance and production, and the emergence of new
forms and styles. Types of drama studied could include Greek Tragedy and
Comedy, Roman Comedy, Cycles and Pageants of the Middle Ages, Shakes-
peare, Restoration, Romanticism, Neo-Classicism, French Comedy,
Realism, Naturalism, and the eclectic forms in the Twentieth Century. Discus-
sions, research and writing projects, and performance activities will offer the
student experience in the theory and practice studied in the course.

EN 1222. SHAKESPEAREAN SAMPLER.
Cat. 1
This course is an introduction to Shakespeare, his theatre, and some important
concepts of his world. Students will have the opportunity to sample representa-
tive Shakespearean tragedies, comedies, and histories. In addition to class
discussions and scene work, students will be able to enhance their readings by
analyzing video recordings of the plays.
EN 1231. INTRODUCTION TO AMERICAN LITERATURE.
Cat. I
This survey course covers American literature from its beginnings in the colo-
nial period through the works of Nathaniel Hawthorne in the early nineteenth
century. Students will read literary works in a variety of genres (narratives,
poems, sermons, plays, stories, and novels) that reflect the emerging nation’s
struggle for cultural self-definition. Topics will include the literature of travel
and discovery, the faith of the colonial founders, the quest for a distinctive
national literature, and the rise of early American fiction.

EN 1242. INTRODUCTION TO ENGLISH POETRY.
Cat. I
This course surveys the poems of our language. From the Anglo-Saxon poems to
the popular verse of Tennyson, the songs and the poets are legion: Chaucer,
Raleigh, Spenser, Marlowe, Shakespeare, Jonson, Donne, Herrick, Milton, Blake,
Wordsworth, Coleridge, Byron, Keats, Tennyson, Browning, and Hopkins. The
England that nourished these writers will be viewed through their ballads,
lyrics, sonnets, epigrams, and epics. “Not marble nor the gilded monuments of
princes shall outlive this powerful rhyme.”

EN 1251. INTRODUCTION TO LITERATURE.
Cat. I
This course introduces the student to a variety of critical perspectives necessary
to an understanding and appreciation of the major forms, or genres, of literary
expression (e.g., novel, short story, poetry, drama, and essay). Writing and class
discussion will be integral parts of this course.

EN 1257. INTRODUCTION TO AFRICAN AMERICAN LITERATURE
AND CULTURE.
Cat. II
This course examines the history and tradition of the African American literature
that has emerged in the United States from slave narratives to contemporary forms in black popular culture. The
student will explore the experiences of African American writing and their
relation to American literature and to black cultural expression.

This course will be offered in 2000-01 and in alternating years thereafter.

EN 2211. ELEMENTS OF WRITING.
Cat. I
This course is designed for students who wish to work intensively on their
writing. The course will emphasize the processes of composing and revising, the
rhetorical strategies of expository prose, and the relationship between writer and
audience. In a workshop setting, students will write. a sequence of short papers and
complete one longer writing project, learn to read critically and respond
helpfully to each other’s writing, and make oral presentations from written
texts.

EN 2221. AMERICAN DRAMA.
Cat. I
An investigation into the development of American drama from its beginnings
to the present. The history of the emergence of the legitimate theatre in this
country will be followed by reading important plays, including the works of
O’Neill, Williams, Mamet, Norman, Henley, and others. Discussion of the
growth of regional theatres and their importance to the continuation of theatre
as a serious and non-profit art form will be included in the course. The student
will investigate the importance of theatre practice in the evolution of the dra-
matic literature of the country.

EN 2222. THEATRE WORKSHOP.
Cat. I
A workshop course which offers the student the opportunity to explore theatre
through creative involvement with playwriting, design, performance, produc-
tion, and criticism. Students will work in a laboratory situation functioning as a
micro-professional theatre which could develop a production that would be
staffed and dramaturged from the group.

EN 2223. SHAKESPEARE: THE UNTUNED STRING.
Cat. II
A study of the political and moral conflicts in such plays as Hamlet, King Lear
and Richard III. The course examines the chaos that results in a society lacking
moral and political leadership.

Opportunities will exist in this course for studying the plays as literature, for
aspects of production and performance, and for their adaptability to film. The
WPI library of video recordings will be available for such work.

This course will be offered in 2001-02 and in alternate years thereafter.

EN 2244. SHAKESPEARE: NOTHING BUT LOVE.
Cat. II
In this course students will be asked to analyze the relationship between love
and tragedy in such plays as Romeo and Juliet, Othello, and Antony and Cleopatra.
The analysis will take into account the conflict between the Christian ideal of
selfless love, which imitates God’s love of man, and the selfish varieties of love
that tempt man to folly. On the lighter side, students will consider the comic
implications of love in Midsummer Night’s Dream and The Merry Wives of
Windsor.

Opportunities will exist in this course for studying the plays as literature, for
aspects of production and performance, and for their adaptability to film. The
WPI library of video recordings will be available for such work.

This course will be offered in 2000-01 and in alternate years thereafter.

EN 2231. AMERICAN LITERATURE: THE RAVEN, THE WHALE,
AND THE WOODCHUCK.
Cat. I
This course surveys developments in American literature, particularly the
movement towards realism, during the period of turbulent change between the
end of the Civil War and the early years of the twentieth century. Topics will
include the rebellion against post bellum sentimentalism, the rise of regional
writing, the emerging literature of social protest, and literary responses to
advances in science, industry, and urban life. Attention will be given to the
works of Mark Twain, a prime exponent of turn-of-the-century literary trends,
as well as to other pioneer realists (James and Crane).

EN 2232. AMERICAN LITERATURE: TWAIN TO WORLD WAR I.
Cat. I
This survey course covers developments in American literature, particularly the
movements towards realism, during the period of turbulent change between the
end of the Civil War and the early years of the twentieth century. Topics will
include the rebellion against post bellum sentimentalism, the rise of regional
writing, the emerging literature of social protest, and literary responses to
advances in science, industry, and urban life. Attention will be given to the
works of Mark Twain, a prime exponent of turn-of-the-century literary trends,
as well as to other pioneer realists (James and Crane).

EN 2233. AMERICAN LITERATURE: MODERNISM TO THE PRESENT.
Cat. I
This final survey course in American literature covers the modern and contem-
porary periods, from World War I to the present. The wide-ranging material
represents the literary response to the broad intellectual, social, and cultural
changes that mark the history of those years of ferment in the United States. The
course includes selected works of fiction, drama, poetry, and essays by such
writers as William Faulkner, Toni Morrison, Thornton Wilder, Sylvia Plath,

EN 2234. MODERN AMERICAN NOVEL.
Cat. II
Selected works of fiction which appeared after World War II will be the focus of this
course. F. Scott Fitzgerald, Ernest Hemingway, William Faulkner, or other
authors of the early modern period will be studied, but significant attention will
also be given to contemporary novelists, such as Alice Walker and Kurt
Vonnegut. The cultural context and philosophical assumptions of the novels will
be studied as well as their form and technique.

This course will be offered in 2001-02 and in alternating years thereafter.

EN 2235. THE AMERICAN DREAM: MYTH IN
LITERATURE AND THE POPULAR IMAGINATION.
Cat. I
American writers from our beginnings have been preoccupied with “The
American Dream” as a benchmark for measuring the attainment of our highest
ideals as a people. The course examines the political, economic, religious, and
rhetorical roots of the concept, assesses its popular and commercial manifesta-
tions, and explores the ironies, paradoxes, and continuities that have shaped this
national self-image for almost 400 years. Readings include works by Puritan and
Revolutionary writers, Native American leaders, Horatio Alger, Jr., William
Dean Howells, F. Scott Fitzgerald, Martin Luther King, Jr., Adrienne Rich, Studs
Terkel, and Archibald MacLeish.

EN 2237. AMERICAN LITERATURE AND THE ENVIRONMENT.
Cat. II
This course will examine the many ways in which American essayists, novelists,
dramatists, and poets have responded to the natural world, and especially to
ecological concerns voiced in contemporary times. Among the topics to be
discussed in class and in papers are the changing attitudes towards the wilder-
ness, the effects of technology on the environment, and the presence of the
spiritual in nature. Readings may include works by such authors as Ernest
Hemingway, Wendell Berry, Mary Oliver, Lawrence Ferlinghetti, and Gary Snyder.
(Offered in 2000-01 and in alternate years thereafter.)
EN 2238. AMERICAN REALISM.
**Cat. I**
By examining authors who reacted against the so-called “gentle tradition,” this course attempts to show how various subjects (death, sex, war, urban life and racial prejudice) were treated more honestly in short stories and novels after the Civil War. Authors may include Mark Twain, Stephen Crane, W. D. Howells, Edith Wharton, Kate Chopin, and Theodore Dreiser.

(Formerly EN 2326. Students who have received credit for this course may not receive credit for EN 2238.)

EN 2241. ENGLISH LITERATURE AFTER SHAKESPEARE.
**Cat. II**
Participants in this course will examine outstanding works of eighteenth- and nineteenth-century English literature as these works raise the question: Who is man, and what is his relationship to God, nature, and to his fellow creatures? Writers covered may include Swift, Pope, Keats, Browning, and Dickens. This course will be offered in 2000-01 and in alternate years thereafter.

(Formerly EN 3245.)

EN 2242. POPULAR FICTION: READING IN INSTALLMENTS.
**Cat. I**
Students in this course will have the opportunity to read two major masterpieces of English fiction the way they should be read: slowly, carefully, and with relish. Victorian novels are long and the term is short, but by reading novels in the way in which they were read by their original readers—serially—we can experience masterworks by Charles Dickens and George Eliot at comparative leisure, examining one serial installment per class session.

EN 2243. MODERN BRITISH LITERATURE.
**Cat. II**
A survey of major modern British authors. The works of many of these writers reflect the political, religious, and social issues of the twentieth century. New psychological insights run parallel with experiments in the use of myth, stream of consciousness, and symbolism. Authors studied may include Hardy, Conrad, Owen, Joyce, Lawrence, Woolf, Eliot, Yeats, and Orwell.

This course will be offered in 2001-02 and in alternate years thereafter.

EN 2251. MORAL ISSUES IN THE MODERN NOVEL.
**Cat. I**
This course focuses on the problem of how to live in the modern world. Emphasis will be placed on the way moral issues evolve within the complications of individual lives, as depicted in fiction. Such authors as Conrad, Kesey, Camus and Eliot show characters struggling with the questions of moral responsibility raised by love, religion, death, money, conformity.

EN 2252. SCIENCE AND SCIENTISTS IN MODERN LITERATURE.
**Cat. I**
This course surveys the ways in which modern literature has represented science and scientists. Beginning with Mary Shelley’s *Frankenstein*, the origin of what Isaac Asimov calls the “damned Frankenstein complex” is examined. More complex presentations of science and scientists occur in twentieth-century British literature, for example, J. G. Ballard’s *The Atrocity Exhibition* and Aldous Huxley’s *Brave New World*.

The course covers major modern works of fiction and drama, including such literary forms as the play, the novel of ideas, and the utopian novel. Attention is focused on the themes (ideas) in, and the structure of, these works.

EN 3215. GENRES OF SCIENCE WRITING.
**Cat. I**
This is an advanced course that focuses on various genres of science writing, including the experimental article, news reports, profiles, feature stories, reviews, and public lectures. The course considers how science writers communicate technical information to other specialists and to general audiences; how writers capture the human experience of science; and how writers treat the public policy implications of science. Students will read and analyze both scientific literature and popular science writing to understand the conventions and contexts that determine the genres of science writing, and they will develop their own writing projects, make oral presentations, and co-author at least one piece of writing.

Recommended background: EN 2211 or equivalent writing course.

EN 3216. WRITING IN THE PROFESSIONS.
**Cat. I**
Studies show that engineers spend 80-90% of their professional time engaged in various kinds of communication. This course emphasizes the management contexts of writing in the professions. Focus is on making informed decisions about approaches, styles, problems, issues, sources, strategies, and human relations aspects of writing in business, industry, and other institutional settings. Special attention is given to business editing and proposal and grant writing.

Recommended background: EN 2211 or equivalent writing course.

EN 3217. CREATIVE WRITING.
**Cat. I**
The purpose of this course is to help students develop or improve the skills of written expression. Small groups are formed in which participants present and discuss their original work in either fiction or poetry.

EN 3222. FORMS IN WORLD DRAMA.
**Cat. II**
The study of the major forms of world drama beginning with the Greeks and ending with contemporary forms. The student will develop the skills to analyze form and structure through dramatic content. The course may include the works of Sophocles, Euripides, Aristophanes, the Renaissance, the Restoration, Moliere, Ibsen, Strindberg, Shaw, Pirandello, and others.

This course will be offered in 2001-02 and in alternate years thereafter.

EN 3223. FORMS IN MODERN DRAMA.
**Cat. II**
The study of the forms in modern drama and their development from the forms of world drama. Contemporary playwrights studied could include Brecht, Bond, Schaeffer, Handke, and others, and the course will devote some concentration to theatre movements of the twentieth century that have operated with textual revision, minimal text, or no texts. Thus, theatre companies studied might include the work of the Living Theatre, the Open Theatre, and the theatre of Grotowski and Brook.

This course will be offered in 2000-01 and in alternate years thereafter.

EN 3224. SHAKESPEARE SEMINAR.
**Cat. II**
This course would allow for the study of various Shakespearian topics in different years. Some representative subjects could include: “Shakespeare and the Arts,” “Shakespeare’s Contemporaries,” “Shakespeare and Science,” “Shakespearean Tragedy,” “Shakespeare’s Roman Plays,” “Shakespeare’s Histories,” “Shakespeare on Film.” The topics will be announced before the seminar meets.

This course will be offered in 2001-02 and in alternate years thereafter.

EN 3231. NEW ENGLAND SUPERNATURALISM.
**Cat. II**
From the colonial period to the 20th century, New England writers have explored the region’s people and its settings (fields, forests, buildings, factories, cities) with shapes of fear. This course will explore New England’s fascination with the supernatural from Puritan writings to the contemporary tale of terror. A primary focus of the course will be the genre of New England Gothicism and its literary conventions. Authors studied may include Hawthorne, Longfellow, Whittier, Freeman, Wharton, Jackson, Lovelcraft, and King.

(Offered in 2001-02 and in alternate years thereafter.)

EN 3232. THE CONCORD WRITERS.
**Cat. II**
Rural, mid-19th-century Concord, Massachusetts, witnessed an unprecedented flowering of important and influential American literature. Why Concord? We sample writings of Ralph Waldo Emerson, Henry D. Thoreau, Nathaniel Hawthorne, Bronson Alcott, and Louisa May Alcott to explore matters of cultural background, biography, contemporary events, uses of the past, literary vocation, and sense of place. Emphasis is on these writers’ friendships and their creative responses to intellectual and social forces of the day—factors that made Concord a community of highly individualistic writers.

(Offered in 2001-02 and in alternate years thereafter. Students who have received credit for EN 2236 (New England Writers: Concord) may not receive credit for EN 3232.)

EN 3233. WORCESTER BETWEEN THE COVERS: LOCAL WRITERS AND THEIR WORKS.
**Cat. II**
Worcester has had a rich and varied literary history from Isaiah Thomas’s founding of the American Antiquarian Society in the early 1800s to the works of S. N. Behrman, Robert Benchley, Elizabeth Bishop, Esther Forbes, Stanley Kurtiz, and Charlesolson in the 20th century. This course will examine selections from Worcester area writers in a number of genres (e.g., fiction, drama, poetry, essay, nonfiction memoir). Attention will be given to the local contexts of these writings as well as to each writer’s contributions to the larger continuum of American Literature.

(Offered in 2000-01 and in alternate years thereafter. Students who have received credit for EN 2236 (New England Writers: Worcester) may not receive credit for EN 3233.)

EN 3234. MODERN AMERICAN POETRY.
**Cat. II**
This course is a study of selected American poets and their reactions to the ferment of the modern period. A thematic approach to poetry will be emphasized. Included in the course are modern poets such as Robert Frost, T. S. Eliot, E. E. Cummings, and Marianne Moore, as well as contemporary poets such as Rita Dove, Li Young Lee, and Robert Pinsky.

This course will be offered in 2000-01 and in alternate years thereafter. (Formerly EN 2123.)
EN 3237. PURSUING MOBY-DICK.
Cat. II
Since 1851, readers of Herman Melville's masterpiece have joined in the chase for the "meaning" of the White Whale. After briefly examining the philosophical context of Emersonian idealism and the literary example of Hawthorne, the course is devoted solely to a close reading of Moby-Dick—one of the most innovative and mysterious novels in the English language. "Whose" book is it, anyway? Captain Ahab's? Ishmael's? The Whale's? The reader's? We conclude by surveying major critical approaches to the novel. (Offered in 2000-01 and in alternate years thereafter.)

EN 3248. THE ENGLISH NOVEL.
Cat. I
Participants in this seminar will examine the English novel from its origins in the eighteenth century to its twentieth-century forms, exploring the rich variety of ways a writer may communicate a personal and social vision. The novels treat love, travel, humor, work, adventure, madness, and self-discovery; the novelists may include Fielding, Austen, Dickens, Eliot, Conrad, and Woolf.

EN ----. DRAMA/THEATRE PERFORMANCES.
TH: IS/P
One-sixth unit of credit will be awarded at the conclusion of two successive terms of participation. Performance activities currently receiving credit are: TH 1225 Theatre Production Practicum
TH 2225 Acting
TH 2227 Advanced Acting
TH 2229 Advanced Theatre Production Practicum
TH 3225 Directing
TH 3227 Advanced Directing
TH 3229 Dramaturgy
TH 4225 Theatre Technology Design
TH 4227 Advanced Theatre Technology Design
TH 4229 Advanced Dramaturgy
Credit would be given on the condition that the performance takes place in a WPI performance directed or advised by a part- or full-time WPI instructor.
Note: A maximum of two one-sixth credits, or a total of one-third unit, may be applied toward the five courses, or five one-third units, taken prior to the final sufficiency term.

IS 1811. WRITING FOR NON-NATIVE SPEAKERS OF ENGLISH.
Cat. I
This course offers, through conferences, tutorial sessions and extensive writing practice, a review of English composition principles for international students.

IS 1812. SPEECH FOR NON-NATIVE SPEAKERS OF ENGLISH.
Cat. I
This course focuses on developing international students' ability to speak effectively, organize ideas logically, improve voice and diction, and use visual aids. Television and audiotapes are used to record competence and poise. This is a course for those electing the "Basic Sufficiency for International Students."

German

GN 1511. ELEMENTARY GERMAN I.
Cat. I
An intensive language course designed to teach concise expression of ideas in writing and speaking. Basic grammar and significant cultural aspects are introduced through the aid of readings, audio-recordings, video, and oral group interaction. (Formerly GN 2616.)

GN 1512. ELEMENTARY GERMAN II.
Cat. I
A continuation of Elementary German I, which is strongly recommended as background.

GN 2511. INTERMEDIATE GERMAN I.
Cat. I
A continuation of Elementary German II, with increased emphasis on oral and written expression. Basic textbook is supplemented by a collection of simple literary texts by the Grimm brothers, Brecht, and Bichsel.
Recommended background: Elementary German II.

GN 2512. INTERMEDIATE GERMAN II.
Cat. I
A continuation of Intermediate German I, which is strongly recommended as background.

History

HI 1311. INTRODUCTION TO AMERICAN URBAN HISTORY.
Cat. I
An introduction to the history of the American city as an important phenomenon in itself and as a reflection of national history. The course will take an interdisciplinary approach to study the political, economic, social, and technological patterns that have shaped the growth of urbanization. In addition to reading historical approaches to the study of American urban history, students may also examine appropriate works by sociologists, economists, political scientists and city planners who provide historical perspective. (Formerly HI 3123.)

HI 1312. INTRODUCTION TO AMERICAN SOCIAL HISTORY.
Cat. I
An introduction to the historical study of American society. It addresses two questions: What is social history? And how do social historians work?

HI 1313. INTRODUCTION TO THE STUDY OF FOREIGN POLICY AND DIPLOMATIC HISTORY.
Cat. I
An introduction to the various components of U.S. foreign policy decision-making and the basic techniques of diplomatic history. The course will focus on one or two topics in the history of American foreign relations, using a variety of primary documents and secondary sources.

HI 1314. INTRODUCTION TO EARLY AMERICAN HISTORY.
Cat. I
An introduction to historical analysis through selected periods or themes in the history of America before the Civil War. A variety of readings will reflect the various ways that historians have attempted to understand the development of America.

HI 1321. INTRODUCTION TO EUROPEAN SOCIAL HISTORY.
Cat. I
An introduction to the study of modern European social history since the Industrial Revolution. Topics will include industrialization in Britain and Europe, class formation, gender and the condition of women, technology and economy, culture and society. Students will learn to work with historical sources, to formulate arguments, to read critically, and to write clearly. No prior knowledge of European history is required.
HI 1322. INTRODUCTION TO EUROPEAN CULTURAL HISTORY.  
Cat. I  
This course surveys the transformation of the United States into an urban and industrial nation. Topics will include the dramatic expansion of government’s role in American life between the Civil War and World War I. It does so by examining the response of constitutional, common, and statutory law to the social, economic, and political change associated with this pivotal period in the nation’s history. (Formerly HI 2111.)

HI 2316. AMERICAN FOREIGN POLICY FROM WOODROW WILSON TO THE PRESENT.  
Cat. I  
This survey of American diplomatic history begins with the legacy of Woodrow Wilson, continues through our apparent isolation in the 1920’s, American neutrality in the 1930’s, World War II, the early and later Cold War periods, and concludes with an overview of the current global involvement of the United States. (Formerly HI 2101.)

HI 2317. LAW AND SOCIETY IN AMERICA, 1865-1910.  
Cat. I  
This course explores the dramatic expansion of government’s role in American life between the Civil War and World War I. It does so by examining the response of constitutional, common, and statutory law to the social, economic, and political change associated with this pivotal period in the nation’s history. (Formerly HI 2111.)

HI 2321. EUROPE FROM THE FRENCH REVOLUTION TO WORLD WAR I.  
Cat. I  
A survey of the major socio-economic, political, and cultural developments in European history from the Old Regime to World War I. The course will focus upon those factors and events that led to the formation of modern society: capitalism and industrialization; liberalism, socialism, and revolution; imperialism; national unification of Italy and Germany; the coming of World War I.  
No prior knowledge of European history is required. (Formerly HI 1202.)

HI 2322. EUROPE SINCE WORLD WAR I.  
Cat. I  
A survey of the major political, socio-economic, and cultural developments in European history since World War I. The course will focus upon those factors and events that have led to the current world situation: the World Wars, fascism and communism, the Holocaust, the Cold War, the welfare state, decolonization, post-industrial society, popular culture, the collapse of communism, contemporary Europe.  
No prior knowledge of European history is required. (Formerly HI 2222.)

HI 2324. INDUSTRY AND EMPIRE IN BRITISH HISTORY.  
Cat. I  
A survey of modern Britain from the 18th century to the present. Topics include the British state and national identity, the industrial revolution, political and social reform, the status of women, sport and society, Ireland, the British Empire, the World Wars, the welfare state, economic decline. Especially appropriate as background for students planning IQP’s or Sufficiency Projects in London.  
No prior knowledge of British history is required.

HI 2325. MODERN FRANCE.  
Cat. I  
A survey of the socio-economic and political currents that led to the creation of modern France. Some of the topics covered will include: Bourbon absolutism in the formation of France; laissez-faire, bourgeoisie, and enlightenment in the Old Regime; the cause and effect of the French Revolution; the struggle for democratic liberalism in the 19th century; social and ideological conflict in the Third Republic; Vichy fascism, and present-day politics in the Fifth Republic.  
No prior knowledge of French history is required.

HI 2326. RUSSIA FROM PETER THE GREAT TO STALIN.  
Cat. II  
A survey of the history of Tsarist and Soviet Russia from the Reign of Peter I (1689) through the first Five-Year Plan (1928-32). The theory of modernization is used as an analytic tool.  
No prior knowledge of Russian/Soviet history is expected.  
This course will be offered in 2001-02 and in alternate years thereafter. (Formerly HI 3222.)

HI 2327. RUSSIA FROM THE SOVIET PERIOD TO THE PRESENT.  
Cat. II  
A survey of Russian history from Stalin to the present. The historical analysis will illuminate problems faced by the current post-Soviet leaders in such diverse areas as housing and foreign policy.  
No prior knowledge of Soviet history is expected.  
This course will be offered in 2000-01 and in alternate years thereafter. (Formerly HI 3242.)

HI 2328. HISTORY OF REVOLUTIONS IN THE TWENTIETH CENTURY.  
Cat. I  
A survey of the history of revolutions in the present century including those in Russia, China, Cuba, and “7”. The theory of modernization will be used as an analytic tool.  
No prior knowledge of the history of revolutions is expected. (Formerly HI 1242.)
HI 2331. AMERICAN SCIENCE AND TECHNOLOGY TO 1859.  
Cat. I  
A survey, stressing the development of a scientific community, of the content and character of American science (and, to some degree, American technology) from the first European explorations until just before the publication of The Origin of Species. Topics include: medieval science in the new world; the Scientific Revolution and its influence in America; the American Industrial Revolution; the rise of science as a profession; the interplay of science and technology with the state and federal governments. (Formerly HI 3421.)

HI 2332. AMERICAN SCIENCE AND TECHNOLOGY FROM 1859.  
Cat. I  
A survey of the content and character of American science (and, to some degree, American technology and medicine) from the publication of The Origin of Species through the present. Topics include: Darwinism and Social Darwinism in America; scientific agriculture and the federal government; scientific technology and the rise of an industrial society; scientific education and the new universities; positivism and the growth of the physical sciences; the new biology and medicine; conservation, scientific management, the gospel of efficiency and progressivism; science, World War I and the 1920's; the intellectual migration and its influence; science, technology and World War II; Big Science and the Military-Industrial-Scientific Complex; attacks on Big Science. (Formerly HI 3431.)

HI 2333. HISTORY OF SCIENCE FROM 1700.  
Cat. I  
A survey of major developments in science since Newton. Topics may include: 18th century physical science within the context of the Enlightenment; the revolution in biological thought in the 19th century; relativity and the quantum theory; key concepts such as the conservation of energy and the electromagnetic field; the changing structure of the scientific community.  
A knowledge of advanced science is not required but would be advantageous. (Formerly HI 2423.)

HI 2334. EUROPEAN TECHNOLOGICAL DEVELOPMENT.  
Cat. I  
A survey of the development of technology in Europe from the late medieval period to World War I. Emphasis will be placed on understanding the evolution of technology within its cultural, social, and political contexts. Topics may include the military, mechanical, maritime, and building technologies of the medieval and Renaissance periods; the commonly misunderstood figures of Leonardo da Vinci; the causes and nature of the Industrial Revolution; the effects of the British Industrial Revolution in France and Germany in the 19th century; the transition from craft-based industries to those that are science based such as the dyestuffs and electrical power industries; World War I as a technological conflict. (Formerly HI 2113.)

HI 3311. AMERICAN LABOR HISTORY.  
Cat. I  
This seminar course will deal with the history of organized labor in America as well as with the historic contributions of working people, whether unionized or not, to the growth and development of American ideas, politics, culture, and society.  
Among the topics to be covered will be: the origins, growth, and expansion of trade and industrial unionism; the roots and development of working class consciousness; the underlying causes and eventual resolution of labor disturbances; the philosophical and ideological perspectives of the labor movement. Students will explore topics raised by common readings via written papers, seminar presentations, and work with primary source materials.  
Suggested background: HI 2314, American History, 1877-1920; or HI 2315, The Shaping of Post-War America. (Formerly HI 2151.)

HI 3312. TOPICS IN AMERICAN SOCIAL HISTORY.  
Cat. I  
A seminar course on analysis of selected aspects of social organization in American history, with emphasis on the composition and changing societal character of various groups over time, and their relationship to larger social, economic, and political developments. Typical topics include: communities, families, minorities, and women.  
Suggested background: Some college American history. (Formerly HI 3113.)

HI 3314. THE AMERICAN REVOLUTION.  
Cat. I  
This seminar course considers the social, political, and intellectual history of the years surrounding American independence, paying particular attention to the changes in society and ideas that shaped the revolt against Great Britain, the winning of independence, and the creation of new political structures that led to the Constitution.

HI 3321. TOPICS IN MODERN EUROPEAN HISTORY.  
Cat. II  
This seminar course examines topics in the cultural, socio-economic and political history of modern Europe, with a focus on Great Britain. Topics may vary each year among the following: nationalism, class and gender, political economy, environmental history, sport and society, film and history. Readings will include primary and secondary sources.  
This course will be offered in 2001-02 and in alternating years thereafter.

HI 3322. TOPICS IN THE WESTERN INTELLECTUAL TRADITION.  
Cat. II  
This seminar course in the history of ideas examines major intellectual-cultural traditions that have helped define Western Civilization. Students will explore the various approaches that Western thinkers have taken to topics such as religion and secularization, communal and individualistic values, relativism and truth. Students will have many opportunities to develop their skills at critical thinking, analysis, oral and written argument.  
This course will be offered in 2001-02 and in alternating years thereafter.

HI 3324. TOPICS IN THE HISTORY OF THE RUSSIAN REVOLUTIONARY TRADITION.  
Cat. I  
This seminar course studies the Russian Revolutionary tradition and the historical and personal factors that shaped it. Emphases are on shared research, written and oral presentations of one’s ideas, and the value of constructive criticism. Some background in the study of Russian history or European history is suggested.

HI 3331. TOPICS IN SCIENCE, TECHNOLOGY, AND SOCIETY.  
Cat. I  
A seminar course on the relationships among science, technology, and society in Europe through a series of case studies. Topics from which the case studies might be drawn include: the harnessing of science for industrial purposes; the role of the chemical industry in war; the function of the science advisor in government; the military-industrial complex in Nazi Germany; the political views and activities of major scientists such as Einstein. Students will use current theories and critiques of “autonomous technology” to analyze the case studies. Courses in European history and the history of science and technology are suggested as background. (Formerly HI 3444.)

HI 3332. TOPICS IN AMERICAN TECHNOLOGICAL DEVELOPMENT.  
Cat. I  
A seminar course examining selected examples of technological change in the United States. Topics from which these case studies might be chosen include: colonial technology; mechanization of ante-bellum industry; the impact of science on Gilded-Age technology; 20th-century behavioral technologies; the evolution of the military-industrial complex; the Manhattan Project; the exploitation of space; computers and post-World-War-II technology; and the emergence of biotechnology. In addressing these cases, this seminar will employ and seek to evaluate one or more significant historical theses about the nature of technological change.  
Suggested background: Some familiarity with the basic outlines and concerns of both American history and the history of American technology.

HI 3341. TOPICS IN IMPERIAL AND POSTCOLONIAL HISTORY.  
Cat. II  
This seminar course examines topics in the history of European imperialism, colonialism, and the postcolonial aftermath. Topics vary each year among the following: culture and imperialism, the expansion of Europe, the economics of empire, travel and exploration narratives, imperialism in literature and anthropology, decolonization in Asia and Africa, postcolonial studies. Readings will include primary and secondary sources.  
This course will be offered in 2000-01 and in alternating years thereafter.

HI 3342. TOPICS IN COMPARATIVE CIVILIZATIONS.  
Cat. II  
This seminar course compares and contrasts major religious, philosophical, social, and political themes in different civilizations. Comparisons will vary each year but may be drawn from Asia, the Indian subcontinent, the Middle East, Africa, and indigenous cultures of the Americas. It examines the historical foundations of these civilizational differences and draws comparisons with common features of Western civilization. One important goal of the course is to enhance student understanding of and for non-Western values and traditions.  
This course will be offered in 2000-01 and in alternating years thereafter.

IS 1813. AMERICAN HISTORY FOR INTERNATIONAL STUDENTS.  
Cat. I  
An introduction to American history designed to provide international students with a basic understanding of the history and culture of the United States. Written and oral assignments will also help these students gain a more effective command of the English language. (Formerly HI 1101.)
Humanities

The courses listed below are general humanities courses and are intended to provide conceptual introductions to the major disciplines within the humanities. Students will encounter the basic methods of critical analysis and discussion required for the future investigation of the specific area they choose for their humanities and arts Sufficiencies. These courses emphasize patterns of thought, methods of inquiry, appropriate vocabulary, and critical attitudes needed to appreciate fully various areas in the humanities; they are not intended as surveys or historical overviews. Consequently, in each course the subject matter used to develop and illustrate key concepts and approaches will change regularly. Practice in analytic thinking and writing will be a significant part of each course. The skills generated by these courses will greatly aid students in developing their themes and will be essential for the completion of the Sufficiency in the final IS/P seminar.

HU 1411. INTRODUCTION TO AMERICAN STUDIES. 
Cat. II
This interdisciplinary course introduces students to three or four basic American Studies methodologies. Emphasis will vary according to the instructor, but usually the course will cover the following: the particular historical, cultural context (at the community and / or national level) of a few literary texts; the relationship of American art to literature in a specific time period; analysis of popular culture entertainments in market-and-message terms of production and reception. This course provides a beginning for a Sufficiency in American Studies. For a description of the American Studies sequence and offerings, see the Sufficiency section of the Undergraduate Catalog.
Suggested background: an interest in American history and American expression. This course will be offered in 2001-02 and in alternate years thereafter.

HU 1412. INTRODUCTION TO ASIA. 
Cat. I
After an introduction to the enormous literature on China and Japan, the course will focus on the historical development of the ASEAN group (Thailand, Singapore, Malaysia, Indonesia, Philippines, Brunei, and Vietnam). This interdisciplinary course will concentrate on common elements within this very diverse association: colonial residues; similar models of economic development; cultural / religious linkages; influences from China, Japan and the U.S. Especially appropriate for Sufficiencies in Global Studies, U.S. Foreign Policy, British Colonial history and literature, or Religion, and as a background for students planning IQPs in Asia.

HU 2441. AFRICAN HISTORY AND CULTURE. 
Cat. II
This survey course uses an interdisciplinary approach to examine fundamental issues in African political, social, and cultural history. The course may include various topics, such as ancient African kingdoms, the influence of Islam, the Atlantic slave trade, imperialism and decolonization, contemporary democracy, or African literature and art.
Suggested background: HI 1341 Introduction to Global History.
This course will be offered in 2001-02 and in alternate years thereafter.

HU 3411. PRO-SEMINAR IN GLOBAL PERSPECTIVES. 
Cat. II
This course examines the fundamentals of intercultural communication to prepare students to live and work with people from other cultures. It explores how different patterns of thinking and behavior, assumptions and values, have arisen from different cultural traditions and divergent histories in the world. Racism, prejudice, and bigotry—often the result of cultural, social, and technological differences in human experience—are among the concerns of the class. This course cannot teach students how to behave and think in all parts of the world, but it raises questions about ethnocentric assumptions often taken for granted by those working or studying in another culture. It is excellent preparation for an international IQP or educational exchange.
Suggested background: Previous courses in Humanities.
This course will be offered in 2001-02 and in alternating years thereafter.

HU 4411. SENIOR SEMINAR IN INTERNATIONAL STUDIES. 
Cat. I
This course is designed to integrate each student’s international courses, projects, and experiences in a capstone seminar in International Studies. Students will reflect on what they have learned in their previous courses and international experiences. They will assess what happened to them overseas, why it happened, and how it might be understood. They will also prepare a paper with an instructor in their area of international studies that integrates their previous academic courses. Students will also explore how they might translate their courses and experiences into future personal and professional opportunities.
Recommended background: Previous courses in international studies, such as HI 1341 and HU 3411, and completion of an international IQP or an international educational exchange.

HU—AAS-50. AMERICAN ANTIQUARIAN SEMINAR. 
ISP
Each fall the American Antiquarian Society and five Worcester colleges sponsor a research seminar at the Antiquarian Society library. The seminar is conducted by a scholar familiar with the Society’s holdings in early American history, and the seminar topic is related to his or her field of research.
Selection is highly competitive. The ten participating students are chosen by a screening committee made up of representatives of the five participating colleges: Assumption College, Clark University, College of the Holy Cross, WPI, and Worcester State College.
The seminar topic and research methods combine several disciplines, and students from a wide variety of majors have participated successfully in this unique undergraduate opportunity.

Music

MU 1611. FUNDAMENTALS OF MUSIC I. 
Cat. I
This course concentrates on basic music theory of the common practice period. If time permits, instruction includes ear training, sight singing, and work on scales and intervals.
A basic knowledge of reading music is assumed. (Formerly MU 1737.)

MU 2611. FUNDAMENTALS OF MUSIC II. 
Cat. I
Fundamentals II is a course on music theory at the advanced level beginning with secondary dominants and modulations and working through 19th-century chromatic harmony. (Formerly MU 1747.)

MU 2612. MUSIC OF THE MEDIEVAL AND RENAISSANCE PERIODS. 
Cat. II
Music of the medieval church and secular troubadours is studied with special attention given to composers such as Machaut, Despres, Palestrina, Byrd and Gabrieli.
This course will be offered in 2000-01 and in alternate years thereafter. (Formerly MU 2717.)

MU 2613. MUSIC OF THE BAROQUE PERIOD. 
Cat. II
Music is examined from the operas of Monteverdi through the cantatas of Buxtehude, culminating in the works of Bach and Handel.
This course will be offered in 2001-02 and in alternate years thereafter. (Formerly MU 2718.)

MU 2614. MUSIC OF THE CLASSIC PERIOD. 
Cat. II
Music of the classic period concentrates on works by C.P.E. Bach, Haydn, Mozart, and Beethoven.
This course will be offered in 2000-01 and in alternate years thereafter. (Formerly MU 2727.)

MU 2615. MUSIC OF THE ROMANTIC PERIOD. 
Cat. II
Emphasis is on the grandeur and madness of the romantic composers of Europe: Beethoven, Schubert, Berlioz, von Weber, Liszt, Chopin, Brahms, Wagner and Tchaikowsky.
This course will be offered in 2001-02 and in alternate years thereafter. (Formerly MU 2728.)

MU 3611. COMPUTER TECHNIQUES IN MUSIC. 
Cat. I
This course concentrates on both the technical and artistic aspects of computer music. Topics covered include the MIDI protocol and specification, sequencer design, voice editing, synthesizer architecture, and literature.

MU 3612. COMPUTERS AND SYNTHESIZERS IN MUSIC. 
Cat. I
This course focuses on technical and aesthetic problem solving in computer music. Using programming languages, students propose and design creative solutions to contemporary problems which currently have no commercial solutions. Students work with sequencers, signal processors, synthesizers, MIDI controllers, editors, and programming languages.

MU 3613. DIGITAL SOUND DESIGN. 
Cat. I
This course introduces the student to the theory and practice of digital sound design. It focuses on creative problem-solving in applications where digital audio production is a key component. Topics include digital sound recording and editing, creation and synchronization of digital sound tracks for video, theatrical sound design, and multimedia production.
MU 4621. INDEPENDENT INSTRUCTION (LESSONS) IN MUSIC.  
**IS/P**

Students electing to take their humanities and arts Sufficiency in music may, for one of their five courses, undertake 1/3 unit (normally at 1/12 unit per term) of private vocal or instrumental instruction. (Supplemental ensemble work is also strongly recommended.) The student must receive prior approval by a member of the WPI music faculty, and the instruction must be beyond the elementary level. Lessons involve a separate fee. Note that the maximum of 1/3 unit credit for lessons may be earned in addition to 1/3 unit credit for performance (see condition A or B below). Additional work, either in performance or lessons, may be acknowledged on the WPI transcript but will carry no WPI credit. (Formerly MU 3767.) Private lessons: voice, piano, organ, winds, brass, strings, and percussion.

MU—. SEMINARS.  
**IS/P**

Seminars (taken as #4 type IS/P only) are available in a variety of areas such as the following:

- **MU 4623** Introduction to Jazz History  
  Cat. II. This seminar will be offered in 2000-01.
- **MU 4624** Introduction to Jazz Theory  
  Cat. II. This seminar will be offered in 1999-2000.
- **MU 4625** Survey of American Popular Music (Formerly DGW 2444.)  
  Cat. II. This seminar will be offered in 2000-01.
- **MU 4626** Counterpoint: An Introduction (Formerly DPM 3341.)  
  Cat. II. This seminar will be offered in 1999-2000.
- **MU 4627** Music of the Twentieth-Century  
  Cat. II. This seminar will be offered in 1999-2000.

MU 4626. PERFORMANCE SUFFICIENCY.  
**IS/P**

A final (sixth term) Sufficiency in music may be fulfilled by a recital performance in addition to a related paper, provided the music faculty determines that the student’s capabilities be of a high order. During this term, the student usually is under private instruction, the cost of which is borne by the student. **NOTE:** Two 1/3 units credit remain the maximum allowed for all lessons and performance credit.

MU—. ENSEMBLES.  
**IS/P**

One-sixth unit of credit will be awarded at the conclusion of two successive terms of participation. Ensembles currently receiving credit are:

- **Choral**  
  - MU 4631 Men’s Glee Club
  - MU 4632 Women’s Choral
- **Instrumental**  
  - MU 4633 Brass Ensemble
  - MU 4634 Jazz Band
  - MU 4635 Stage Band
  - MU 4636 Concert Band
  - MU 4637 String Ensemble

Credit would be given only under one of the two conditions below:

Condition A  
The performance or experience takes place in a course or ensemble at a college or other institution from which WPI would normally accept transfer credit. The determination of which institutions are acceptable will be made by the WPI Humanities and Arts Department Head in conjunction with the relevant faculty members.

Condition B  
The performance or experience takes place in a WPI ensemble taught by a part- or full-time WPI instructor.

PY 2711. PHILOSOPHICAL THEORIES OF KNOWLEDGE AND REALITY.  

**Cat. I**

This course introduces students to methods of philosophical analysis relating to the classification and conceptualization of entities and the nature of knowledge. The course will focus on a related set of problems or on the elaboration of a philosophical issue of knowledge or reality in the history of philosophy. Among these problems considered might be: How has the being of nature and knowledge of nature been represented in Western philosophy and science? What kind of a phenomenon is mind or thought and can entities in addition to human beings, such as computers, be said to have this attribute? What are reliable methods of arriving at and evaluating scientific knowledge, and are these methods identical for the natural and human sciences? Readings might include excerpts from the works of Plato, Aristotle, Bacon, Descartes, Kant, James, Dewey and Heidegger, as well as numerous contemporary philosophers. Familiarity with basic philosophical concepts and terms (as in PY/RE 1731) is assumed. (Formerly PY 2003.)

PY 2712. SOCIAL AND POLITICAL PHILOSOPHY.  

**Cat. II**

This course examines metaphysical and moral questions that philosophers have raised about social and political life. Among questions treated might be: What are the grounds, if any, of the obligation of a citizen to obey a sovereign? Are there basic principles of justice by which societies, institutions and practices are rightly evaluated? What is democracy, and how can we tell if an institution or practice is democratic? To what degree do economic institutions put limits on the realization of freedom, democracy and self-determination? Readings might include excerpts from the works of Plato, Hobbes, Locke, Rousseau and Marx, as well as numerous contemporary philosophers. Familiarity with basic concepts in philosophy (as in PY/RE 1731) is assumed. (Formerly PY 2500.)

This course will be offered in 2001-02 and in alternative years thereafter.

PY 2713. BIOETICS.  
**Cat. II**

The purpose of this course is to evaluate the social impact of technology in the areas of biology/biotechnology, biomedical engineering and chemistry. The focus of the course will be on the human values in these areas and how they are affected by new technological developments. The course will deal with problems such as human experimentation, behavior control, death, genetic engineering and counseling, abortion, and the allocation of scarce medical resources. These problems will be examined through lectures, discussions and papers. A knowledge of key terms and concepts as given in PY/RE 1731 and PY/RE 2731 is assumed. (Formerly PY 3003.)

This course will be offered in 2001-02 and in alternate years thereafter.

PY 2714. ETHICS AND THE PROFESSIONS: PERSONAL, PROFESSIONAL, AND SOCIAL DILEMMAS.  

**Cat. II**

This course will present a framework by which various ethical dilemmas that arise in the professions, especially the science-related professions, can be identified, examined, and evaluated on the level of personal morality, professional codes of ethics, and social values. The goal is to study the solutions of these dilemmas in each of the three levels to determine what relation there may be between them, and whether or not resolutions of a dilemma on one level are appropriate for another level. Ethical concepts, professional codes of ethics, and policy positions will be used to analyze and evaluate these issues in a case study format. Representatives of appropriate professions will be invited to address specific issues pertaining to ethical dilemmas in their field. This course will be offered in 2000-01 and in alternate years thereafter. (Formerly PY 3103.)

PY 2715. PHILOSOPHICAL THEORIES OF THE SELF.  
**Cat. II**

This course will focus on philosophical questions concerning the nature of human identity. It will examine arguments from various philosophical traditions on topics such as the nature of personhood, self-deception, the importance or unimportance of everyday concerns, the comparative role of individual decisions and social norms, and the differences between secular and religious, Western and Eastern, political and apolitical approaches to all these issues. Authors may include some of the following: Thoreau, Kierkegaard, Hegel, Camus, Buddha, Plato, Marx, Freud and de Beauvoir.

Familiarity with basic ethical concepts and terms (as in PY/RE 1731) is assumed. It will be helpful to have taken at least one of the following: PY/RE 2731 or PY 2712.

This course will be offered in 2001-02 and in alternate years thereafter. (Formerly PY 3400.)
PY 276. PHILOSOPHY OF DIFFERENCE.
Cat. I
This course examines philosophical presuppositions and questions of value underlying and expressed in the construction of masculinity and femininity in modern society. The course may also examine social identities rooted in race, ethnicity, sexual preference, and ability/disability. Possible topics include: changing conceptions of love, sex, marriage, and parenting; how our conceptions of masculinity and femininity are influenced by and influence (for example) religion, science, politics, work, and art; and the relations between feminist theory and other critical social theories. (Formerly HU 2411, Women's Studies: Analysis of Gender in Modern Society; students may not receive credit for both this course and PY 276.)

PY 277. PHILOSOPHY AND THE ENVIRONMENT.
Cat. I
This course will focus on the following questions: What is the scope of the current environmental crisis? What does this crisis reveal about the philosophical presuppositions and dominant values of our intellectual worldviews and social institutions? How can existing social theories help explain the environmental crisis? What implications does the crisis have for our sense of personal identity? What moral and spiritual resources can help us respond to it?

Readings will be taken from contemporary and historical philosophers and naturalists. Familiarity with basic concepts in philosophy (as in PY/RE 1731) is assumed.

PY/RE 2731. INTRODUCTORY ETHICS.
Cat. I
This course will review at an introductory level theories of ethics, individual figures in the history of ethics, and selected problems in ethics. The emphasis will be on philosophical or religious ethics depending on the instructor. (Formerly PY/RE 2122.)

PY 3711. TOPICS IN PHILOSOPHY.
Cat. I
The purpose of this course is to expose students to somewhat more advanced or specialized study in philosophy. Its focus will vary, but will typically be one of the following types: a particular philosopher (e.g., Plato, Kant, Mill); a particular philosophical tradition (e.g., Pragmatism, Ordinary Language philosophy, Empiricism); a particular philosophical problem (free will, knowledge of other minds, historical explanation); or a particular philosophical classic (Hegel's Phenomenology of Mind, Aristotle's Ethics).

It is suggested that students not register for this course until they have taken three other philosophy courses. (Formerly PY 3800.)

PY 3712. PHILOSOPHY OF RELIGION.
Cat. II
This course will focus on philosophical questions concerning the following topics: the existence and nature of God; the compatibility of God and evil; the nature of religious faith and the relationship between religion, science and ethics; interpretations of the nature of religious language; the philosophically interesting differences between Western and Eastern religions; philosophical critiques of the role of religion in social life. Authors may include: Hume, Kant, Kierkegaard, Buber, Tillich, Daly, Nietzsche and Buddha.

Familiarity with basic religious concepts and terms (as in PY/RE 1731) is assumed.

This course will be offered in 2000-01 and in alternate years thereafter. (Formerly PY 3200.)

PY/RE 3731. PROBLEMS IN ETHICS AND SOCIAL PHILOSOPHY.
Cat. I
This course will examine in depth selected problems in ethical theory and social philosophy. The specific content or emphasis will be determined by the instructor.

A knowledge of either PY/RE 2731 or PY 2712 is assumed. (Formerly RE 2323.)
Spanish

SP 1523. ELEMENTARY SPANISH I.
Cat. I
A very intensive course that will introduce the student to the basic grammar of Spanish, emphasizing the four language skills: listening, speaking, reading and writing. It will also introduce the student to different aspects of Hispanic cultures in the U.S. and in Spanish-speaking countries. Students who have taken Spanish in high school are urged to take a placement exam before enrolling in either level of Elementary Spanish. See the instructor.

SP 1524. ELEMENTARY SPANISH II.
Cat. I
A continuation of Elementary Spanish I, which is strongly recommended as background.

SP 2521. INTERMEDIATE SPANISH I.
Cat. I
A course designed to allow students to improve their written and oral skills, expand their vocabulary and review some important grammatical structures. Students will also read short stories and poems by some of the most representative Spanish American and Spanish authors, such as Horacio Quiroga, Jorge Luis Borges, Gabriela Mistral and Ana María Matute.
Recommended background: Elementary Spanish II.

SP 2522. INTERMEDIATE SPANISH II.
Cat. I
A continuation of Intermediate Spanish I, which is strongly recommended as background.

SP 3521. ADVANCED SPANISH I.
Cat. I
A course that continues to improve student’s language skills while deepening their understanding of Hispanic cultures. Some of the topics studied are: the origins of Hispanic cultures in Spain and Spanish America; family; men and women in Hispanic societies; education; religion.
Recommended background: Intermediate Spanish II.

SP 3522. ADVANCED SPANISH II.
Cat. I
A continuation of Advanced Spanish I, which is strongly recommended as background.

SP 3523. TOPICS IN LATIN AMERICAN CULTURE.
Cat. I
An introduction to various aspects of life in Latin American countries from early times to the present. Focusing on the social and political development of Latin America, the course will reveal the unity and diversity that characterize contemporary Latin American culture. Typical topics for study include: the pre columbian civilizations and their cultural legacy; the conquistadores and the colonial period; the independence movements; the search for and the definition of an American identity; the twentieth-century dictatorships; and the move toward democracy.
Recommended background: SP 3521 (Advanced Spanish I) and SP 3522 (Advanced Spanish II) or equivalent.

SP 3524. SPANISH-AMERICAN LITERATURE IN THE TWENTIETH CENTURY.
Cat. I
This course, taught in the Spanish language, focuses on the major literary movements in Spanish America, from the “Modernista” movement at the turn of the century to the Latin American “Boom” of the 1960s to the political literature of the ’70s and ’80s. The work of representative authors, such as Rubén Darío, Julio Cortázar, Rosario Castellanos, Elena Poniatowska, will be discussed.
Recommended background: SP 3521 (Advanced Spanish I) and SP 3522 (Advanced Spanish II) or equivalent.

INTERDISCIPLINARY

ID 1050. INTRODUCTION TO ENTREPRENEURSHIP.
Cat. I
This course is to provide students with the fundamentals of entrepreneurship. It is designed for students interested in starting their own business, or for those interested in leading an entrepreneurial group within an existing business. Topics include: new product development; sources of venture capital; patents and copyrights; market research for new ventures; organization and control for new ventures; management stages in an entrepreneurial business.

ID/SS 2050. SOCIAL SCIENCE RESEARCH FOR THE IQP.
Cat. I
This course is open to students conducting IQPs in the Washington, London, and Puerto Rico off-campus Project Centers, and may count towards their Social Science distribution requirement. The course introduces students to the basic tools for social science research and for economic analysis such as cost-benefit analysis. It provides training in research skills: and topics include: research design, data collection, analysis, writing and presentation. Students learn to develop social science hypotheses based upon literature reviews in their topic areas, construct and administer questionnaires, conduct interviews, analyze data using computerized statistical packages, and make recommendations based upon their findings. Students make presentations, write an organized project proposal as well as develop a written model for reporting their project findings. Examinations will cover the social science text and lecture material, while the project proposal will serve as the term paper.

ID/AR 3150. LIGHT, VISION AND UNDERSTANDING.
Cat. I
By using material from the sciences and the humanities this course examines the ways in which ideas of knowledge and of human nature have been fashioned. The specific topics include physical theories about light, biological and psychological theories of visual perception, and artistic theories and practices concerned with representation. The mixing of material from different academic disciplines is deliberate, and meant to counter the notion that human pursuits are “naturally” arranged in the neat packages found in the modern university. The course draws upon the physical and social sciences, and the humanities, to examine how those fields relate to one another, and how they produce knowledge and self-knowledge. Cultural as well as disciplinary factors are assessed in this process.

Light, Vision and Understanding is conducted as a seminar. The diverse collection of reading materials includes a number of primary texts in different fields. In addition, the students keep a journal in which they record the results of numerous individual observations and experiments concerning light and visual perception. The course can fit into several Sufficiency areas as well as serve as a starting point for an IQP. There are no specific requirements for this course, although some knowledge of college-level physics, as well as an acquaintance with the visual arts, is helpful.

RH 3111. THE STUDY OF WRITING.
Cat. I
This course introduces students to issues in the study of writing such as the history and uses of literacy, the relationship of thought to language, the role of writing in producing knowledge, and research on composing. The focus of the course will be on professional and academic writing. The course will be organized around a series of interrelated research questions: How do writers in professional and academic settings know when they have something to write about? How do they define a problem to investigate? How do they define or construct an audience to address? How do they locate their work in relation to others’ work? How do they know which forms of writing to use? Why do they write in the first place? What functions does writing perform?

RH 3112. RHETORICAL THEORY.
Cat. I
Rhetoric concerns both the art of mastering the available means of persuasion and the study of how oral, written, and visual communication projects the intentions of individuals and groups, makes meanings, and affects audiences. The purpose of this course therefore is two-fold. It is intended to help students become more effective communicators by learning about the rhetorical situation and various rhetorical techniques. And it is designed to help them understand how various forms of communication work by learning some of the strategies of rhetorical analysis.
MG 1100. FINANCIAL ACCOUNTING.

Cat. I
An introduction to the basic concepts of the accounting process and underlying principles. The course covers the basic techniques of analyzing financial transactions, journalizing and posting them, summarizing data on trial balances, and preparation of financial statements. The course seeks to explain the role of accounting within the firm, and to show the distinctive purposes of record-keeping, planning and control. Topics presented include: generally accepted accounting principles, classifications within the balance sheet and operating statement, consolidated financial statements, and an overview of accounting data processing. Upon completion of the course, the student should have acquired a sound understanding of how internal accounting techniques help with the accumulation, classification and interpretation of information which assists firm owners and managers to set and attain goals for the firm.

MG 1250. PERSONAL FINANCE.

Cat. I
This course is designed to help the student make well-informed judgments when faced with personal financial decisions. Such decisions are growing in importance, and the student's degree of financial expertise in order to utilize optimally their limited incomes. Principal topics include: insurance (medical, life, automobile and disability), consumer credit, estate planning, taxation, personal investments (bonds, stocks, etc.), social security legislation and personal financial planning. Recommended background: no background in finance is presupposed or required.

MG 1900. INTRODUCTION TO BUSINESS IN AN INTERNATIONAL ENVIRONMENT.

Cat. I
This course focuses on the operation of a company conducting business in an international environment. It addresses cultural differences and their importance in international trade and in such business functions as operations, human resources, marketing and accounting. MG 1900 is an appropriate course for all WPI students regardless of a major. Students may not receive credit for both MG 1050 and MG 1900.

MG 2101. MANAGEMENT ACCOUNTING.

Cat. I
This course is intended to familiarize the student with the wide variety of ways in which accounting data are used by management as a tool for the attainment of predetermined organizational objectives. The emphasis of the course is on the application of accounting data, rather than on its preparation, and particular attention is given to the use of financial data both in controlling day-to-day activities and planning future operations. Principal topics include: master budgets, cost analysis and classification systems, cost-volume-profit analysis, standard cost accounting and an introduction to capital budgeting. Recommended background: the student should be familiar with the basic principles of financial accounting and fully acquainted with the preparation and interpretation of the fundamental accounting statements (MG 1100 or equivalent).

MG/IE 2200. FINANCIAL MANAGEMENT.

Cat. I
An analysis of the financial decisions of the firm: the questions of what assets to acquire, the level of investment in each asset, the advantages and disadvantages of alternative sources of funds. This course is designed primarily for business and management majors, for whom it is virtually indispensable. All business students should have some familiarity with an area of management as important as finance. This is also a good choice for engineering students who plan to get a graduate degree in business and/or who anticipate becoming involved in management at some stage of their careers. Ideally students should have had introductory accounting and micro- and macroeconomic theory at least at the introductory level. Students will be particularly handicapped if they have not had accounting. Such students will be expected to do outside reading to familiarize themselves with double entry bookkeeping and financial statements. Students without economics should read the chapters in an introductory text dealing with capital theory, the equilibrium of the firm, competition, the money supply and its velocity of circulation, the role of interest rates in determining the level of economic activity. Topics include: financial analysis—ratio analysis of financial statements; accounts receivable management; inventory management; capital budgeting and investment evaluation; cash budgeting and cash management; factors to consider in the overall planning of methods of financing; the cost of capital and its determinants; the alternate sources of short-term financing; trade credit, bank loans, secured loans, etc.; intermediate-term loans; capital markets (an overview); the mechanics of long-term funds; financing with long-term debt; financing with new equity; dividend policy.

MG 2250. FINANCIAL SYSTEM OF THE UNITED STATES.

Cat. II
An analysis of how the financial system of the United States has developed and contributed to the achievement of broad national economic goals as high national income, satisfactory economic growth, stable prices, and equilibrium in balance of payments with other countries. Emphasis is placed on the theory of the supply and demand for short-term money and long-term capital, and the resultant effect on interest rates.

Primary concentration on the sources and uses of funds of the major non-bank financial institutions, such as insurance companies, pension funds, mutual funds, finance companies, savings and loan banks and mutual savings banks. A discussion of the role of financial institutions, and of money and capital markets to more efficiently allocate the scarce resources of the country.

This course is intended to serve the business major and other students interested in understanding the role of financial intermediaries in the United States economy. Some knowledge of accounting and economics will be helpful in taking this course.

This course will be offered in 2000-01 and in alternate years thereafter.

MG 2260. INVESTMENT AND SECURITY ANALYSIS.

Cat. I
This course is designed to provide an introduction to the language and methodology of security analysis. It is intended to serve two different groups of students: those interested in the subject from the viewpoint of intelligent management of their own portfolios, and those students who have a possible career interest in some facet of the securities industry. Principal topics include: institutional structure and language of the securities market; investment research; alternative investment opportunities; financial statement analysis; fundamental evaluation of common stocks; preferred stocks and bonds; technical analysis; and business cycle analysis.

Recommended background: although no specific background is presupposed or required, a knowledge of elementary macroeconomic theory and financial accounting is of a great value to the student.

MG/IE 2300. ORGANIZATIONAL SCIENCE—FOUNDATION.

Cat. I
This first course in organizational science provides the foundation for an understanding of organization and management. It is a survey of the social science of work, describing the basic knowledge and processes required of managers, including: motivation, communication, supervision, managerial control, leadership, the group processes of decision making, conflict, labor relations, management development, work and organizational design, and reconciliation of the goals of individuals and organizations. Lecture, video presentation, group discussion and group mini-projects will be employed to introduce and illustrate the basic elements of management.

MG/IE 2500. MANAGEMENT SCIENCE I: DETERMINISTIC DECISION MODELS.

Cat. I
This course is designed to provide an introduction to a variety of tools and techniques found useful by modern industrial engineers, operations researchers and managers. They are oriented toward the creation and use of mathematical models to aid in managerial decision making in business and other organizations.

The models discussed in this course deal with deterministic decision-making problems where there are constraints on available actions. Discussion centers on "classical" methods of optimization and basic methods of linear programming. It is hoped that the student will develop an ability to recognize situations in which a given technique is appropriate. The conference portion will be devoted to student participation in studies of actual situations, where the student will analyze existing procedures, set up and solve the model, and provide a critique of his or her (and others') studies.

The mathematical techniques used are introduced and developed to the extent needed. The student is not required to have prior familiarity with these subjects, although knowledge of basic calculus is presupposed.

MG 2710. BUSINESS APPLICATION PLATFORMS.

Cat. I
This course provides an introduction to business computer hardware architectures and their operating systems. It enables students to assess the capabilities of different computer architectures for effective use in a business environment and to allow coherent development of an efficient business computing infrastructure. The course covers the basic components of different microcomputer platforms for use as personal workstations and information servers in a connected environment of networks: CPUs, memory, busses, peripheral devices: disks, displays, device controllers; basic network components: network adaptors, switches, and media; and operating systems. The course includes a laboratory for hands-on design and application such as configuring and installing workstations, servers, and small local area networks.

Recommended background: CS 1005 or ability to program in a higher level programming language.
MG/IE 3410. CASE STUDIES IN INDUSTRIAL ENGINEERING.
Cat. I
A number of in-depth case studies in Industrial Engineering and Operations Research are analyzed. The cases will cover both manufacturing and service systems ranging from production system design to operations planning and control. Specific topics may include: technology selection and replacement, facilities planning, production planning and control, quality control.
Familiarity with basic material from the methods courses MG/IE 3400, MG/IE 3401, MG/IE 2500 and MG/IE 3501 is assumed.

MG/IE 3420. QUALITY PLANNING, DESIGN AND CONTROL.
Cat. I
This course focuses on the quality aspects of product design and manufacturing. Topics include: Total Quality Management, Poka-yoke systems, Statistical Process Control, Capability Studies, Quality Loss Function, and Design of Experiments (Taguchi Methods).
This course is intended for both industrial and systems engineering (MGE) and product engineering (MFE, EE, ME, CE) students. A knowledge of differential and integral calculus is assumed. More importantly, the ability to think quantitatively is strongly desirable.
Recommended background: MG/IE 3400 and MA 2612 or consent of the instructor.

MG/IE 3430. WORK SYSTEMS AND FACILITIES PLANNING.
Cat. I
An introduction to the planning and control of production systems. Designed for students in engineering or management who may wish to assume managerial roles. Intended primarily for third- and fourth-year students. A knowledge of differential and integral calculus is assumed. More importantly, the ability to think quantitatively is strongly desirable.
Recommended background: CS 1005 or ability to program in a high level programming language.

MG/IE 3450. HUMAN FACTORS ENGINEERING.
Cat. I
This course examines the human-machine interface in the workplace, concentrating on how workplace design can influence effectiveness and enhance health, safety, and satisfaction. Human sensory, motor, and decision systems are studied, as well as principles for designing visual and auditory displays, control devices and tools, and work spaces. Problems with repetitive and high physical effort tasks, illumination, noise, and atmospheric conditions, along with relevant governmental regulations, are also considered.
Recommended background: none.

MG/IE 3501. MANAGEMENT SCIENCE II: RISK ANALYSIS.
Cat. I
This course provides coverage in decision analysis. Decision analysis is a technology that assists decision makers in quantifying consideration of complexity and uncertainty in problems of choice. The course applies decision analysis to problems in risk assessment and risk evaluation. Decision making in risk analysis is examined across a wide set of management engineering problems including case studies in environmental risk, product liability, facilities design, and R and D management. The course is intended to be highly integrative with respect to risk analysis including issues such as business ethics and risk communication.
While the course is self contained, a knowledge of calculus and introductory probability and statistics is preferred.

MG 2720. BUSINESS APPLICATION DEVELOPMENT TOOLS.
Cat. I
This course introduces students to the concepts and principles of visual, object-oriented techniques for the development of business applications. Students will use commercial, computer-based development tools and rapid development and prototyping techniques for the design of small business applications for such areas as customer tracking, order processing, and financial analysis.
Recommended background: CS 1005 or ability to program in a high level programming language.

MG/IE 2850. ENGINEERING ECONOMICS.
Cat. I
To aid all engineering students in understanding economics and business constraints on engineering decision making.
Topics include economic evaluation of alternative; the six time-value-of-money factors; present worth, annual cash flow and rate-of-return analysis; incremental analysis; depreciation and income taxes; replacement analysis; inflation; handling probabilistic events; public economy; break-even and minimum cost points.
Recommended background: basic understanding of economic principles; fourth (or third) year standing in an engineering curriculum or similar interest in engineering design or other technical decision making.

MG 2950. BUSINESS LAW AND ETHICS.
Cat. I
Imparts an understanding of how the legal system, especially the regulatory system, works. Specific topics such as consumer protection, investor protection, environmental law, anti-trust law and management-law are covered in detail. Numerous actual court cases are used to illustrate the regulatory system of the business environment. Specific fact problems will be discussed throughout the course to develop the notion that managerial philosophy should be broadened to include moral, social, ethical and human aspects of business activities.

MG/IE 3351. ORGANIZATIONAL SCIENCE—MANAGEMENT OF CHANGE.
Cat. I
This second course in organizational science provides experience in analyzing and applying the theories of leadership, motivation, conflict management and the management of planned change. The thrust of the course is the examination of managerial theories to determine appropriate approaches to their use. The course is conducted as a seminar and workshop and concentrates on the problems experienced in the workplace.
Recommended background is MG/IE 2300 or agreement of the professor.

MG/IE 3400. PRODUCTION SYSTEM DESIGN.
Cat. I
An introduction to the planning, analysis and design of production systems. Designed for students in engineering or management who may wish to assume responsibilities in the production of goods or services.
Topics to be covered will include: microscopic and macroscopic analysis of the production process, facilities location and arrangement, resource allocation and optimization of the use of facilities, work measurement and economic evaluation of alternatives.
A knowledge of differential and integral calculus is assumed. More importantly, knowledge of basic statistics and the ability to think quantitatively are desirable. Intended primarily for third- and fourth-year students. Students in engineering curricula are encouraged to enroll.

MG/IE 3401. PRODUCTION PLANNING AND CONTROL.
Cat. I
An introduction to the planning and control of production systems. This course complements MG 3400 and may precede or follow it.
Topics include: forecasting, scheduling, and production and inventory control maintenance, and quality control.
A knowledge of differential and integral calculus is assumed. Some knowledge of probability and statistics is helpful but not mandatory.

MG/IE 3405. WORK SYSTEMS AND FACILITIES PLANNING.
Cat. I
This course covers the fundamentals of developing efficient layouts for production and service facilities, as well as analysis of location and distribution configurations. Methods analysis, work measurement, material handling and material flow analysis are also covered. Mathematical models and computer tools are used to assist decision-making.
Recommended background: MG/IE 2500 and MG/IE 3400.

MG/IE 3410. CASE STUDIES IN INDUSTRIAL ENGINEERING.
Cat. I
This course introduces students to the management of information technology within complex organizations. It covers the range of information technologies employed by business organizations and the manner in which they are deployed. The course places special emphasis on the management of information resources from a user and manager point of view and will help students understand how particular technological arrangements can facilitate achievement of organizational goals. The impact of information technology on management control, organizational structure, individual workers, relationships between organizations, and business transformational will be discussed. Students may not receive credit for both MG 2700 and MG 3700.
Recommended background: MG 2101 and MG 2200 or equivalent business background.
MG 3720. BUSINESS DATA MANAGEMENT.
Cat. I
This course introduces students to the theory and practice of database management and the application of database software to implement business information systems which support managerial and operational decision making. Special topics covered include relational and hierarchical datamodels, query languages, normalization, locking, concurrency control and recovery. The course covers data administration and the design of data tables for computerized databases. Students will use a commercial database package to design and implement a small business database application. Students may not receive credit for both MG 4700 and MG 3720.
Recommended background: MG 2720 or equivalent knowledge.

MG 3740. ORGANIZATIONAL APPLICATIONS OF TELECOMMUNICATIONS.
Cat. II
Students taking this course will develop an understanding of how organizations can effectively use telecommunications technology to enhance business functionality. Students will analyze the development of organizational communications infrastructures and their use for the development of “virtual” organizational structures and to support globally-distributed organizations. The course will begin with a survey of the concepts and technologies which form the basis of a business telecommunications system and which allow the merging of voice, data and video in an integrated multimedia communications structure. Students may not receive credit for both MG 4701 and MG 3740.
Recommended background: MG 2710 and MG 3700.
This course will be offered in 2000-01 and in alternating years thereafter.
Students may not receive credit for both MG/IE 3740 and MG 3740.

MG/IE 3760. SIMULATION MODELING AND ANALYSIS.
Cat. I
This course covers the application of simulation to a variety of managerial problems with examples from operations management, industrial engineering, and manufacturing engineering. It introduces the student to the concepts of computer simulation, with an emphasis on the design of a simulation experiment and statistical interpretation of its results. It will discuss simulation of queuing models, inventory and industrial dynamics, and gaming situations. The role and use of computers for the execution of simulations will also be highlighted.

A commercial simulation language such as SIMAN will be used to solve problems from the manufacturing and service industries. Recommended background: computer programming and statistics (as in MA 2612 or MA 3619).

MG 3800/SS 3111. MANAGERIAL ECONOMICS.
Cat. I
An application of economic theory to the problems of the firm with special emphasis on decision-making. A study of how the firm manipulates such variables as output, price, advertising and product quality so as to achieve its goals; and of how its pricing and selling strategy choices are affected by considerations of the reactions of rival firms.

Also covered are demand forecasting and cost analysis using regression and other techniques. A knowledge of the expected future distribution of demand for individual goods and services and their costs of production is vital in establishing national economic policies and priorities. In demand and cost analysis, there is an interface between economics and technology. Consequently, this area provides a source of interactive projects that will enable students of engineering or science to draw on knowledge of their own discipline as well as economics in analyzing important social problems.

Students taking this course should be familiar with the material covered in SS 1110, Introductory Microeconomics.

MG 3960. SMALL BUSINESS MANAGEMENT.
Cat. I
This course addresses itself to the practical problems of starting and managing a small business for profit.

It focuses on the planning required to buy an existing business or to start a small business from the ground up and develop it into a profitable on-going concern. The course uses the case method giving the student an opportunity to apply and integrate the knowledge previously acquired in such areas as accounting, finance, marketing, production, engineering and business management.

MG 4151. COST ACCOUNTING.
Cat. II
This course is designed to give basic understanding and skill in the area of cost accumulation to anyone concerned with recording the expenses associated with a given activity or project.

Cost accounting provides data for three major purposes: 1) planning and controlling routine operations; 2) making non-routine decisions, and 3) inventory valuation and income determination. All three are important, but the course stresses the first two as they relate to project activity.

The goal of the course is to put cost accounting in focus as a highly useful technique in any decision-making situation where expense levels are important. While some attention is directed toward accounting systems and procedures for data accumulation, stress is given to the theme that cost accounting is a vital and dynamic tool for problem-solving.

Because of the technical nature of the subject, students should have mastered the material of MG 1100, Financial Accounting, in order to be able to comprehend the concepts and techniques of cost accounting procedures.

This course will be offered in 2001-02 and in alternate years thereafter.

MG 4364. HUMAN RESOURCE MANAGEMENT.
Cat. II
This undergraduate/graduate course in applied organizational sciences introduces concepts and techniques of human resource management. It provides experience in the solution of a variety of human resource problems through classroom exercises and organizational cases, introducing and building upon the basic concepts and techniques of industrial and organizational psychology. The course focuses on changing labor markets, employee recruitment and selection, performance appraisal and compensation, job evaluation, training and development, job design, labor relations, diversity and gender issues in the workplace, government involvement in human resource issues, job satisfaction, and motivation to work.

Recommended background: MG/IE 2300 (or agreement of the professor).
This course will be offered in 2001-02 and in alternate years thereafter.

MG 4365. LEADERSHIP IN GROUPS AND ORGANIZATIONS.
Cat. II
This undergraduate/graduate course considers the essence of leadership in groups and organizations. Specifically, it examines the personal, interpersonal, group, and contextual factors which affect formal and emergent leadership in groups and organizations. It also examines the effectiveness of various leadership approaches and styles under various conditions. Using case studies, simulations, group projects, and selected readings on leadership in groups and organizations, this course will give students an opportunity to assess and develop their own leadership talents. Recommended background: MG/IE 2300 (or agreement of the professor).
This course will be offered in 2001-02 and in alternate years thereafter.

MG/IE 4460. GLOBAL PLANNING AND LOGISTICS.
Cat. II
This case-based course will examine methods and strategies for managing and controlling material movement, with particular emphasis on international operations, from the purchase of production materials to the control of work in process to the distribution of the finished product. Strategies that will be discussed include the design of international distribution networks, the use of third-party logistics providers, and the creation of links between logistic systems and marketing to create competitive advantage. The course will also explore critical issues that must be addressed in pursuit of a logistics strategy successfully, including choices regarding means of transportation, packaging, and inventory policies. Underlying themes of the course will be the use of information technologies (such as electronic data interchange and bar coding) and mathematical models to support logistics decision-making.
Recommended background: MG/IE 3400, MG/IE 2200 or MG/IE 2850.
This course will be offered in 2001-02 and in alternate years thereafter.

MG/IE 4720. SYSTEMS ANALYSIS AND DESIGN.
Cat. I
This course integrates students' background in MIS in a one-term project focusing on development of creative solutions to open-ended business and manufacturing problems. The project will utilize systems analysis and design tools such as systems development life cycle, feasibility study, cost-benefit analysis, structured analysis and design. Students will acquire the skills necessary to analyze, design, implement, and document real-life information systems. Students must be able to organize themselves and the project to complete their work within a seven week term. It is recommended that MIS majors take this course in preparation for their MQP. Students may not receive credit for both MG 3750 and MG 4720.
Recommended background: MG 3720.
MG 4750. MANAGEMENT OF THE IS FUNCTION.  
Cat. II  
This course integrates students' background in management policy and business analysis and addresses the practical problems of developing and running an IS organization. It focuses on the planning and management required to assure systems performance and monitoring, systems reliability and quality change management, backup and recovery, security, new technology assessment and implementation, staffing and staff development. Through case studies and mini-projects students will analyze existing structures in industry IS organizations. Recommended background: MG 3700.

This course will be offered in 2001-02 and in alternating years thereafter.

IS4-MG SEMINAR*:  
Current developments in management seminars will be organized periodically and announced in the Undergraduate Catalog. No more than 1/3 credit will be available for this type #4 IS/P.

*Initials of instructors in charge will appear in Undergraduate Catalog in addition to a description of seminar to be offered.

MATHEMATICAL SCIENCES

The second digit in mathematical sciences course numbers is coded as follows:

0 — Basic  
2 — Applied mathematics (general)  
4 — Applied mathematics (differential equations)  
6 — Statistics and probability  
8 — Mathematics (general)

MA 1020. CALCULUS I WITH PRELIMINARY TOPICS.  
Cat. I (14-week course)  
This course includes the topics of MA 1021 and also presents selected topics from algebra, trigonometry, and analytic geometry.  
This course, which extends for 14 weeks and offers 1/3 unit of credit, is designed for students whose precalculus mathematics is not adequate for MA 1021. Although the course will make use of computers, no programming experience is assumed.

MA 1021. CALCULUS I.  
Cat. I  
This course provides an introduction to differentiation and its applications.  
Topics covered include: functions and their graphs, limits, continuity, differentiation, linear approximation, chain rule, min/max problems, and applications of derivatives.  
Recommended background: Algebra, trigonometry and analytic geometry.  
Although the course will make use of computers, no programming experience is assumed.

MA 1022. CALCULUS II.  
Cat. I  
This course provides an introduction to integration and its applications.  
Topics covered include: inverse trigonometric functions, Riemann sums, fundamental theorem of calculus, basic techniques of integration, volumes of revolution, arc length, exponential and logarithmic functions, and applications.  
Recommended background: MA 1021. Although the course will make use of computers, no programming experience is assumed.

MA 1023. CALCULUS III.  
Cat. I  
This course provides an introduction to series, parametric curves and vector algebra.  
Topics covered include: numerical methods, indeterminate forms, improper integrals, sequences, Taylor’s theorem with remainder, convergence of series and power series, polar coordinates, parametric curves and vector algebra.  
Recommended background: MA 1022. Although the course will make use of computers, no programming experience is assumed.

MA 1024. CALCULUS IV.  
Cat. I  
This course provides an introduction to multivariable calculus.  
Topics covered include: vector functions, partial derivatives and gradient, multivariable optimization, double and triple integrals, polar coordinates, other coordinate systems and applications.  
Recommended background: MA 1023. Although the course will make use of computers, no programming experience is assumed.

MA 2051. ORDINARY DIFFERENTIAL EQUATIONS.  
Cat. I  
This course develops techniques for solving ordinary differential equations.  
Topics covered include: introduction to modeling using first-order differential equations, solution methods for linear higher-order equations, qualitative behavior of nonlinear first-order equations, oscillatory phenomena including spring-mass system and RLC-circuits and Laplace transform. Additional topics may be chosen from power series method, methods for solving systems of equations and numerical methods for solving ordinary differential equations.  
Recommended background: MA 1024.

MA 2071. MATRICES AND LINEAR ALGEBRA I.  
Cat. I  
This course provides a study of computational techniques of matrix algebra and an introduction to vector spaces.  
Topics covered include: matrix algebra, systems of linear equations, eigenvectors and eigenvalues and eigenvectors, least squares, vector spaces, inner products, and introduction to numerical techniques, and applications of linear algebra.  
Recommended background: MA 1022.

MA 2073. MATRICES AND LINEAR ALGEBRA II.  
Cat. I  
This course provides a deeper understanding of topics introduced in MA 2071 and also continues the development of those topics. Topics covered include: abstract vector spaces, linear transformations, matrix representations of a linear transformation, characteristics and minimal polynomials, diagonalization, eigenvalues and eigenvectors, inner product spaces.  
This course is designed primarily for Mathematical Science majors and those interested in the deeper mathematical issues underlying linear algebra.  
Undergraduate credit may not be earned both for this course and for MA 3071.  
Recommended background: MA 2071.

MA 2201/CS 2202. DISCRETE MATHEMATICS.  
Cat. I  
This course serves as an introduction to some of the more important concepts, techniques, and structures of discrete mathematics providing a bridge between computer science and mathematics.  
Topics include functions and relations, sets, countability, groups, graphs, propositional and predicate calculus, and permutations and combinations.  
Students will be expected to develop simple proofs for problems drawn primarily from computer science and applied mathematics.  
Intended audience: computer science and mathematical sciences majors.  
Recommended background: None.

MA 2210. MATHEMATICAL METHODS IN DECISION MAKING.  
Cat. I  
This course introduces students to the principles of decision theory as applied to the planning, design and management of complex projects. It will be useful to students in all areas of engineering, actuarial mathematics as well as those in such interdisciplinary areas as environmental studies. It emphasizes quantitative, analytic approaches to decision making using the tools of applied mathematics, operations research, probability and computations. Topics covered include: the systems approach, mathematical modeling, optimization and decision analyses. Case studies from various areas of engineering or actuarial mathematics are used to illustrate applications of the materials covered in this course.  
Recommended background: MA 1024. Suggested background: Familiarity with vectors and matrices. Although the course makes use of computers, no programming experience is assumed. Students who have received credit for CE 2010 may not receive credit for MA 2210.

MA 2251. VECTOR AND TENSOR CALCULUS FOR ENGINEERS.  
Cat. I  
This course introduces the student to vector and tensor calculus.  
Topics covered include: scalar and vector functions and fields, tensors, basic differential operations for vectors and tensors, line and surface integrals, change of variable theorem in integration, integral theorems of vector and tensor calculus. The theory will be illustrated by applications to areas such as electromestatics, theory of heat, electromagnetics, elasticity and fluid mechanics.  
Recommended background: MA 1024.
MA 2631. PROBABILITY.
Cat. I
This course introduces the concepts and techniques of graph theory—a part of mathematics with applications to diverse areas such as management, computer science and electrical engineering. Topics covered include: graphs and digraphs, paths and circuits, graph and digraph algorithms, trees, cliques, planarity, duality and colorability.

This course is designed primarily for Mathematical Sciences majors and those interested in the deeper mathematical issues underlying graph theory.

Undergraduate credit may not be earned both for this course and for MA 3271.
Recommended background: MA 2071. This course will be offered in 2000-01 and in alternate years thereafter.

MA 2273. COMBINATORICS.
Cat. II
This course introduces the concepts and techniques of combinatorics—a part of mathematics with applications in computer science and in the social, biological, and physical sciences. Emphasis will be given to problem solving. Topics will be selected from: basic counting methods, inclusion-exclusion principle, generating functions, recurrence relations, systems of distinct representatives, combinatorial designs, combinatorial algorithms and applications of combinatorics.

This course is designed primarily for Mathematical Sciences majors and those interested in the deeper mathematical issues underlying combinatorics.

Undergraduate credit may not be earned both for this course and for MA 3273.
Recommended background: MA 2071. This course will be offered in 2001-02 and in alternate years thereafter.

MA 2431. MATHEMATICAL MODELING WITH ORDINARY DIFFERENTIAL EQUATIONS.
Cat. I
This course focuses on the theoretical foundations of ordinary equations while building models for physical and biological systems. Mathematical topics may include methods for solving systems of ordinary differential equations, existence and uniqueness theory, stability theory, phase-plane analysis and limit cycles. Examples will be chosen from electrical and mechanical oscillations, control theory, ecological models and reaction kinetics. Students will learn how to turn a real-life physical or biological problem into a mathematical one and to interpret the mathematical results.

This course is designed primarily for Mathematical Sciences majors and those interested in the deeper mathematical issues underlying mathematical modeling.

Undergraduate credit may not be earned both for this course and for MA 3431.
Recommended background: MA 1024, MA 2051 and MA 2071.

MA 2611. APPLIED STATISTICS I.
Cat. I
This course is designed to introduce the student to data analytic and applied statistical methods commonly used in industrial and scientific applications as well as in course and project work at WPI. Emphasis will be on the practical aspects of statistics with students analyzing real data sets on an interactive computer package.

Topics covered include analytic and graphical representation of data, introduction to least squares, discrete and continuous probability models, the central limit theorem, elementary sampling theory, point and interval estimation, and one sample hypothesis tests of means including p-values and significance levels.

Recommended background: MA 1022.

MA 2612. APPLIED STATISTICS II.
Cat. I
This course is a continuation of MA 2611.

Topics covered include tests of hypotheses, chi-square tests, regression analysis, survey sampling, and design and analysis of one factor experiments and, as time allows, of multifactor experiments.

Recommended background: MA 2611.

MA 2631. PROBABILITY.
Cat. I
The purpose of this course is twofold:
- To introduce the student to probability. Topics to be covered will be chosen from: axiomatic development of probability; independence; Bayes theorem; discrete and continuous random variables; expectation; special distributions including the binomial and normal; moment generating functions; multivariable distributions; conditional and marginal distributions; independence of random variables; transformations of random variables; limit theorems.
- To introduce fundamental ideas and methods of mathematics using the study of probability as the vehicle. These ideas and methods may include systematic theorem-proof development starting with basic axioms; mathematical induction; set theory; applications of univariate and multivariate calculus.

This course is designed primarily for Mathematical Sciences majors and those interested in the deeper mathematical issues underlying probability theory.

Undergraduate credit may not be earned both for this course and for MA 3613.

MA 3211. ACTUARIAL MATHEMATICS I.
Cat. I
An introduction to actuarial mathematics is provided for those who may be interested in the actuarial profession.

Topics usually included are: measurement of interest, including accumulated and present value factors; annuities certain; amortization schedules and sinking funds; and bonds.

Recommended background: MA 2051 and the ability to write computer programs.

MA 3212. ACTUARIAL MATHEMATICS II.
Cat. I
A continuation of a study of actuarial mathematics with emphasis on the theory and application of contingency mathematics in the areas of life insurance and annuities.

Topics usually included are: survival functions and life tables; life insurance; life annuities; net premiums; and premium reserves.

Recommended background: MA 3211 and MA 3613.

MA 3231. LINEAR PROGRAMMING.
Cat. I
This course considers the formulation of real-world optimization problems as linear programs, the most important algorithms for their solution, and techniques for their analysis.

Topics covered include: the primal and dual simplex algorithms, duality theory, parametric analysis, network flow models and, as time permits, bounded variable linear programs or interior methods.

Undergraduate credit may not be earned both for this course and for MA 4231.
Recommended background: MA 2071.

MA 3233. DISCRETE OPTIMIZATION.
Cat. II
Discrete optimization is a lively field of applied mathematics in which techniques from combinatorics, linear programming, and the theory of algorithms are used to solve optimization problems over discrete structures, such as networks or graphs.

The course will emphasize algorithmic solutions to general problems, their complexity, and their application to real-world problems drawn from such areas as VLSI design, telecommunications, airline crew scheduling, and product distribution.

Topics will be selected from: Network flow, optimal matching, integrality of polyhedra, matroids, and NP-completeness.

Undergraduate credit may not be earned both for this course and for MA 4233.
Recommended background: At least one of MA 2271, MA 2273 or MA 3231.

This course will be offered in 2000-01 and in alternate years thereafter.

MA 3255/CS 4031. NUMERICAL ANALYSIS I.
Cat. I
Topics covered include: solution of nonlinear equations, finding roots of polynomials, interpolation and polynomial approximation, approximation theory, numerical differentiation and integration. Numerical linear algebra and numerical solution of differential equations will not be studied: see MA 4255 and MA 4411 for these materials.

Recommended background: MA 2051 or MA 2071 and the ability to write programs in a scientific language. Computer programming will be necessary to utilize existing scientific subroutines for case studies but the details of programming will not be emphasized.

MA 3471. ADVANCED ORDINARY DIFFERENTIAL EQUATIONS.
Cat. II
The first part of the course will cover existence and uniqueness of solutions, continuous dependence of solutions on parameters and initial conditions, maximal interval of existence of solutions, Gronwall’s inequality, linear systems and the variation of constants formula, Floquet theory, stability of linear and perturbed linear systems. The second part of the course will cover material selected by the instructor. Possible topics include: Introduction to dynamical systems, stability by Lyapunov’s direct method, study of periodic solutions, singular perturbation theory and nonlinear oscillation theory.

Undergraduate credit may not be earned both for this course and for MA 4471.
Recommended background: MA 3431 and MA 3832.

This course will be offered in 2000-01 and in alternate years thereafter.

MA 3475. CALCULUS OF VARIATIONS.
Cat. II
This course covers the calculus of variations and select topics from optimal control theory. The purpose of the course is to expose students to mathematical concepts and techniques needed to handle various problems of design encountered in many fields, e.g., electrical engineering, structural mechanics and manufacturing.

Topics covered will include: derivation of the necessary conditions of a minimum for simple variational problems and problems with constraints, variational principles of mechanics and physics, direct methods of minimization of functions, Pontryagin’s maximum principle in the theory of optimal control and elements of dynamic programming.

Undergraduate credit may not be earned both for this course and for MA 4475.
Recommended background: MA 2051 and MA 4451.

This course will be offered in 2000-01 and alternate years thereafter.
MA 3613. PROBABILITY FOR APPLICATIONS.

Cat. I
This course is designed to introduce the student to probability.
Topics to be covered are: basic probability theory including Bayes' theorem; discrete and continuous random variables; special distributions including the Bernoulli, Binomial, Geometric, Poisson, Uniform, Normal, Exponential, Chi-square, Gamma, Weibull, and Beta distributions; multivariate distributions; conditional and marginal distributions; independence; expectation; transformations of univariate random variables.
Recommended background: MA 1024.

MA 3619. INTERMEDIATE REGRESSION, ANALYSIS OF VARIANCE AND EXPERIMENTAL DESIGN.

Cat. II
This course extends the student's knowledge of multiple regression, ANOVA and experimental design beyond the level of MA 2612. The matrix formulation of the general linear model and its applications to multiple regression will be discussed. Other topics include diagnostics and remedial measures, regression model building methods, blocking in experimental design, nested designs, repeated measures, split plot, Latin square designs, and crossover designs. Special emphasis will be given to fitting models to real data sets using statistical software.
Recommended background: MA 2071 and MA 2612.
This course will be offered in 2000-01 and in alternate years thereafter.

MA 3625. TOPICS IN STATISTICS AND PROBABILITY.

Cat. II
This course covers one or more selected topics from such subjects as time series analysis, nonparametric and robust methods, decision theory, Bayesian inference, survival analysis, categorical data analysis, modern data analysis, and statistical computing and simulation.
Statistical software will be used wherever appropriate.
Recommended background: MA 2612.
This course will be offered in 2001-02 and in alternate years thereafter.

MA 3823. GROUP THEORY.

Cat. II
This course provides an introduction to one of the major areas of modern algebra. Topics covered include: groups, subgroups, permutation groups, normal subgroups, factor groups, homomorphisms, isomorphisms and the fundamental homomorphism theorem. Recommended background: MA 2073.
This course will be offered in 2000-01 and in alternate years thereafter.
Undergraduate credit may not be earned both for this course and for MA 3821.

MA 3825. RINGS AND FIELDS.

Cat. II
This course provides an introduction to one of the major areas of modern algebra. Topics covered include: rings, integral domains, ideals, quotient rings, ring homomorphisms, polynomial rings, polynomial factorization, extension fields and properties of finite fields. Recommended background: MA 2073.
This course will be offered in 2001-02 and in alternate years thereafter.
Undergraduate credit may not be earned both for this course and for MA 3821.

MA 3831. ADVANCED CALCULUS I.

Cat. I
Advanced Calculus is a two-part course giving a rigorous presentation of the important concepts of classical real analysis.
Topics covered in the two-course sequence include: basic set theory, elementary topology of Euclidean spaces, limits and continuity, differentiation Reimann-Stieltjes integration, infinite series, sequences of functions, and topics in multivariable calculus.
Recommended background: MA 2051 and MA 2071.

MA 3832. ADVANCED CALCULUS II.

Cat. I
MA 3832 is a continuation of MA 3831.
For the contents of this course, see the description given for MA 3831.
Recommended background: MA 3831.

MA 4213. RISK THEORY.

Cat. II
This course covers topics in risk theory as it is applied, under specified assumptions, to insurance.
Topics covered include: economics of insurance, short term individual risk models, single period and extended period collective risk models, and applications.
Recommended background: MA 3212.
This course will be offered in 2001-02 and in alternate years thereafter.

MA 4214. SURVIVAL MODELS.

Cat. II
This course introduces the nature and properties of survival models and techniques for life table construction are considered.
Topics covered include: parametric and tabular models, estimation techniques for both model types from both complete and incomplete data samples. For tabular models the actuarial, moment, and maximum likelihood estimation techniques will be discussed. Parametric models with concomitant variables will be introduced.
Recommended background: MA 3212.
This course will be given in 2000-01 and alternate years thereafter.

MA 4235. MATHEMATICAL OPTIMIZATION.

Cat. II
This course explores theoretical conditions for the existence of solutions and effective computational procedures to find these solutions for optimization problems involving nonlinear functions.
Topics covered include: classical optimization techniques, Lagrange multipliers and Kuhn-Tucker theory, duality in nonlinear programming, and algorithms for constrained and unconstrained problems.
Recommended background: Vector calculus at the level of MA 3251.
This course will be offered in 2001-02 and in alternate years thereafter.

MA 4237. PROBABILISTIC METHODS IN OPERATIONS RESEARCH.

Cat. II
This course develops probabilistic methods useful to planners and decision makers in such areas as strategic planning, service facilities design, and failure of complex systems.
Topics covered include: decisions theory, inventory theory, queuing theory, reliability theory, and simulation.
Recommended background: Probability theory at the level of MA 3613.
This course will be offered in 2001-02 and in alternate years thereafter.

MA 4255. NUMERICAL ANALYSIS II.

Cat. II
The objective of this course is to acquaint the student with a broad set of algorithms for the numerical solution of problems in linear algebra and ordinary differential equations.
Topics covered include: direct and iterative algorithms for the solution of systems of linear equations, the inverse of a matrix, the eigenvalue problem for matrices, and initial and boundary value problems for ordinary differential equations.
Recommended background: MA 3255 or CS 4301.
This course will be offered in 2001-02 and in alternate years thereafter.

MA 4291. APPLICABLE COMPLEX VARIABLES.

Cat. I
This course provides an introduction to the ideas and techniques of complex analysis that are frequently used by scientists and engineers. The presentation will follow a middle ground between rigor and intuition.
Topics covered include: complex numbers, analytic functions, Taylor and Laurent expansions, Cauchy integral theorem, residue theory, and conformal mappings.
Recommended background: MA 1024 and MA 2051.

MA 4411. NUMERICAL SOLUTIONS OF DIFFERENTIAL EQUATIONS.

Cat. II
Since most differential equations that arise in science and engineering cannot be solved exactly in terms of elementary functions, it is crucial to develop methods for obtaining approximate solutions. This course is primarily concerned with developing such approximate solutions. Other topics in numerical analysis are treated in MA 3255 and MA 4255.
Topics covered include: methods for the solution of initial value problems, stiff differential equations, shooting methods, finite differences and the numerical solution of boundary value problems. Additional advanced topics (such as the method of finite elements) will be included depending on student interest and time limitations.
Recommended background: MA 2051 and MA 2071. An ability to write computer programs in a scientific language is assumed. Students enrolling in this course must have knowledge either of numerical methods or of boundary value problems. The former can be obtained from MA 3255/CS 4301; the latter may be obtained from MA 4451.
This course will be offered in 2000-01 and in alternate years thereafter.

MA 4451. BOUNDARY VALUE PROBLEMS.

Cat. I
Science and engineering majors often encounter partial differential equations in the study of heat flow, vibrations, electric circuits and similar areas. Solution techniques for these types of problems will be emphasized in this course.
Topics covered include: derivation of partial differential equations as models of prototype problems in the areas mentioned above, Fourier Series, solution of linear partial differential equations by separation of variables, Fourier integrals and a study of Bessel functions.
Recommended background: MA 1024 or and MA 2051.

MA 4473. PARTIAL DIFFERENTIAL EQUATIONS.

Cat. II
The first part of the course will cover the following topics: boundary value problems in two and three dimensions using multiple Fourier series, classification of partial differential equations, solving single first order equations by the method of characteristics, solutions of Laplace’s and Poisson’s equations including the construction of Green’s function, solutions of the heat equation including the construction of the fundamental solution, maximum principles for elliptic and parabolic equations. For the second part of the course, the instructor may choose to expand on any one of the above topics.
Recommended background: MA 4451 and MA 3832.
This course will be offered in 2000-01 and in alternate years thereafter.
ME 4631. PROBABILITY AND MATHEMATICAL STATISTICS I.

Cat. I (14 week course)

Intended for advanced undergraduates and beginning graduate students in the mathematical sciences and for others intending to pursue the mathematical study of probability and statistics, this course begins by covering the material of MA 3613 at a more advanced level. Additional topics covered are: one-to-one and many-to-one transformations of random variables; sampling distributions; order statistics, limit theorems.

Recommended background: MA 3613, MA 3831 - MA 3832.

MA 4632. PROBABILITY AND MATHEMATICAL STATISTICS II.

Cat. I (14 week course)

This course is designed to complement MA 4631 and provide background in principles of statistics.

Topics covered include: point and interval estimation; sufficiency, completeness, efficiency, consistency; the Rao-Blackwell theorem and the Cramer-Rao bound; minimum variance unbiased estimators, maximum likelihood estimators and Bayes estimators; tests of hypothesis including uniformly most powerful, likelihood ratio, minimax and bayesian tests.

Recommended background: MA 4631.

MA 4891. TOPICS IN MATHEMATICS.

Cat. I

MECHANICAL ENGINEERING

For a detailed description of each of these courses, check the video tape index at the Gordon Library.

The second digit in mechanical engineering course numbers is coded as follows:

0 — General mechanical engineering
1 —
2 —
3 — Design
4 — Thermal—fluids
5 — Engineering mechanics
6 — Fluid mechanics—hydraulics
7 — Aerospace
8 — Materials
9 — Engineering experimentation

ME 1520. THE TECHNOLOGY OF ALPINE SKIING.

Cat. II

This course explores science and engineering issues associated with equipment and technique for alpine skiing, particularly racing. A diverse group of technical subjects related to engineering mechanics are discussed: tribology, beams, rigid body motion, material science, machining and biomechanics. Specifically we will examine: ski-snow interactions, technique for gliding, turning and stepping, selection of line in racing; equipment design, testing and performance; and ski injuries. We will also address issues in the epidemiology of skiing injuries, the calculation of the cost of ski injuries to society, the impact of ski equipment technology on litigation and the impact of litigation on equipment and trial design.

ME 1800. MATERIALS SELECTION AND MANUFACTURING PROCESSES.

Cat. I

This course is designed to introduce the student to the engineering fundamentals of the most commonly encountered manufacturing processes. A thorough treatment of sketching, casting, welding, machining, and material properties are developed through a combination of class work and machine shop experience. Each student is required to sketch and fabricate his/her own prototype part. Experience is also provided in the area of automated process parameter selection through the use of microcomputers.

This course is recommended for all majors, for students who plan to utilize the machine shop facilities as part of their MQP work, or for those students who wish a fundamental background in manufacturing processes.

ME 2300. INTRODUCTION TO ENGINEERING DESIGN.

Cat. I

Real world engineering design problems usually have more than one correct solution. This course utilizes a realistic design process to introduce students to the methods and techniques for solving engineering problems. Lectures will support the design projects and may cover engineering economics, fluid dynamics, heat transfer, mechanics, statistics, and basic circuits. No prior knowledge of fluids, heat transfer, economics, statistics or electrical circuits is required. Laboratory sessions will be used to build, test and demonstrate various designs.

This course is designed for sophomores and juniors to provide a broad overview of engineering design.

The course includes a significant writing component and makes extensive use of PCs for word processing, spread sheet calculations and programming.

Recommended background: Calculus, MA 2051, PH 1110, ES 2501, and any programming language (BASIC, Fortran, Pascal, C).

Recommended preparation: Ordinary Differential Equations (MA 2051), Mechanics (PH 1110), Statics (ES 2501), any programming language.

ME 2434. INTRODUCTION TO THERMOFLUID SCIENCE.

Cat. I

This course unifies the basic principles of thermofluids. Conservation of mass, energy, and momentum are introduced, particularly for control volume analysis. Equations of state and constitutive relationships, entropy, and the Second Law are introduced to formulate solutions, and application of dimensional analysis is used for analysis of experimental data.

Recommended preparation: Ordinary Differential Equations (MA 2051).

ME 2713. ASTRONAUTICS.

Cat. I

Topics studied: Orbital mechanics including spacecraft maneuvering and station keeping, transfer orbits, and interplanetary transfers; space environment including characteristics of low earth highly elliptical and geosynchronous orbits; ascent and reentry trajectories.

Recommended preparation: Dynamics (ES 2503).

ME 2820. MATERIALS PROCESSING.

Cat. I

An introduction to material processing in manufacturing. This course provides important background for anyone interested in manufacturing, design engineering, sales, or management.

Processing of polymers, ceramics, metals and composites is discussed. Processes covered include: rolling, injection molding, forging, powder metallurgy, joining and machining. The relationships between materials, processes, processing parameters and the properties of manufactured parts are developed. During the course the students should develop the ability to choose materials, processes, and processing parameters for designing manufacturing procedures to take a prototype part to production.

ME 3023. MECHANICAL BEHAVIOR AND MODELING PROPERTIES OF ENGINEERING MATERIALS.

Cat. I

This course is concerned with different types of material response to mechanical loads. The course studies the constitutive equations that are used to model the properties of engineering materials. The behavior of elastic, plastic, composite and visco-elastic materials is considered. Experiments describing materials behaviors will be conducted and the behavior will be modeled.

Topics include: descriptions of material behavior, methods of determining the material parameters from experimental tests, behavior of different types of materials under simple states of loading and deformation such as tensile stress-strain response (elastic and plastic), and time-dependent behavior at room and elevated temperature (viscoelasticity and creep) are studied. Theories of failure and failure modes under monotonic and cyclic loading, fracture and fracture mechanics, and methods of modifying material behavior are discussed. These topics will be integrated in several material selection projects.


ME 3310. KINEMATICS OF MECHANISMS.

Cat. I

An introduction to the synthesis and analysis of linkages, cams and gear trains is presented. The design process is introduced and used to solve unstructured design problems in linkage and cam design. Algebraic and graphical techniques to analyze the displacement, velocity and acceleration of linkages and cams are developed. Computer programs for the design and analysis of linkages are used by students. Results of student design projects are presented in professional engineering reports.

Recommended preparation: Ordinary Differential Equations (MA 2051), Statics (ES 2501), Dynamics (ES 2503).

ME 3311. DYNAMICS OF MECHANISMS AND MACHINES.

Cat. I

This course provides an in-depth study of forces in dynamic systems. Dynamic force analysis is developed using matrix methods. Computer programs are used to solve the sets of simultaneous equations derived by students for realistic situations. The course studies the constitutive equations that are used to model the behavior of visco-elastic materials is considered. Experiments describing materials behaviors will be conducted and the behavior will be modeled.

Inertial and shaking forces, elementary mechanical vibrations, torque-time functions, rotational and reciprocating balance and cam dynamics are covered using the internal combustion engine as a design example. Students execute unstructured design projects and prepare professional engineering reports on the results. Computers are used extensively to solve the dynamic equations.

Recommended preparation: Ordinary Differential Equations (MA 2051), Statics (ES 2501), Dynamics (ES 2503), Kinematics (ME 3310), linear algebra.

ME 3320. DESIGN OF MACHINE ELEMENTS.

Cat. I

This is an introductory course in mechanical design analysis, and it examines stress and fatigue in many machine elements. Common machine elements are studied and methods of selection and design are related to the associated hardware.

Topics covered include: combined stresses, fatigue analysis, design of shafts, springs, gears, bearings and miscellaneous machine elements.

ME 3321. DYNAMIC MODELING.
Cat. I
This course introduces students to the modeling and analysis of dynamic systems. A unified treatment of mechanical, electrical, fluid and thermal systems is presented using the bond graph modeling language. The creation of dynamic models and the analysis of model response is emphasized.

Lecture topics include energy storage and dissipation elements, transducers, transformers, formulation of equations for a dynamic system and time response of linear systems. Computers are used extensively for both system modeling and analysis.

Recommended preparation: Mathematics (MA 2051, MA 2071), Statics (ES 2501), Dynamics (ES 2503).

ME 3410. COMPRESSIBLE FLOW.
Cat. I
The application of basic thermodynamics and fluid mechanics to model the flow phenomena of compressible fluids. The assumptions leading to various flow modeling models and the limits of these models are emphasized. The research approach is, in the main, one-dimensional control volume analysis, and the course is designed for engineering students.

Topics covered include: reversible flow, flow with heat transfer, flow with friction, normal and oblique shock waves, flow with chemical reaction, and flow with applied electric and magnetic fields.

Recommended preparation: Thermodynamics (ES 3001), Fluids (ES 3004).

ME 3422. ENVIRONMENTAL ISSUES AND ANALYSIS.
Cat. II
The links are examined among energy usage, population growth, and environmental impact. Various world energy scenarios are analyzed. Atmospheric transport and a global energy balance are used to model the Greenhouse effect. Issues of dosage/toxicity are explored. Indoor air quality is discussed. Modeling is emphasized throughout the course.

This course will be offered in 2001-02 and in alternate years thereafter.

ME 3501. ELEMENTARY CONTINUUM MECHANICS.
Cat. I
In typical mathematics courses, students learn principles and techniques by solving many short and specially prepared problems. They rarely gain experience in formulating and solving mathematical equations that apply to real-life engineering problems. This course will give students this type of applied mathematical experience.

The course emphasizes the application of basic laws of nature as they apply to differential elements which lead to differential equations that need to be solved; all of these ideas are used in higher level engineering science courses such as fluid mechanics, heat transfer, elasticity, etc. Emphasis will be placed on understanding the physical concepts in a problem, selecting appropriate differential elements, developing differential equations, and finding ways to solve these equations. Limitations on the mathematical solutions due to assumptions made will be considered.

Recommended preparation: Ordinary Differential Equations (MA 2051), Statics (ES 2501), Dynamics (ES 2503).

ME 3502. ADVANCED MECHANICS OF MATERIALS.
Cat. I
An intermediate level course in stress analysis suitable for students in applied mechanics, design, and materials sciences.

Topics included are: non-symmetric bending, torsion of non-circular bars, pressure vessels, elastic stability, energy methods in mechanics, beams on elastic foundations and other advanced topics in stress analysis.

Recommended preparation: Ordinary Differential Equations (MA 2051), Statics (ES 2501), Stress (ES 2502).

ME 3505. MECHANICAL VIBRATIONS.
Cat. I
This course is an introduction to the fundamental concepts of mechanical vibrations, which are important in the design and analysis of mechanical and structural systems subjected to time varying loads. The objective of the course is to expose the students to the mathematical modeling and analysis of mechanical systems under the action of dynamic loads.

Topics covered include: formulation of the equations of motion for flexible and deformable bodies using Newton's Laws, D'Lambert's Principle, and energy methods; prediction of natural frequency for single-degree-of-freedom systems, modeling the stiffness characteristics, damping, and other vibrational properties of a mechanical systems, some basics of frequency response analysis and Duhamel integral methods. The course is mainly focused on the analysis of single-degree-of-freedom systems, however, a basic introduction to multi-degree-of-freedom systems may also be considered.

Recommended preparation: Ordinary Differential Equations (MA 2051), Statics (ES 2501), Dynamics (ES 2503).

ME 3506. REHABILITATION ENGINEERING.
Cat. I
This course introduces energy storage and dissipation elements, transducers, transformers, formulation of equations for a dynamic system and time response of linear systems. Computers are used extensively for both system modeling and analysis.

Recommended preparation: Mechanics (ES 2501), ES 2502, ES 2503), Kinematics (ME 3310), Design (ME 2300), Materials (ME 1800, ME 2820), Electrical Engineering (EE 3601).

ME 3512. INTRODUCTION TO THE FINITE ELEMENT METHOD.
Cat. I
This course introduces the concept of matrix structural analysis for uniaxial bars and beams. The finite element method is established by utilizing variational methods for problems in one- and two-dimensional stress analysis and heat conduction. The digital computer will be used throughout the course to gain hands-on experience in using finite element programs.

Recommended preparation: Mathematics (MA 2051, MA 2071), Mechanics (ES 2502).

ME 3602. INTERMEDIATE FLUID DYNAMICS.
Cat. I
A second course in fluid mechanics concerned with the application of basic principles. Applications include velocity potentials and stream functions, fluid machinery, pipe networks and unsteady flow. The equations of viscous flow are developed with applications including exact solutions, energy dissipation and introductory boundary layer theory.

Recommended preparation: Fluids (ES 3004).

ME 3711. AERODYNAMICS I.
Cat. I
A first course in the science and engineering of heavier-than-air flight vehicles. Topics covered include: application of fluid mechanic and thermodynamic principles to study lift and drag, the effects of viscosity and compressibility, methods of estimating performance, and the elements of stability. The theory of airflow circulation is developed and used to examine induced drag, downwash, ground effect and vortex wake turbulence.

Methods of characterizing and presenting airflow performance data are developed and utilized to examine the performance of wings. Propulsion systems, including propellers and their effects on flight performance are discussed. Longitudinal, lateral and turning stability of aircraft are considered for both static and dynamic conditions.

Recommended preparation: Thermodynamics (ES 3001), Fluids (ES 3004).

ME 3714. PROPULSION.
Cat. I
This course provides a study of air breathing and rocket engines for aircraft, rockets and spacecraft.

Recommended preparation: Mathematics (MA 2051, MA 2071), Statics (ES 2501), Dynamics (ES 2503), Thermodynamics (ES 3001), Fluids (ES 3004).

ME 3811. MICROSTRUCTURE ANALYSIS AND CONTROL.
Cat. I
An in-depth study of the microstructure and properties of alloy systems in current use.


ME 3820. COMPUTER-AIDED MANUFACTURING.
Cat. I
This introductory course in modern control systems will give students an understanding of the basic techniques, and the range of equipment used in most computer controlled manufacturing operations. The class work is reinforced by hands-on laboratories in the Robotics/CAM lab.

Class topics include: Manufacturing Automation, Microcomputers for Process Monitoring and Control, Computer Numerical Control, Switching Theory and Ladder Logic, Transducers and Signal Conditioning, and Closed Loop Digital Control. The laboratories allow students to program and implement several types of the controllers, and will provide an introduction to the topic of industrial robotics.

Recommended preparation: Manufacturing (ME 1800), Materials processing (ME 2820), elementary computer/logic device programming.
ME 3825. MECHANICAL METALLURGY LABORATORY.
Cat. I
A laboratory course designed to develop skills in modem materials testing techniques and plastic deformation processing.
Laboratory experiments will include tension testing, impact testing, fatigue testing, and fracture toughness testing according to industry-accepted standards.

ME 3901. ENGINEERING EXPERIMENTATION.
Cat. I
A course designed to develop analytical and experimental skills in modern engineering measurement methods, based on electronic instrumentation and computer-based data acquisition systems. The lectures are concerned with the engineering analysis and design as well as the principles of instrumentation, whereas the laboratory periods afford the student an opportunity to use modern devices in actual experiments.
Lecture topics include: review of engineering fundamentals and, among others, discussions of standards, measurement and sensing devices, experiment planning, data acquisition, analysis of experimental data, and report writing.
Laboratory experiments cover areas of: heat transfer, flow measurement/visualization, force/torque/stRAIN measurement, motion/vibration measurement, laser/ (fiber optics, and other selected topics.

ME 4010. MECHANICAL ENGINEERING SENIOR SEMINAR.
Cat. I
For students who will soon be entering the engineering profession.
Current thought on mechanical engineering and related engineering problems presented by staff members and visiting lecturers from the engineering profession. Emphasis is placed on the transition from engineering student to professional engineer.
Registration as a junior or senior is assumed; not for credit.

ME 4320. ADVANCED ENGINEERING DESIGN.
Cat. I
This course integrates students' background in ME in one-term design project that is usually taken from a local company. Students must organize themselves and the project to successfully realize a product that meets customer needs. Activities include problem definition, design analysis, mathematical modeling, CAD modeling, manufacturing, testing, liaison to vendors, customer relations, marketing, technical management, purchasing, report writing, and oral presentations.
Recommended preparation: Mechanisms (ME 3310, ME 3311), Stress Analysis (ES 3502), Design (ME 3320), Thermo- (ES 3001, ES 3003, ES 3004), Materials (ES 2001), Manufacturing (ME 1800).

ME 4412. INTRODUCTION TO COMBUSTION.
Cat. II
This course will be an introduction to chemical and physical aspects of combustion.
Topics covered include thermodynamics of combustion, combustion kinetics, premixed flames, diffusion flames, ignition, detonation, pollutant formation, advanced and conventional combustion systems and combustion measurement techniques.
Course emphasis will be on developing basic understanding of combustion phenomena relevant to engineering applications of combustion. Computer programming and available software may be employed to solve combustion problems.
This course may be used toward a graduate degree by submission of an additional report based on a review of research literature as arranged with the instructor.
Recommended preparation: Thermodynamics (ES 3001), Fluids (ES 3004).
Offered in 2001-02 and in alternating years thereafter.

ME 4429. THERMOSFLUID APPLICATION AND DESIGN.
Cat. I
This course integrates thermodynamics, fluid mechanics and heat transfer through the use of design projects involving modern technologies, such as electronic cooling, vapor compression power cycles, and turbines. Activities include problem definition, design creation and analysis, mathematical modeling, cost analysis and optimization.
Recommended preparation: Thermofluids (ES 3001, ES 3003, ES 3004) and an introduction to design.

ME 4430. INTEGRATED THERMOMECHANICAL DESIGN AND ANALYSIS.
Cat. II
Current state-of-the-art computer based methodologies used in the design and analysis of thermomechanical systems will be presented and illustrated by selected laboratory demonstrations, and used in projects. Projects will include thermal, mechanical, electronic, and photonic loads of steady state and dynamic nature and will integrate design, analysis, and testing. Students will prepare a technical report and present their results. Topics will include, but not be limited to, thermomechanics of fiber optic telecommunication cables, high-energy beam interactions with materials, shape memory alloys, microelectronics, MEMS and mechatronics.
Recommended background: MA 2051, ES 2001, ES 2502, ES 3003, EE 3601, ME 3901, and an introduction to design.
This course will be offered in 2001-02 and in alternating years thereafter.

ME/BE 4504. BIOMECHANICS.
Cat. II
This course emphasizes the applications of mechanics to describe the material properties of living tissues. It is concerned with the description and measurement of these properties as related to their physiological functions. Emphasis on the interrelationship between biomechanics and physiology in medicine, surgery, body injury and prostheses.
Topics covered include: review of basic mechanics, stress, strain, constitutive equations and the field equations, viscoelastic behavior, and models of material behavior. The measurement and characterization of properties of tendons, skin, muscles and bone. Biomechanics as related to body injury and the design of prosthetic devices.
Recommended preparation: Mechanics (ES 2501, ES 2502, ES 2503, ME 3501), Mathematics (MA 2051).
Offered in 2001-02 and in alternating years thereafter.

ME 4505. ADVANCED DYNAMICS.
Cat. I
This course completes a sequence of sophomore, junior and senior courses in Dynamic Systems, i.e., ES 2503, ME 3505, and ME 4505, which are essential in an undergraduate Mechanical Engineering curriculum. An advanced course intended to emphasize the development and applications of dynamics in threedimensional space. Problem solutions emphasize the use of vector algebra, matrix methods and differential equations with a goal of developing the student's ability to translate physical problems into mathematical models.
Topics covered include: three-dimensional kinematics using rotating and stationary frames of reference, development of force, energy and momentum equations governing general particle and rigid body systems. Applications of equations to rigid, etc., and fluid problems.
Recommended preparation: Dynamics (ES 2503).

ME 4520. ANALYTICAL METHODS IN MECHANICAL ENGINEERING.
Cat. I
This course presents some selected advanced mathematical concepts and procedures and their applications for analyzing complicated practical problems of mechanical engineering. Applications of these advanced analytical methods are illustrated for design and response prediction of mechanical systems, for processing of experimental data, and for mathematical modeling of physical phenomena involved. Mathematical tools such as linear algebra, differential equations, harmonic analysis, probability theory, and dimensional analysis are presented and illustrated by various examples in mechanical engineering including: analysis of equilibrium states, stability of static and dynamic systems, dynamic response of mechanical systems, and modern signal analysis. Analytical procedures and physical interpretation of the solutions are emphasized.
Problems presented in the course are selected from different disciplines within mechanical engineering such as biomechanics, design, materials science, applied mechanics, thermo-fluids, etc.
Recommended preparation: Mechanics (ES 2501, ES 2502, ES 2503, ME 3501), Mathematics (MA 2051).

ME 4530. COMPUTATIONAL METHODS IN MECHANICAL ENGINEERING.
Cat. I
This course teaches the students how to analyze and solve complicated mechanical engineering problems utilizing state-of-the-art numerical analysis methods and digital computer. Some fundamental numerical schemes such as roots of algebraic and transcendental equations; solution of simultaneous algebraic equations; matrix analysis; curve fitting and data interpolation; numerical integration and differentiation; numerical solution of differential equations; symbolic manipulation and numerical solution of linear and nonlinear differential equations; Fourier and frequency response analysis; eigenvalue problems; and other numerical analysis problems are considered. Emphasis will be on modeling, numerical formulation and numerical and symbolic solution of practical problems in mechanical engineering. Fundamentals of FORTRAN programming are also included.
Recommended preparation: Mechanics (ES 2501, ES 2502, ES 2503), Mathematics (MA 2051, MA 2071).

ME 4604. FLUID MECHANICS OF MACHINES.
Cat. II
Introduction to the principles and applications of turbo-machines.
Topics covered include: vortex flow relations, blade element analysis, cavitation, dimensionless coefficients, ideal and actual fans, pumps and turbines, and operation of pumps and fans in various systems.
Recommended preparation: Fluids (ES 3004).
Offered in 2001-02 and in alternating years thereafter.
ME 4605. COMPUTATIONAL FLUID MECHANICS.  
Cat. I  
This course serves as an introduction to the use of finite-difference methods to solve fluid flow problems.  
Topics covered include: difference approximations; truncation error and consistency; the development of difference equations from partial differential equations using Taylor series, polynomial fitting, integral methods, and control volume; algebraic and structural grid generation; stability of inviscid flow solutions using Gaussian elimination, Thomas’ algorithm, Gaussian-Seidel, and Successive Over-Relaxation; boundary layer solutions using Dufort-Frankel and Crank-Nicolson; Navier-Stokes solutions using the vorticity transport-stream function and primitive variable approaches.  
Recommended preparation: Fluids (ES 3602).  

ME/BE 4606. BIOFLUIDS.  
Cat. II  
This course emphasizes the applications of fluid mechanics to biological problems. The course concentrates primarily on the human circulatory and respiratory systems. Topics covered include: blood flow in the heart, arteries, veins and microcirculation and air flow in the lungs and airways. Mass transfer across the walls of these systems is also presented.  
Recommended preparation: Continuum Mechanics (ME 3501), Fluids (ES 3004).  
Offered in 2000-01 and in alternating years thereafter.  

ME 4715. AEROSPACE STRUCTURES.  
Cat. I  
Aircraft and space vehicle structural design including finite element analysis, modal analysis, and thermal loading along with traditional and composite material characteristics and selection for atmospheric and space environment are studied. Flutter, transient response, and large structure dynamics are typical examples used.  
Recommended preparation: Mechanics (ES 2501, ES 2502, ES 2503), Aerodynamics (ME 3711).  
Offered in 2000-01 and in alternating years thereafter.  

ME 4724. HIGH SPEED FLOW.  
Cat. II  
This course will introduce the students to the physical phenomena associated with flows at supersonic/hypersonic speeds. Emphasis will be placed on the hypersonic limit and various models developed to treat the continuum flow at this limit.  
Topics covered include: characterization of supersonic flow, normal shock relations, the piston analogy and shock tube equations, oblique shock waves and expansion fans at the hypersonic limit, similarity methods, the Newtonian model, Mach number independence of the inviscid equations, small disturbance theory for planar and axially symmetric bodies, lift and drag coefficients, dynamics of the viscous portion of the flow, and real gas effects.  
Recommended preparation: Thermodynamics (ES 3001), Compressible Flow (ME 3410).  
Offered in 2001-02 and in alternating years thereafter.  

ME 4770. AEROSPACE SYSTEMS DESIGN.  
Cat. I  
A senior-level course emphasizing design of aerospace systems. Aircraft or spacecraft design issues will be emphasized. Students undertake the conceptual design of aircraft and/or space systems in term-long projects. These projects incorporate fundamentals of aerodynamics, structures, controls, propulsion, and astronautics into a capstone design experience. Design teams, computational simulation, design analysis, technical communication, and final design reviews are emphasized.  
Recommended preparation: Astronautics (ME 2713), Heat Transfer (ES 3003), Intermediate Fluid Mechanics (ME 3602), Compressible Flow (ME 3410), Aerodynamics I (ME 3711), Propulsion (ME 3714), Aerospace Structures (ME 4715).  

ME 4815. INDUSTRIAL ROBOTICS.  
Cat. I  
This course introduces the student to the field of industrial automation. Topics include: kinematics, dynamics, mechanics, sensors, end effectors and parts presentation devices. Programming languages, system design and safety issues are also covered. This course is a combination of lecture, laboratory and project work, and utilizes industrial robots. Theory and application of robotic systems will be emphasized.  
Recommended preparation: Dynamics (ES 2502), Kinematics (ME 3310), Electric Eng. (EE 3601), computer programming.  

ME 4821. CHEMISTRY, PROPERTIES, AND PROCESSING OF PLASTICS.  
Cat. I  
Topics covered include: polymer chemistry, physical and chemical properties, processing methods, selection of materials, comparisons of plastics with metals, design considerations, and new materials. Laboratory studies are included. Use of current literature is stressed.  

ME 4825. MICROELECTRONIC TECHNOLOGY.  
Cat. I  
This course introduces the student to the field of microelectronics. Topics include: microprocessor systems, microprocessor programming, and data communications. Use of current literature is stressed.  
Recommended preparation: Computer Engineering (EE 1201).  

ME 4827. DESIGN OF MICROELECTRONICS SYSTEMS.  
Cat. I  
This course introduces the student to the field of microelectronics. Topics include: microprocessor systems, microprocessor programming, and data communications. Use of current literature is stressed.  
Recommended preparation: Computer Engineering (EE 1201).  

ME 4832. CORROSION AND CORROSION CONTROL.  
Cat. II  
An introductory course designed to acquaint the student with the different forms of corrosion and the fundamentals of oxidation and electro-chemical corrosion.  
Topics covered include: corrosion principles, environmental effects, metallurgical aspects, galvanic corrosion, crevice corrosion, pitting, intergranular corrosion, erosion corrosion, stress corrosion, cracking and hydrogen embrittlement, corrosion testing, corrosion prevention, oxidation and other high-temperature metal-gas reactions.  
Recommended preparation: Materials (ES 3001).  
Offered in 2001-02 and in alternating years thereafter.  

ME 4840. PHYSICAL METALLURGY.  
Cat. I  
Fundamental relationships between the structure and properties of engineering materials are studied. Principles of diffusion and phase transformation are applied to the strengthening of commercial alloy systems. Role of crystal lattice defects on material properties and fracture are presented.  
Strongly recommended as a senior-graduate level course for students interested in pursuing a graduate program in materials or materials engineering at WPI, or other schools.  

ME 4850. SOLID STATE THERMODYNAMICS.  
Cat. I  
Classical and atomistic thermodynamics are developed and applied to the behavior of solids, liquids and gases. Phase equilibria and phase diagrams are discussed. Emphasis is placed on the gas phase reactions and reactions between solids and gases as well as the behavior or solutions. Applications to Materials Engineering processes and phenomena are discussed.  
Recommended preparation: Materials (ES 2001), Chemistry (CH 1020).
ME 4922. THEORY AND PRACTICE OF LASER INSTRUMENTATION.
Cat. II
This course introduces and analyzes the fundamentals of optical and image processing techniques applicable to engineering measurements. Optical instrumentation is widely used in high precision position, vibration, and inspection applications in the industrial environment. The goal of this course is to provide a rigorous background in the basic principles preparing the student for the more advanced courses on laser instrumentation. The course will include both in-class lectures and laboratories. Topics to be covered include: accelerated review of light, waves, and polarization; basic building blocks including lenses, detectors, optical components, and fiber optics; interferometry and coherence; basic holography and speckle; infrared temperature measurement; stress birefringence; basic video, imaging, and digital image processing.
Recommended preparation: Mathematics (MA 3051), Experimentation (ME 3901).
Suggested preparation: Physics (PH 1140).
Offered in 2000-01 and in alternating years thereafter.

IS/P. SPECIAL TOPICS.
Cat. I
For students who wish to pursue in depth various mechanical engineering topics.
Topics covered include: theoretical or experimental studies in subjects of interest to mechanical engineers.
Registration as a junior or senior is assumed.

MILITARY SCIENCE

The intent of the Military Science program of courses is that they be taken in sequential order. Any student who wishes to depart from this recommendation must consult with the Military Science department head.

MS 1051 and MS 1071 will appear on the WPI transcript as a zero credit course with a grade. Successful completion of MS 1051 and MS 1061 earns 1/9 unit in MS 1061. Successful completion of MS 1071 and MS 1081 earns 1/9 unit in MS 1081.

MS 1051. INTRODUCTION TO ROTC I.
Cat. I (no units)
This course familiarizes students with the ROTC program, the US Army and Armed Services. The concepts of citizenship, responsibility and duty are introduced. Students participate in basic team building through marching, physical fitness, and social activities. Students are introduced to the roles, organization and branches of the Army. Students study the characteristics of a profession, management of risk and first aid. Students are introduced to the elements of leadership and their measurements.
Course includes one hour of class work and one hour of physical fitness per week. Students are required to attend two labs and encouraged to attend a field training exercise.
Recommended background: none.

MS 1061. INTRODUCTION TO ROTC II.
Cat. I (1/9 unit)
This course continues the studies begun in MS 1051. Students make oral presentations on the elements of leadership. Students practice the art of recognizing and scoring leadership traits.
Course includes one hour of class work and one hour of physical fitness per week. Students are required to attend two labs and encouraged to attend a formal dining in.
Recommended background: MS 1051.

MS 1071. INTRODUCTION TO LEADERSHIP I.
Cat. I (no units)
This course introduces leader doctrine based upon the study of the elements of leadership. The course also includes customs and traditions of the services, and requires writing biographical sketches.
Course includes one hour of class work and one hour of physical fitness per week. Students are required to attend two labs and encouraged to attend a formal military ball.
Recommended background: MS 1061.

MS 1081. INTRODUCTION TO LEADERSHIP II.
Cat. I (1/9 unit)
Course stresses fundamental competencies from leader doctrine. Students are introduced to basic land navigation, values and obligations of an officer, and duties of the non-commissioned officer. Required is submission of written reports on field training and memoranda for record.
Course includes one hour of class work and one hour of physical fitness per week. Students are required to attend two labs and encouraged to attend field training exercise.
Recommended background: MS 1071.

MS 2051. SELF AND TEAM DEVELOPMENT I.
Cat. I (1/6 unit)
Cadets learn how to build teams through a step by step approach. They build upon the basic leader doctrine and leadership development methodologies to refine their understanding of leadership. More fundamental competencies are drilled with planning and organizing functions. Cadets are required to write and orally present military operations orders.
Course includes two hours of class work and two hours of physical fitness per week. Students are required to attend two labs and encouraged to attend a formal dining in.
Recommended background: MS 2051.

MS 2061. SELF AND TEAM DEVELOPMENT II.
Cat. I (1/6 unit)
Cadets learn and practice more complex personal skills in land navigation. An oral presentation on military history is required.
Course includes two hours of class work and two hours of physical fitness per week. Students are required to attend two labs and encouraged to attend a formal dining in.
Recommended background: MS 2061.

MS 2071. INDIVIDUAL AND TEAM MILITARY TACTICS I.
Cat. I (1/6 unit)
Students continue study of leader doctrine and are introduced to formal policies such as equal opportunity, ethics, and values. Military communication skills are trained along with the principles of camouflage. More complex cases of risk management are studied. Students submit a written information paper.
Course includes two hours of class work and two hours of physical fitness per week. Students are required to attend two labs.
Recommended backgrounds: MS 2061.

MS 2081. INDIVIDUAL AND TEAM MILITARY TACTICS II.
Cat. I (1/6 unit)
This course covers small unit movement and tactics. It combines previous study in weapons, movement and communications to teach the combination of firepower and maneuver to the cadet. The course introduces the elements of training. A written decision paper and practical exercise in conducting training is included.
Course includes two hours of class work and two hours of physical fitness per week. Students are required to attend two labs and encouraged to attend a field training exercise.
Recommended background: MS 2071.

MS 2091. BASIC CAMP.
Cat. I (no units)
A five-week summer camp conducted at Fort Knox, KY in a rigorous environment. This course serves as a replacement for students missing all or parts of the basic course. No service obligation is accrued. All costs are born by the Army and students are paid by the Army during the camp.
The course is a full-time commitment for the duration of the five weeks.
Suggested background: Completion of MS 2071 and MS 2081 is suggested and Department Head approval is required.

MS 3051. LEADING SMALL ORGANIZATIONS IA.
Cat. I (1/6 unit)
Cadets write self evaluations throughout the course. Cadets are graded on the conduct of practical exercised in leadership. This course reviews the leadership elements and doctrine, operations and orders and training. Cadets study more complex weapons, analyze terrain and the infantry squad in defense.
The course requires three hours of class work and three hours of physical fitness per week. Three lab exercises and a field training exercises are required. Recommended background: Cadets must have completed the basic course and have signed a personal contract with the US Army. Department Head approval is required.

MS 3061. LEADING SMALL ORGANIZATIONS IB.
Cat. I (1/6 unit)
Cadets write self evaluations throughout the course. Cadets are graded on the conduct of practice exercises in leadership. Cadets learn how to counter terrorist activities, counsel and develop subordinates, and squad movements. Cadets study terrain analysis, danger areas and reactions to hostile fire.
The course requires three hours of class work and three hours of physical fitness per week. Three lab exercises and a formal dining in are required.
Recommended background: MS 3051.

MS 3071. LEADING SMALL ORGANIZATIONS II.
Cat. I (1/6 unit)
Cadets write self evaluations throughout the course. Cadets are graded on the conduct of practice exercises in leadership. Cadets study law of war, indirect fire, and the squad offense. Case studies in ethical leaderships are included and submission of a military history essay is required.
This course requires three hours of class work and three hours of physical fitness per week. Three lab exercises and a formal military social are required.
Recommended background: MS 3061.
MS 3081. LEADING SMALL ORGANIZATIONS IIIB.
Cat. I (1/6 unit)
Cadets write self evaluations throughout the course. Cadets are graded on the
conduct of practice exercises in leadership. This course stresses the junior
and platoon level tactics required for summer training. All previous study culmi-
nates in practical exercises that represent expected combat experiences. Leader-
ship skills are deeply inculcated and measured.
This course requires three hours of class work and three hours of physical
fitness per week. Three lab exercises and a field training exercise are required.
Recommended background: MS 3071.

MS 3091. ADVANCED CAMP.
Cat. I (no units)
This summer camp is mandatory and must be passed to complete ROTC train-
ing. This is a five-week summer camp conducted at Fort Lewis, WA in a rigor-
ous environment. All costs are born by the Army and students are paid by the
Army during the camp.
This course is a full-time commitment for the duration of the five weeks.
Recommended background: MS 3081.

MS 4051. LEADERSHIP CHALLENGES AND GOAL SETTING I.
Cat. I (1/6 unit)
Cadets organize and lead all the junior cadets. Written submission of a report on
summer camp is required and the students perform leadership evaluations
under cadre supervision on the junior level students. Cadets learn about the
Army officer personnel system and attend seminars on various professional
development topics. Cadets develop and submit career requests to the Army
Accessions Board and complete a field trip to the Association of the United
States Army national convention.
This course requires three hours of class work and three hours of physical
fitness per week. Three lab exercises and a field training exercise are required.
Participation in the field trip is strongly encouraged.
Recommended background: MS 4051.

MS 4061. LEADERSHIP CHALLENGES AND GOAL SETTING II.
Cat. I (1/6 unit)
Cadets organize and lead all the junior cadets. Cadets conduct a field trip to a
site of military history significance. Cadets conduct two briefings and submit an
integrating essay for grade. Other topics covered include Army families, mainte-
nance management for military equipment, and logistic systems management.
This course requires three hours of class work and three hours of physical
fitness per week. Three lab exercises and a formal dining is required. Partici-
pation in the military history field trip is strongly encouraged.
Recommended background: MS 4051.

MS 4071. TRANSITION TO LIEUTENANT I.
Cat. I (1/6 unit)
Cadets organize and lead all the junior cadets. This course covers joint opera-
tions (Army combined with Air Force and Navy), the Army Reserve, and
National Guard. The course focuses on the morality of warfare, principles and
law of war, and professional ethics. Cadets submit a written essay of ethics and
written counseling reports on subordinates.
This course requires three hours of class work and three hours of physical
fitness per week. Three lab exercises and a formal military ball are required.
Recommended background: MS 4061.

MS 4081. TRANSITION TO LIEUTENANT II.
Cat. I (1/6 unit)
Cadets organize and lead all the junior cadets. This course covers the military
legal system, personnel actions and personal finances. It certifies fundamental
competencies in land navigation, tactics, counseling, and interpersonal
communications.
This course requires three hours of class work and three hours of physical
fitness per week. Three lab exercises and a formal military ball are required.
Recommended background: MS 4061.

NUCLEAR ENGINEERING

The second digit in the Nuclear Engineering course numbers is coded as follows:
0 — General Nuclear Engineering
1 — Nuclear Reactor Theory
2 — Radioisotope Applications
3 — Radiation, Radioisotope Transport, and Waste Management
4 — Nuclear Laboratory

INTRODUCTORY NUCLEAR ENGINEERING SEQUENCE.
The introductory sequence, NE 2011-2012, presents a unified treatment of the
basic concepts of nuclear engineering. While this sequence is the foundation for
additional work in nuclear engineering, it also provides a suitable background
to enable students from other fields to understand the diverse applications of
nuclear technology. Examples are:
• nuclear gauging (thickness, density, etc.),
• processes (food irradiation, polymerization, etc.),
• tracer applications (flow, biology, etc.),
• analysis (activation, radiography, etc.),
• medical (diagnostic, therapeutic),
• heat sources (space and terrestrial),
• power generation.
This sequence is available to any student having mathematics through
MA 1022 (including elementary differentiation and integration). Participation by
upper-level students from all departments is encouraged.

NE/ES 2011. INTRODUCTION TO NUCLEAR TECHNOLOGY.
Cat. I
Overview of the basic phenomena which form the foundation of the field of
nuclear engineering, including radioisotope production and utilization, and
controlled chain reactions. Familiarization with nuclear laboratory techniques
and instrumentation is emphasized.
Topics covered include: structure of the atom and nucleus, decay laws, prop-
erties of decay emanations, and nuclear interactions.
Recommended background: MA 1022.

NE 2012. INTRODUCTION TO HEALTH PHYSICS.
Cat. I
A continuation of NE 2001 which focuses on radiation protection in the applica-
tion of nuclear technology. The basic concepts of radiation biology, dosimetry,
and shielding are developed. The applications, regulatory considerations,
accident, and emergency procedures are studied.
Laboratory work involving the use, measurement, and detection of radiation
and radioactive materials is emphasized.
Recommended background: NE 2011.

NE 3101. NUCLEAR REACTOR PRINCIPLES.
Cat. I
Basic nuclear concepts pertinent to nuclear reactor theory are studied, including
the slowing down and diffusion of neutrons, criticality calculations, reactor
control, and reactor systems.
Laboratory experimentation and measurements with the WPI 10-KW open-
pool nuclear reactor are included.
Recommended background: NE 2011, MA 2051.

NE 3401. NUCLEAR REACTOR LABORATORY.
Cat. I
Quantitative and qualitative measurement techniques utilizing the WPI 10 kw
Nuclear Reactor Facility and associated nuclear instrumentation.
Selected experiments involving: measurement of alpha, beta, gamma, and
neutron radiation; counting efficiency and calibration; statistical analysis;
activation analysis; neutron radiography; reactor response and control; measure-
ment of environmental radiation.
Recommended background: NE 2012, NE 3101.

NE 4102. NUCLEAR POWER GENERATION.
Cat. I
Consideration of reactor physics, including introduction to two group theory and
use of computer codes to analyze/design critical configurations. Development of
engineering models for core thermal behavior and other reactor parameters.
Recommended background: NE 3101, junior status (or approval of instructor).
NE 4301. RADIATION TRANSPORT.
Cat. II
Mathematical modeling of the mechanisms of radiation and radioactive material transport.
Topics covered include: point kernel model, source analysis, geometry effects, nuclide movement, dosimetry, and Monte Carlo techniques. Course emphasis will be on the understanding of the basic processes, leading to predictive models which may be employed to assess the safety of various situations which involve the use of radioactive materials. Radiation standards.
Offered in 2000-01 and in alternating years thereafter.
Recommended background: NE 2012, MA 2051.

NE 4302. RADIOACTIVE WASTE MANAGEMENT.
Cat. II
A technical overview of the sources of radioactive waste and the techniques available for its proper management.
The production and radioisotopes for medicine and industry; the nuclear fuel cycle; low level, transuranic, and high level radioactive wastes; mixed wastes; and decommissioning. Disposal facility design. Regulation of wastes.
Offered in 2001-02 and in alternating years thereafter.
Recommended background: NE 2012.

PHYSICAL EDUCATION

PE 1001, 1002, 1003, 1004. PHYSICAL EDUCATION—GENERAL.
Cat. I (1/12 unit)
Out-of-doors in the fall and spring. Indoors during the winter months. Skills in a number of lifetime sports are taught.

PE 1001. INTRODUCTION TO LIFETIME SPORTS: GOLF, TENNIS, RECREATIONAL.
Cat. I (1/12 unit)

PE 1002. INTRODUCTION TO LIFETIME SPORTS: VOLLEYBALL, SQUASH, RECREATIONAL.
Cat. I (1/12 unit)

PE 1003. INTRODUCTION TO LIFETIME SPORTS: SWIMMING, BADMINTON, RECREATIONAL.
Cat. I (1/12 unit)

PE 1004. INTRODUCTION TO LIFETIME SPORTS: TABLE TENNIS, GOLF, TENNIS.
Cat. I (1/12 unit)

PE 1005. INTRODUCTION TO LIFETIME SPORTS: SWIMMING, RECREATIONAL, TABLE TENNIS, RACQUETBALL.
Cat. I (1/12 unit)

PE 1006. WELLNESS.
Cat. I (1/12 unit)
Introductory course designed to acquaint students with knowledge and skills necessary to make choices that foster health and well-being.

PE 1007. BASIC WATER SAFETY.
Cat. I (1/12 unit)
Prerequisite for PE 1057.

PE 1011. TOUCH FOOTBALL.
Cat. I (1/12 unit)
Basic rules, individual and team skills, practical application through game competition.

PE 1012. BASKETBALL.
Cat. I (1/12 unit)
Basic rules, individual and team skills, practical application through game competition.

PE 1013. SOFTBALL.
Cat. I (1/12 unit)
Basic rules, individual and team skills, practical application through game competition.

PE 1014. RACQUETS—TENNIS.
Cat. I (1/12 unit)
Basic strokes and techniques for beginning tennis.

PE 1015. RACQUETS—BADMINTON, TABLE TENNIS.
Cat. I (1/12 unit)
Techniques and tactics offered for all levels of ability.

PE 1016. RACQUETS—SQUASH, RACQUETBALL.
Cat. I (1/12 unit)
Basic strokes and techniques for beginning squash and racquetball.

PE 1017. BEGINNERS SWIMMING.
Cat. I (1/12 unit)
This program follows the Red Cross Manual.

PE 1018. CO-ED VOLLEYBALL.
Cat. I (1/12 unit)
Basic rules, individual and team skills, practical application through game competition.

PE 1021. BOWLING.
Cat. I (1/12 unit)
Introductory course designed to acquaint students with the basic skills, knowledge and practical experience.

PE 1024. RACQUETS—INTERMEDIATE TENNIS.
Cat. I (1/12 unit)

PE 1027. INTERMEDIATE SWIMMING.
Cat. I (1/12 unit)
The program follows the Red Cross Manual for certification; fee is required.

PE 1055. PHYSICAL CONDITIONING.
Cat. I (1/2 unit)
This course provides an opportunity for students to work on an individual conditioning program.

PE 1057. LIFEGUARDING.
Cat. I (1/12 unit)
The program follows the Red Cross Manual for lifeguarding. Red Cross fee and books are required.
Required background: PE 1007 Basic Water Safety.

PE 1059. WEIGHT TRAINING PROGRAM FOR WOMEN.
Cat. I (1/2 unit)
This introductory course is designed to acquaint students to circuit training and free weight programs.

PE 1070. LEISURE EDUCATION: REDEFINING SOCIAL NORMS.
Cat. I (1/2 unit)
Introductory course designed to explore various leisure education alternatives.

PE 1077. SWIM AND STAY FIT.
Cat. I (1/12 unit)
This is a program designed for persons who want to improve their physical fitness through swimming.

PE 1100. PHYSICAL EDUCATION EQUIVALENCY.
Cat. I (1/12 unit)
Credit by equivalent activity in one of four categories: 1) WPI athletic team participation, 2) club sports, 3) approved courses not offered at WPI, 4) individualized program at WPI, 5) Proficiency testing. Advance approval by the Physical Education Department Head is necessary.
PHYSICS

The second digit in physics course numbers is coded as follows.
1 — General physics
2 — Theoretical mechanics, statistical physics, kinetic theory, etc.
3 — Electricity and magnetism, electromagnetic theory
4 — Quantum mechanics
5 — Particular topics
6 — Laboratory

INTRODUCTORY PHYSICS SEQUENCE

There are four course topics in the introductory physics sequence. The four topics are Classical Mechanics (PH 1110/PH 1111), Electricity and Magnetism (PH 1120/PH 1121), 20th Century Physics (PH 1130), and Oscillations and Waves (PH 1140). Each course includes a laboratory component.

Students should take either PH 1110 or PH 1111, but not both; similarly, either PH 1120 or PH 1121, but not both. The primary difference between the PH 1110-PH 1120 option and PH 1111-PH 1121 is that the material in PH 1111-PH 1121 is treated somewhat more formally and rigorously than in PH 1110-PH 1120, thus presuming a better-than-average mathematics background. The recommended mathematics background for each course is indicated in the respective course description and should be considered carefully in each case.

Because the topics covered in the two mechanics courses and in the two electricity and magnetism courses are the same, it is possible to cross over from one sequence to the other. For example, PH 1120 could be taken after PH 1111, or, upon consulting with the course instructor, PH 1121 could be taken after successful completion of PH 1110. Finally, it should be noted that any combination of the first two introductory courses provides adequate preparation for both of the remaining courses in 20th Century Physics (PH 1130), and Oscillations and Waves (PH 1140).

The courses in classical mechanics and electricity and magnetism are regarded as essential preparation for many fundamental engineering courses as well as for further work in physics. PH 1130 gives a first introduction to 20th century physics and is designed to provide a context for the appreciation of present-day advances in physics and high-technology applications. PH 1140 deals in depth with oscillating systems, a topic area of fundamental importance in physics, and whose engineering applications span the range from electromagnetic oscillations to the mechanical vibrations of machinery and structures.

PH 1110. GENERAL PHYSICS—MECHANICS.

Cat. 1
Introductory course in Newtonian mechanics.

Topics include: kinematics of motion, vectors, Newton’s laws, friction, work-energy, impulse-momentum, for both translational and rotational motion.

Mathematical level: basic calculus concepts of limit and derivative will be introduced as needed. Concurrent study of MA 1021 will be adequate preparation.

PH 1111. PRINCIPLES OF PHYSICS—MECHANICS.

Cat. 1
An introductory course in Newtonian mechanics that stresses invariance principles and the associated conservation laws.

Topics include: kinematics of motion, vectors and their application to physical problems, dynamics of particles and rigid bodies, energy and momentum conservation, rotational motion.

Mathematical level: concurrent study of MA 1023 (or higher) is assumed. Students with limited prior college-level calculus preparations are advised to take PH 1110.

PH 1120. GENERAL PHYSICS—ELECTRICITY AND MAGNETISM.

Cat. 1
An introduction to the theory of electricity and magnetism.

Topics include: Coulomb’s law, electric and magnetic fields, capacitance, electrical current and resistance, and electromagnetic induction.

Mathematical level: concurrent study of MA 1022 will constitute adequate mathematical preparation.

PH 1121. PRINCIPLES OF PHYSICS—ELECTRICITY AND MAGNETISM.

Cat. 1
An introduction to electricity and magnetism, at a somewhat higher mathematical level than PH 1120.

Topics include: Coulomb’s Law, electric fields and potentials, capacitance, electric current and resistance, magnetism, and electromagnetic induction.

A working knowledge of material covered in PH 1111 is assumed. Mathematical level: concurrent study of MA 1024 (or higher) is assumed. Students concurrently taking MA 1022 or MA 1023 are advised to take PH 1120.

PH 1130. INTRODUCTION TO 20TH CENTURY PHYSICS.

Cat. 1
An introduction to the pivotal ideas and developments of twentieth-century physics.

Topics include: special relativity, photoelectric effect, X-rays, Compton scattering, blackbody radiation, DeBroglie waves, uncertainty principle, Bohr theory of the atom, atomic nuclei, radioactivity, and elementary particles.

Familiarity with material covered in PH 1110 and PH 1120 (or PH 1111 and PH 1121) is assumed. Mathematical level: completion of MA 1021 and MA 1022 will provide adequate preparation.

PH 1140. OSCILLATIONS, AND WAVES.

Cat. 1
An introduction to oscillating systems and waves.

Topics include: free, clamped forced, and coupled oscillations of physical systems, traveling waves and wave packets, reflection, and interference phenomena.

Working knowledge of the material covered in PH 1110 and PH 1120 (or PH 1111 and PH 1121) is assumed. Mathematical level: completion of MA 1021, MA 1022 and MA 1023 will provide adequate preparation.

PH 2201. INTERMEDIATE MECHANICS I.

Cat. 1
This course emphasizes a systematic approach to the mathematical formulation of mechanics problems and to the physical interpretation of the mathematical solutions.

Topics covered include: Newton’s laws of motion, kinematics and dynamics of a single particle, vector analysis, motion of particles, rigid body rotation about an axis.

Completion of the introductory physics sequence (PH 1110, PH 1120, PH 1130, PH 1140) and the first four calculus courses (MA 1021, MA 1022, MA 1023, MA 1024) is assumed. Concurrent registration in or completion of MA 2051 is expected.

PH 2202. INTERMEDIATE MECHANICS II.

Cat. 1
This course is a continuation of the treatment of mechanics started in PH 2201. Topics covered include: rigid-body dynamics, rotating coordinate systems, Newton’s law of gravitation, central-force problem, driven harmonic oscillator, an introduction to generalized coordinates, and the Lagrangian and Hamiltonian formulation of mechanics.

PH 2301. ELECTROMAGNETIC FIELDS.

Cat. 1
Introduction to the theory and application of electromagnetic fields, appropriate as a basis for further study in electromagnetism, optics, and solid-state physics.

Topics: electric field produced by charge distributions, electrostatic potential, electrostatic energy, magnetic force and field produced by currents and by magnetic dipoles, introduction to Maxwell’s equations and electromagnetic waves.

Recommended background: introductory electricity and magnetism, vector algebra, integral theorems of vector calculus as covered in MA 2251.

PH 2601. PHYSICS LABORATORY.

Cat. 1
Students will measure a variety of physical constants such as the density, resistivity and thermal conductivity of solids, the viscosity and surface tension of liquids, the frequency of sound, the wavelength of light, etc. In doing these measurements students will at the same time learn how to use oscilloscopes, op-amps, various digital devices, etc.

Students are expected to have had the Introductory Physics course sequence or equivalent, but no prior laboratory background beyond that experience is expected.

Students who have received credit for PH 2600 or PH 3600 may not receive credit for PH 2601.
PH 2651. INTERMEDIATE PHYSICS LABORATORY.
Cat. I
This course offers experience in experimentation and observation for students of the sciences and others. In a series of subject units, students learn or review the physical principles underlying the phenomena to be observed and the basis for the measurement techniques employed. Principles and uses of laboratory instruments including the cathode-ray oscilloscope, meters for frequency, time, electrical, and optical quantities are stressed. In addition to systematic measurement procedures and data recording, strong emphasis is placed on processing of the data, preparation and interpretation of graphical presentations, and analysis of precision and accuracy, including determination and interpretation of best value, measures of error and uncertainty, linear best fit to data, and identification of systematic and random errors. Preparation of high-quality experiment reports is also emphasized. Representative experiment subjects are: mechanical motions and vibrations; free and driven electrical oscillations; electric fields and potential; magnetic materials and fields; electron beam dynamics; optics; diffraction-grating spectroscopy; radioactive decay and nuclear energy measurements.
Students are expected to have had the Introductory Physics course sequence or equivalent, but no prior laboratory background beyond that experience is required.
Students who have received credit for PH 2600 or PH 3600 may not receive credit for PH 2651.

PH 3117. PROBLEM SOLVING SEMINAR.
Cat. I
This course is intended to give students some experience in solving the kinds of problems that form the daily diet of a working physicist. Small groups of students will be presented with a series of problems, which they will solve under the guidance of one or more faculty members.
Topics will be selected from a wide variety of physical disciplines.
This course is intended for third- and fourth-year physics majors, after completion of intermediate-level classical mechanics, electromagnetism, and quantum mechanics.

PH 3301. ELECTROMAGNETIC THEORY.
Cat. I
A continuation of PH 2301, this course deals with more advanced subjects in electromagnetism, as well as study of basic subjects with a more advanced level of mathematical analysis. Fundamentals of electric and magnetic fields, dielectric and magnetic properties of matter, quasi-static time-dependent phenomena, and generation and propagation of electromagnetic waves are investigated from the point of view of the classical Maxwell’s equations.

PH 3401. QUANTUM MECHANICS I.
Cat. I
This course includes a study of the basic postulates of quantum mechanics, its mathematical language and applications to one-dimensional problems. The course is recommended for physics majors and other students whose future work will involve the application of quantum mechanics.
Topics include wave packets, the uncertainty principle, introduction to operator algebra, application of the Schroedinger equation to the simple harmonic oscillator, barrier penetration and potential wells.
Junior standing is expected. Knowledge (or concurrent study) of linear algebra, Fourier series, and Fourier transforms is helpful. Prior completion of MA 4451 is recommended. Completion of the introductory physics sequence, including the introduction to 20th century physics, is expected.

PH 3402. QUANTUM MECHANICS II.
Cat. I
This course represents a continuation of PH 3401 and includes a study of three-dimensional systems and the application of quantum mechanics in selected fields.
Topics include: the hydrogen atom, angular momentum, spin, perturbation theory and examples of the application of quantum mechanics in fields such as atomic and molecular physics, solid state physics, optics, and nuclear physics.
Knowledge of the material of PH 3401 is assumed.

PH 3501. RELATIVITY.
Cat. I
This course is designed to help the student acquire an understanding of the formalism and concepts of relativity as well as its application to physical problems.
Topics include the Lorentz transformation, 4-vectors and tensors, covariance of the equations of physics, transformation of electromagnetic fields, particle kinematics and dynamics.
Knowledge of mechanics and electrodynamics at the intermediate level is assumed.
This course will be offered in 2000-01 and in alternate years thereafter.

PH 3502. SOLID STATE PHYSICS.
Cat. II
An introduction to solid state physics.
Topics include: crystallography, lattice vibrations, electron band structure, metals, semiconductors, dielectric and magnetic properties.
Prior knowledge of quantum mechanics at an intermediate level is assumed.
Knowledge of statistical physics is helpful but not required.
This course will be offered in 2000-01 and in alternate years thereafter.

PH 3503. NUCLEAR PHYSICS.
Cat. II
This course is intended to acquaint the student with the measurable properties of nuclei and the principles necessary to perform these measurements.
Topics include: binding energy, nuclear models and nuclear reactions. The deuteron will be discussed in detail and the nuclear shell model will be treated as well as the nuclear optical model.
Students are assumed to have had some knowledge of the phenomena of modern physics at the level of an introductory physics course. A knowledge of intermediate level quantum mechanics is assumed.
This course will be offered in 2001-02 and in alternate years thereafter.

PH 3504. OPTICS.
Cat. I
This course provides an introduction to classical physical optics, in particular interference, diffraction and polarization, and to the elementary theory of lenses.
The theory covered will be applied in the analysis of one or more modern optical instruments.
A knowledge of introductory electricity and magnetism and of differential equations is assumed. A knowledge of intermediate electromagnetic fields at the level of PH 2301 is advised.
This course will be offered in 2001-02 and in alternate years thereafter.

PH 4201. ADVANCED CLASSICAL MECHANICS.
Cat. I
A review of the basic principles and introduction to advanced methods of mechanics, emphasizing the relationship between dynamical symmetries and conserved quantities, as well as classical mechanics as a background to quantum mechanics.
Topics include: Lagrangian mechanics and the variational principle, central force motion, theory of small oscillations, Hamiltonian mechanics, canonical transformations, Hamilton-Jacobi Theory, rigid body motion, and continuous systems.
This course is designed for seniors and beginning graduate students, and requires classical mechanics preparation at the level of PH 2201/2202.
This is a 14-week course.

PH 4206. STATISTICAL PHYSICS.
Cat. I
An introduction to the basic principles of thermodynamics and statistical physics.
Topics covered include: basic ideas of probability theory, statistical description of systems of particles, thermodynamic laws, entropy, microcanonical and canonical ensembles, ideal and real gases, ensembles of weakly interacting spin 1/2 systems.
Knowledge of quantum mechanics at the level of PH 3401-3402 and of thermodynamics at the level of ES 3001 is assumed.

PH——. PHOTONICS.
IS/P (RSQ)
An introduction to the use of optics for transmission and processing of information. The emphasis is on understanding the physical principles underlying practical photonic devices. Topics include lasers, light emitting diodes, optical fiber communications, fiber lasers and fiber amplifiers, planar optical waveguides, light modulators and photodetectors. Undergraduates may take the course for either 1/3 or 1/6 units, graduate students may enroll for 3 credit hours.
Students having taken PH 1110, PH 1120, PH 1130 and PH 1140 (or their equivalents) should have adequate preparation. When available, this IS/P is taught by R. Quimby of the Physics Department. See him for information regarding the next scheduled offering and registration procedure.
Graduate Physics Courses of Interest to Undergraduates

PH 511/PH 4201. CLASSICAL MECHANICS.

PH 514. QUANTUM MECHANICS I.
Schrödinger wave equation. Harmonic oscillator, hydrogen atom, potential wells, approximation methods.

PH 515. QUANTUM MECHANICS II.

PH 522. THERMODYNAMICS AND STATISTICAL MECHANICS.
Quantum concepts applied to thermodynamics. Bose-Einstein and Fermi-Dirac statistics.

PH 533. ADVANCED ELECTROMAGNETIC THEORY.
Classical electrodynamics and radiation theory.

SOCIAL SCIENCE AND POLICY STUDIES

The second digit for courses in this department has the following meaning:

1 — Economics
2 — Sociology
3 — Political Science and Law
4 — Psychology
5 — System Dynamics

SS 1110. INTRODUCTORY MICROECONOMICS.
Cat. I
This course focuses upon the implications of reliance upon markets for the allocation of resources in a society, at the household, firm, and community level. Outcomes of current market systems are examined in terms of the efficient use of natural and other economic resources, as well as their impact upon the environment, fairness, and social welfare. Special interest in these analyses is the role of prices in the determination of what commodities are produced, their means of production, and distribution among households. In cases where current market outcomes have features subject to widespread criticism, such as the presence of excessive pollution, risk, discrimination, and poverty, the analysis is extended to suggest economic solutions. There are no prerequisites for the course. Term A/D Microeconomic implications of rapid technological change. Term B Microeconomics of international relations. Term C Microeconomics policy in the New England region. There are no prerequisites for the course.

SS 1120. INTRODUCTORY MACROECONOMICS.
Cat. I
This course is designed to acquaint students with the ways in which macroeconomic variables such as national income, employment and the general level of prices are determined in a modern economic system. It also includes a study of how the techniques of monetary policy and fiscal policy attempt to achieve stability in the general price level and growth in national income and employment. The problems of achieving these national goals (simultaneously) are also analyzed. The latter half of the course stresses economic issues in public policy and international trade. There are no prerequisites for SS 1120.

SS 1202. SOCIOLOGICAL CONCEPTS AND COMPARATIVE ANALYSIS.
Cat. I
The aim of this course is to give students a general idea of the nature sociology while illustrating concepts using examples from a variety of societies to enhance one’s comparative perspective. The secondary theme of the course is to focus on what field of sociology can offer those interested in the social implications of technological change and the social processes that shape science and technology. The course begins with a review of the debate over the nature of technology, whether it is more properly viewed as an aspect of social structure or culture, an integral part of society or a force external to it. Cases drawn from around the world and different technical fields are then developed both to address these questions and to illustrate various ways in which one might go about studying society-technology interaction effects. Classic sociological issues such as the distribution of wealth and power, intergroup relations, family structures and the nature of community are all covered as the cases unfold.

The cases covered range from the impact of disasters on different kinds of communities to a comparative analysis of the space agencies of Europe, the U.S. and Japan, and the different kinds of technology they tend to produce. Such observations are placed in the context of their differing processes of modernization and international positions. This course is appropriate preparation for many types of IQP’s. There are no prerequisites.

SS 1203. SOCIAL PROBLEMS AND POLICY ISSUES.
Cat. II
The goal of this course is to examine various problematic features of the emerging post-modern social organization and contemporary social issues. The course involves an examination of both the process whereby public consensus is shaped and of the “life cycle” of a social problem. Social movements, cultural values, institutional structures, media interpretation and political authorities all get attention in this process whereby some objective conditions come to be considered social problems requiring public action and others do not. Attention is also given to the warring conservative, liberal and radical perspectives on the nature of each social problem, their relative importance and what a proper response to them would be. Several specific problem areas are detailed in address illustrations. These may include subsets of energy, welfare, environmental racism, homelessness, the crisis in education, and environmental problems, international conflict, the end of work debate, changes in unionism and advanced capitalism, the role and limitations of national government, and global environmental issues, the challenges facing the American family and the relationship between drugs and crime. These issues have all been featured in one or more offering of the course in recent years. The students in each class will be given some choice as to which topics are covered as illustrations so long as they are in text.

The course requirements generally include an individual or group (your choice) project and an oral presentation. The topics are selected by the student with the approval of the instructor. There are no prerequisites.

SS 1301*, U.S. GOVERNMENT.
Cat. I
This course is an introduction to the fundamental principles, institutions, and procedures of the constitutional democracy of the United States. It examines the formal structure of the Federal system of government, including Congress, the presidency, the judiciary, and the various departments, agencies, and commissions which comprise the executive branch. Emphasis is placed on the relationships among Federal, state and local governments in the formulation and administration of domestic policies, and on the interactions among interest groups, elected officials and the public at large with administrators in the policy process. The various topics covered in the survey are linked by consideration of fiscal and budgetary issues, executive management, legislative oversight, administrative discretion, policy analysis and evaluation and democratic accountability.

SS 1303. AMERICAN PUBLIC POLICY.
Cat. I
American Public Policy focuses on the outcomes or products of political institutions and political controversy. The course first addresses the dynamics of policy formations and stalemate, the identification of policy goals, success and failure in implementation, and techniques of policy analysis. Students are then encouraged to apply these concepts in the study of a specific policy area of their choosing, such as foreign, social, urban, energy or environmental policy. This course is an important first step for students wishing to complete IQP’s in public policy research. Students are encouraged to complete SS 1303 prior to enrolling in upper level policy courses such as SS 2305, SS 2304 or SS 2311. There is no specific preparation for this course, but a basic understanding of American political institutions is assumed.

SS 1310. LAW, COURTS, AND POLITICS.
Cat. I
This course is an introduction to law and the role courts play in society. The course examines the structure of judicial systems, the nature of civil and criminal law, police practice in the enforcement of criminal law, and the responsibilities of judges, attorneys and prosecutors. Additional topics for discussion include the interpretation of precedent and statute in a common law system and how judicial discretion enables interest groups to use courts for social change. The student is expected to complete the course with an understanding of how courts exercise and thereby control the power of the state. As such, courts function as political actors in a complex system of governance. It is recommended that students complete this course before enrolling in SS 2310, Constitutional Law.

SS 1320. TOPICS IN INTERNATIONAL POLITICS.
Cat. II
SS 1320 is a survey course designed to introduce students to the basic concepts of international relations: power and influence, nations and states, sovereignty and law. These concepts will be explored through the study of issues such as diplomacy and its uses, theories of collective security and conflict, and international order and development. The study of international organizations such as the UN, the European Union or the Organization of American States will also supplement the students’ understanding of the basic concepts. The course may also include a comparative political analysis of states or regions. It is designed to provide the basic background materials for students who wish to complete IQP’s on topics that involve international relations or comparative political systems. This course will be offered in 2000-01.
SS 1401. INTRODUCTION TO COGNITIVE PSYCHOLOGY.

Cat. I

This course is concerned with understanding and explaining the mental processes and strategies underlying human behavior. The ways in which sensory input is transformed, reduced, elaborated, stored, and recovered will be examined in order to develop a picture of the human mind as an active processor of information. Topics will include perception, memory, problem-solving, judgment and decision making, human-computer interaction, and artificial intelligence. Special attention will be paid to defining the limitations of the human cognitive system. Students will undertake a project which employs one of the experimental techniques of cognitive psychology to collect and analyze data on a topic of their own choosing. There are no prerequisites for this course.

SS 1402*. INTRODUCTION TO SOCIAL PSYCHOLOGY.

Cat. I

Social psychology is concerned with how people think about, feel for, and act toward other people. Social psychologists study how people interact by focusing on the individual (not society as a whole) as the unit of analysis, by emphasizing the effect on the individual of the situation or circumstances in which behavior occurs, and by acquiring knowledge through empirical scientific investigation. This course will examine the cause of human behavior in a variety of domains of social life. Topics will include, but not be limited to, person perception, attitude formation and change, interpersonal attraction, stereotyping and prejudice, and small group behavior. Special attention will be given to applied topics: How can the research methodology in social psychology be used in real-life problems? Students will work together in small groups to explore in depth topics in social psychology of their own choosing. There are no prerequisites for this course.

SS 1503 THE PSYCHOLOGY OF DECISION MAKING AND PROBLEM SOLVING.

Cat II

This course provides the psychological background and practical skills needed to improve both professional and personal decision making and problem solving. Topics will include memory improvement, creativity, methods of problem solving, group problem solving and decision making, multiattribute utility models, social judgment theory, expert-novice differences, risky decision making, dynamic decision making, and human ability to manage complex systems. Special attention will be paid to the rationale for and appropriate use of decision support tools, including system dynamics software.

This course will be offered in 2000-01 and in alternate years thereafter.

SS 1510. INTRODUCTION TO ECONOMIC AND SOCIAL SYSTEMS.

Cat. I

The goal of this course is to provide students with an introduction to the field of system dynamics computer simulation modeling. The course begins with the history of system dynamics and the study of why policy makers can benefit from its use. Next, students systematically examine the various types of dynamic behavior that socioeconomic systems exhibit and learn to identify and model the underlying nonlinear stock-flow-feedback loop structures that cause them. The course concludes with an examination of a set of well-known system dynamics models that have been created to address a variety of socioeconomic problems. Emphasis is placed on how the system dynamics modeling process is used to test proposed policy changes and how the implementation of model-based results can improve the behavior of socioeconomic systems.

Although the course exercises and homework problems in SS 1510 involve computer simulation modeling, there are no computer or math prerequisites beyond the knowledge of basic arithmetic.

Undergraduate credit may be earned for both this course and SS 1105.

SS 1520 DYNAMIC MODELING OF ECONOMIC AND SOCIAL SYSTEMS.

Cat. I

The purpose of this course is to prepare students to produce original system dynamics computer simulation models of economic and social systems. Models of this type can be used to examine the possible impacts of policy changes and technological innovations on socioeconomic systems.

The curriculum in this course is divided into three distinct parts. First, a detailed examination of the steps of the system dynamics modeling process: problem identification (including data collection), feedback structure conceptualization, model formulation, model testing and analysis, model documentation and presentation, and policy implementation. Second, a survey of the “nuts and bolts” of continuous simulation modeling: information and material delays, time constants, the use of noise and numerical integration techniques, control theory heuristics, and software details (both simulation and model presentation and documentation software). Third, a step-by-step, in-class project that involves the construction, testing, and assembly of subsectors. Students will be required to complete modeling assignments working in groups and take in-class quizzes on modeling issues.

Recommended background: SS1510. Undergraduate credit may not be earned for both this course and SS2105.

SS/ID 2050. SOCIAL SCIENCE RESEARCH FOR THE IQP.

Cat. I

This course is open to students conducting IQPs in the Washington, London, and Puerto Rico off-campus Project Centers, and may count towards their Social Science distribution requirement. The course introduces students to the basic tools for social science research and for economic analysis such as cost-benefit analysis. It also provides practice in specific research skills using the project topic. Students will work closely with the sponsoring agencies. Students learn to develop social science hypotheses based upon literature reviews in their topic areas, construct and administer questionnaires, conduct interviews, analyze data using computerized statistical packages, and make recommendations based upon their findings. Students make presentations, write an organized project proposal as well as develop a written model for reporting their project findings. Examinations will cover the social science text and lecture material, while the project proposal will serve as the term paper.

SS 2110. INTERMEDIATE MICROECONOMICS.

Cat. II

The topics addressed in this course are similar to those covered in SS 1110 Introductory Microeconomics but the treatment proceeds in a more rigorous and theoretical fashion to provide a firm platform for students majoring in Economics or Management, or those having a strong interest in economics. Mathematics at a level comparable to that taught in MA 1021-MA 1024 is frequently applied to lend precision to the analysis. The course rigorously develops the fundamental microeconomics foundations of the theory of the firm, the theory of the consumer, the theory of markets, and the conditions required for efficiency in economic systems. Prior exposure to the microeconomic theory covered in SS 1110 Introductory Microeconomics is suggested but not required. This course will be offered in 2001-02 and in alternate years thereafter.

SS 2111. SOCIAL CONTROL OF BUSINESS.

Cat. I

An examination of government policies toward business. This course is focused on the antitrust laws: their rationale, present scope, judicial interpretation and enforcement. The direct regulation of business: its problems and effects are also explored. Public ownership as an alternative to regulation is discussed. The performance of the American mixed economy and present government techniques for the control of business are evaluated. Alternate government policies for improving industrial efficiency and social welfare are considered. This course will be of interest to students concerned with understanding how business behavior affects social and economic welfare and the role of the government in maintaining and improving the performance of a mixed economy.

Since the course will examine how different types of product and factor markets function and the relationship between market conditions and that of technological development, it will be helpful to students whose IQPs involve assessing the impact of a technical innovation on the economy or identifying the socioeconomic conditions that promote technical progress. Students taking this course should be familiar with the material covered in SS 1110, Introductory Microeconomics. This course will be offered in 2001-02 and in alternate years thereafter.

SS 2117. ENVIRONMENTAL ECONOMICS.

Cat. II

This course investigates the effect of human activity upon the environment as well as the effect of the environment on human well-being. It pays special attention to the impact of production and consumption of material goods upon the quantity and quality of environmental goods. The analysis focuses on the economic conditions that promote technical progress. Students taking this course should be familiar with the material covered in SS 1110, Introductory Microeconomics. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2120. INTERMEDIATE MACROECONOMICS.

Cat. II

This course is an advanced treatment of macroeconomic theory well suited for students majoring in Economics or Management, or others with a strong interest in economics. Knowledge of the material presented in SS 1120 – Introductory Macroeconomics will be assumed. The topics addressed in SS 2120 are similar to those covered in SS 1120, however the presentation of the material will proceed in a more rigorous and theoretical fashion. This course will be offered in 2000-01 and in alternate years thereafter.
SS 2121. GOVERNMENT BUDGETS AND FISCAL POLICY.
Cat. II
This course is a general introduction to the field of government budgets and fiscal policy. The focus is on how budgeting and fiscal policy are used to influence economic growth and development. The course emphasizes the role of government in regulating the economy and promoting social welfare. Students will learn about the principles of government budgeting, fiscal policy, and their impact on economic growth and development. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2122. DEVELOPMENT ECONOMICS.
Cat. II
This course is an introduction to the field of development economics. It focuses on the analysis of economic development in developing countries, with a particular emphasis on theories of economic growth and development. Students will study the role of economic policies, institutions, and institutions of the developing countries in promoting economic growth. This course will be offered in 2001-02 and in alternate years thereafter.

SS 2123. GOVERNMENTAL DECISION MAKING AND ADMINISTRATIVE LAW.
Cat. II
This course addresses the role of administrative law in shaping public policy decisions. It focuses on the structure and function of administrative agencies and the legal principles that govern their actions. Students will study the principles of administrative law, including substantive and procedural law, and their impact on public policy. This course will be offered in 2001-02 and in alternate years thereafter.

SS 2124. CONSTITUTIONAL LAW.
Cat. II
Constitutional Law is a study of the mechanisms through which the Constitution of the United States is interpreted and applied by the courts. The course examines the structure and powers of the federal government, the rights and freedoms of the people, and the role of the Supreme Court in interpreting the Constitution. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2125. LEGAL REGULATION OF THE ENVIRONMENT.
Cat. II
This course addresses the legal regulation of the environment, focusing on legal principles and institutions that govern environmental protection and policy. Students will study the role of legal institutions in addressing environmental issues, including pollution, waste management, and climate change. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2126. INTERNATIONAL RELATIONS.
Cat. II
This course is an introduction to the field of international relations. It focuses on the analysis of international politics, including the structure of the international system, the role of states, and the impact of global economic and political trends. Students will study the principles of international relations, including the role of institutions such as the United Nations, and their impact on global governance. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2127. SCIENCE-TECHNOLOGY POLICY.
Cat. II
This course is an introduction to the field of science and technology policy. It focuses on the analysis of policies related to science and technology, focusing on the economic, social, and ethical implications of scientific research and technology development. Students will study the role of political and economic institutions in shaping science and technology policy. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2128. THE SOCIETY - TECHNOLOGY DEBATE.
Cat. II
This course is a study of the relationship between society and technology, focusing on the ethical and social implications of technological change. Students will study the role of technology in shaping society, including the impact of technology on social institutions, economic policies, and political systems. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2129. INTERNATIONAL ENVIRONMENTAL POLICY.
Cat. II
This course is an introduction to the field of international environmental policy. It focuses on the analysis of international environmental problems, including climate change, biodiversity loss, and pollution. Students will study the role of international institutions in addressing environmental issues, focusing on the role of the United Nations and other international organizations. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2130. GOVERNMENTAL DECISION MAKING AND ADMINISTRATIVE LAW.
Cat. II
This course addresses the role of administrative law in shaping public policy decisions. It focuses on the structure and function of administrative agencies and the legal principles that govern their actions. Students will study the principles of administrative law, including substantive and procedural law, and their impact on public policy. This course will be offered in 2001-02 and in alternate years thereafter.

SS 2131. LEGAL REGULATION OF THE ENVIRONMENT.
Cat. II
This course addresses the legal regulation of the environment, focusing on legal principles and institutions that govern environmental protection and policy. Students will study the role of legal institutions in addressing environmental issues, including pollution, waste management, and climate change. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2132. INTERNATIONAL RELATIONS.
Cat. II
This course is an introduction to the field of international relations. It focuses on the analysis of international politics, including the structure of the international system, the role of states, and the impact of global economic and political trends. Students will study the principles of international relations, including the role of institutions such as the United Nations, and their impact on global governance. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2133. SCIENCE-TECHNOLOGY POLICY.
Cat. II
This course is an introduction to the field of science and technology policy. It focuses on the analysis of policies related to science and technology, focusing on the economic, social, and ethical implications of scientific research and technology development. Students will study the role of political and economic institutions in shaping science and technology policy. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2134. THE SOCIETY - TECHNOLOGY DEBATE.
Cat. II
This course is a study of the relationship between society and technology, focusing on the ethical and social implications of technological change. Students will study the role of technology in shaping society, including the impact of technology on social institutions, economic policies, and political systems. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2135. INTERNATIONAL ENVIRONMENTAL POLICY.
Cat. II
This course is an introduction to the field of international environmental policy. It focuses on the analysis of international environmental problems, including climate change, biodiversity loss, and pollution. Students will study the role of international institutions in addressing environmental issues, focusing on the role of the United Nations and other international organizations. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2136. GOVERNMENTAL DECISION MAKING AND ADMINISTRATIVE LAW.
Cat. II
This course addresses the role of administrative law in shaping public policy decisions. It focuses on the structure and function of administrative agencies and the legal principles that govern their actions. Students will study the principles of administrative law, including substantive and procedural law, and their impact on public policy. This course will be offered in 2001-02 and in alternate years thereafter.

SS 2137. LEGAL REGULATION OF THE ENVIRONMENT.
Cat. II
This course addresses the legal regulation of the environment, focusing on legal principles and institutions that govern environmental protection and policy. Students will study the role of legal institutions in addressing environmental issues, including pollution, waste management, and climate change. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2138. INTERNATIONAL RELATIONS.
Cat. II
This course is an introduction to the field of international relations. It focuses on the analysis of international politics, including the structure of the international system, the role of states, and the impact of global economic and political trends. Students will study the principles of international relations, including the role of institutions such as the United Nations, and their impact on global governance. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2139. SCIENCE-TECHNOLOGY POLICY.
Cat. II
This course is an introduction to the field of science and technology policy. It focuses on the analysis of policies related to science and technology, focusing on the economic, social, and ethical implications of scientific research and technology development. Students will study the role of political and economic institutions in shaping science and technology policy. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2140. THE SOCIETY - TECHNOLOGY DEBATE.
Cat. II
This course is a study of the relationship between society and technology, focusing on the ethical and social implications of technological change. Students will study the role of technology in shaping society, including the impact of technology on social institutions, economic policies, and political systems. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2141. INTERNATIONAL ENVIRONMENTAL POLICY.
Cat. II
This course is an introduction to the field of international environmental policy. It focuses on the analysis of international environmental problems, including climate change, biodiversity loss, and pollution. Students will study the role of international institutions in addressing environmental issues, focusing on the role of the United Nations and other international organizations. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2142. GOVERNMENTAL DECISION MAKING AND ADMINISTRATIVE LAW.
Cat. II
This course addresses the role of administrative law in shaping public policy decisions. It focuses on the structure and function of administrative agencies and the legal principles that govern their actions. Students will study the principles of administrative law, including substantive and procedural law, and their impact on public policy. This course will be offered in 2001-02 and in alternate years thereafter.

SS 2143. LEGAL REGULATION OF THE ENVIRONMENT.
Cat. II
This course addresses the legal regulation of the environment, focusing on legal principles and institutions that govern environmental protection and policy. Students will study the role of legal institutions in addressing environmental issues, including pollution, waste management, and climate change. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2144. INTERNATIONAL RELATIONS.
Cat. II
This course is an introduction to the field of international relations. It focuses on the analysis of international politics, including the structure of the international system, the role of states, and the impact of global economic and political trends. Students will study the principles of international relations, including the role of institutions such as the United Nations, and their impact on global governance. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2145. SCIENCE-TECHNOLOGY POLICY.
Cat. II
This course is an introduction to the field of science and technology policy. It focuses on the analysis of policies related to science and technology, focusing on the economic, social, and ethical implications of scientific research and technology development. Students will study the role of political and economic institutions in shaping science and technology policy. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2146. THE SOCIETY - TECHNOLOGY DEBATE.
Cat. II
This course is a study of the relationship between society and technology, focusing on the ethical and social implications of technological change. Students will study the role of technology in shaping society, including the impact of technology on social institutions, economic policies, and political systems. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2147. INTERNATIONAL ENVIRONMENTAL POLICY.
Cat. II
This course is an introduction to the field of international environmental policy. It focuses on the analysis of international environmental problems, including climate change, biodiversity loss, and pollution. Students will study the role of international institutions in addressing environmental issues, focusing on the role of the United Nations and other international organizations. This course will be offered in 2000-01 and in alternate years thereafter.
Protocol limiting CFC use, ocean dumping, biodiversity), international institutions (UNEP, the Rio Convention, the OECD) and private initiatives (international standards organizations, KOLP (Industry Committee for Ozone Layer Protection), etc.) In addition, the US policy on environmental issues will be compared with that in Japan, Europe and developing countries, from which it differs significantly. Students will design and undertake term projects that address particular issues in detail in an interdisciplinary manner. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2313. INTELLECTUAL PROPERTY LAW.
Cat. II
Intellectual property includes ideas, and the works of inventors, authors, composers and other creative people. Patents, copyrights and trademarks establish legal rights in intellectual property. Alternatively, control over the use of an idea might be maintained by treating it as a trade secret. In these ways, the ideas of inventors and creators are protected and others are prohibited from appropriating the ideas and creative works of others. This course addresses the concept of intellectual property and the public policies that support the law of patent, copyright and trademark. Subjects include the process of obtaining patents, trademarks and copyrights; requirements of originality and, for patents, utility; infringement issues, and the problems posed by international trade and efforts to address them through the World Intellectual Property Organization. It is recommended that students take SS 1310, SS 2310 or MG 2950 prior to enrolling in this course.

This course will be offered in 2001-02 and in alternate years thereafter.

SS 2401. THE PSYCHOLOGY OF EDUCATION.
Cat. II
This course is concerned with the learning of persons in educational settings from pre-school through college. Material in the course will be organized into five units covering a wide range of topics: Unit 1: Understanding Student Characteristics - Cognitive, Personality, Social, and Moral Development; Unit 2: Understanding the Learning Process - Basic Learning Theories; Unit 3: Interdependence of peoples of the world. Traditional topics of psychology provide the background and methodology for an examination of the thought processes of individuals and groups when they are faced with environmental problems in the course of their daily lives. This evaluating alternative public policies in such areas as global warming, hazardous waste disposal, cancer prevention, and species extinct. Topics will include, but not be limited to: (1) Environmental values (How do people decide what a cleaner environment is worth to them?); (2) Environmental perception and judgment (How do people decide that an environmental problem is severe enough to warrant remedial action?); (3)Environmental education (How accurate are people’s mental conceptions of environmental problems and how can accuracy be improved by educational programs?); (4) Environmental attitudes and behavior (What is the relationship between what people say they do about the environment and what they actually end up doing?). Students considering or planning IQP projects on environmental topics will find this course to be particularly valuable. Students enrolling in this course will be most successful if they have first taken either SS 1401 (Cognitive Psychology) or SS 1402 (Social Psychology) as some knowledge of introductory psychology will be assumed. This course will be offered in 2001-02 and in alternate years thereafter.

SS 2405. THE PSYCHOLOGICAL STUDY OF ENVIRONMENTAL ISSUES.
Cat. II
Environmental policymakers are increasingly coming to the realization that, in order to be effective, their policies must be based on an understanding of how people think. In this course the fields of social and cognitive psychology will provide the background and methodology for an examination of the thought processes of individuals and groups when they are faced with environmental problems in the course of their daily lives. This evaluating alternative public policies in such areas as global warming, hazardous waste disposal, cancer prevention, and species extinct. Topics will include, but not be limited to: (1) Environmental values (How do people decide what a cleaner environment is worth to them?); (2) Environmental perception and judgment (How do people decide that an environmental problem is severe enough to warrant remedial action?); (3)Environmental education (How accurate are people’s mental conceptions of environmental problems and how can accuracy be improved by educational programs?); (4) Environmental attitudes and behavior (What is the relationship between what people say they do about the environment and what they actually end up doing?). Students considering or planning IQP projects on environmental topics will find this course to be particularly valuable. Students enrolling in this course will be most successful if they have first taken either SS 1401 (Cognitive Psychology) or SS 1402 (Social Psychology) as some knowledge of introductory psychology will be assumed. This course will be offered in 2001-02 and in alternate years thereafter.

SS 2406. CROSS-CULTURAL PSYCHOLOGY: HUMAN BEHAVIOR IN GLOBAL PERSPECTIVE.
Cat. II
This course is an introduction to the study of the ways in which social and cultural forces shape human behavior. Cross-Cultural psychology takes a global perspective of human behavior that acknowledges both the uniqueness and interdependence of peoples of the world. Traditional topics of psychology (learning, cognition, personality development) as well as topics central to social psychology, such as intergroup relations and the impact of changing cultural settings, will be explored. Cultural influences on technology development and transfer, as they relate to and impact upon individuals, will also be investigated. Students preparing to work at international project centers, International Scholars, and students interested in the global aspects of science and technology will find the material presented in this course especially useful. A background in social psychology and/or sociology would be helpful. This course will be offered in 2000-01 and in alternate years thereafter.

SS 2530. ADVANCED TOPICS IN SYSTEM DYNAMICS MODELING.
Cat. II
This course will focus on advanced issues and topics in system dynamics computer simulation modeling. A variety of options for dealing with complexity through the development of models of large-scale systems and the partitioning complex problems will be discussed. Topics will include an extended discussion of model analysis, the use of summary statistics and sensitivity measures, the validity validation process and policy design. The application of system dynamics to theory building and social policy are also reviewed. Complex nonlinear dynamics and the chaotic behavior of systems will be discussed. Students will be assigned group exercises centered on model analysis and policy design.

Recommended background: SS1520, MA2051, MA3255.
This course will be offered in 2000-01 and in alternate years thereafter.

SS 2540. GROUP MODEL BUILDING.
Cat. II
This course will review the system dynamics practice of group model building, in which a system dynamics model is created through close interaction with a team of policy makers or managers. Topics will include theories of mental models, alternate techniques for eliciting, mapping, and sharing mental models for use in model building, procedures for group facilitation, individual and team learning, group communication and decision making processes, and factors that promote or impede group performance. Special attention will be paid to the rigorous assessment of learning and group performance.

Recommended background: SS1520.
This course will be offered in 2001-02 and in alternate years thereafter.

SS 3111/MG 3800. MANAGERIAL ECONOMICS.
Cat. I
An application of economic theory to the problems of a firm with special emphasis on decision-making. A study of how the firm manipulates such variables as output, price, advertising and product quality so as to achieve its goals; and of how its pricing and selling strategy choices are affected by consideration of the reactions of rival firms. Also covered are demand forecasting and cost analysis using regression and other techniques. A knowledge of the expected future distribution of demand and for individual goods and services and their costs of production is vital in establishing national economic policies and priorities. In demand and cost analysis, there is an interface between economics and technology. Consequently, this area provides a source of interactive projects that will enable students of engineering or science to draw on knowledge of their own discipline as well as economics in analyzing important social problems. Students taking this course should be familiar with the material covered in SS 1110, Introductory Microeconomics.

SS 3278. TECHNOLOGY ASSESSMENT AND IMPACT ANALYSIS SEMINAR.
Cat. II
The Indicators, Impact and Assessment Seminar is a specialized concepts and methods course designed primarily for Society-Technology Majors and students presently engaged in planning projects to carry out such analyses. It is run “semi¬nar” style with one third of the sessions being reserved for student presentations. The course includes a laboratory experience and will stress the assessment of the research designs of existing and proposed social impact and reception of innovation studies. One focus of attention will be the national effort to devise “science indicators” by the National Science Foundation to monitor the vitality of the research enterprise in the United States. Prospective and retrospective technology assessments will also be compared. Typical of the case studies to be considered would be an examination of the predicted impact of nuclear power 30 years ago and assessments of its promise today. Assessment of the promise and problems of computers, robotics and space technology being made today are possible topics of discussion, depending on class interest. The “Creativity and Scientific Community” or “The Technology-Society Debate” courses would be a good preparation for this seminar. Students with background in social science research methods and at least one social concepts course would be fully prepared for participation. This course will be offered in 2001-02 and in alternate years thereafter. *May be included in certain Humanities and Arts Sufficiency programs.

SS 3350. SYSTEM DYNAMICS SEMINAR.
Cat. II
This special topics course is designed primarily for system dynamics majors and students presently engaged in planning system dynamics projects. The course will be conducted as a research seminar, with many sessions being reserved for student presentations. Classical system dynamics models will be replicated and discussed. Students will read, evaluate, and report on research papers representing the latest developments in the field of system dynamics. They will also complete a term project that addresses a specific problem using the system dynamics method.

Recommended background: SS2530.
This course will be offered in 2001-02 and in alternate years thereafter.