

**University of Miami Bulletin, 2009 – 2010**  
**Undergraduate Course Listing**

\* 500 level courses appear in both the undergraduate and graduate course listing and may be considered undergraduate or graduate at the discretion of the department. Prerequisites, co-requisites and other course requirements are subject to change.

**University of Miami Bulletin, 2009-2010**  
**Undergraduate Course Listing**  
**COLLEGE OF ENGINEERING**  
**BIOMEDICAL ENGINEERING**

**BME100 Introduction to Biomedical Engineering for Summer Scholars**

*3 credits*

*First & Second Summer Session*

This introductory course is designed to expose high school students to biomedical engineering. The program is designed for the exemplary high school student interested in applied mathematics and science. The students will be provided with an understanding and some hands-on experience on topics relative to the discipline of Biomedical Engineering. The course content changes throughout the 3-week duration and includes topics on lasers, medical imaging, biomaterials, bioelectricity and biomechanics. The students will be able to understand the challenges associated with the design, testing and FDA clearance of biomedical devices and the importance of the scientific methods in engineering. The laboratory and field trip experiences will deal with the design and testing of a bioelectric device. Summer Scholar Students only.

PREREQUISITE: SUMMER SCHOLAR STUDENTS ONLY.

**BME111 Introduction to Engineering I**

*3 credits*

*Fall & Spring Semester*

Use of engineering tools for problem solving are discussed. Topics include the use of computer techniques for data acquisition, analysis, presentation, software design, computer aided drafting, and development of design skills through several design and building competitions. Introduction to professional ethics and intellectual property rights, the use of MATLAB, AutoCAD, and programming in C++.

**BME112 Introduction to Engineering II**

*2 credits*

*Fall & Spring Semester*

Introduction to biomedical engineering analysis, design, and manufacturing processes. Ethics, regulatory factors, and biomedical engineering design tools (mechanical, electrical and computer tools) are introduced. Hands on experience is provided through a project in which the students design, assemble, program, and test biomedical devices.

PREREQUISITE: BME 111.

**BME265 Medical Systems Physiology**

*3 credits*

*Spring Semester*

Human physiological processes from a bioengineering and medical point of view. Pertinent aspects of anatomy, biophysics, biochemistry, and disease mechanisms are also included.

PREREQUISITE: BIL 150, 151, CHM 112.

**BME301 Practical Training**

*1- 3 credits*

*Fall & Spring Semester & First & Second Summer Session*

This course serves as a way to acknowledge and evaluate a student's work on a design or research project that is conducted in a non-teaching laboratory or in a corporation. The activity supplements rather than substitutes for any of the degree requirements in BME.

**BME305 Biomedical Technology**

*3 credits*

*Spring Semester*

Non-mathematical introduction to technical and clinical aspects of biomedical engineering. Biomedical signals and instrumentation, sensors, transducers, physiological measurements, laboratory instrumentation, implants, cardiac assist devices, radiology, ultrasound, CT, MRI, transmission, and scanning electron microscopy. Field trips to clinical and research laboratories are included. Open only to non-BME students.

PREREQUISITE: BIL 150, CHM 111.

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**BME310 Mathematical Analysis in Biomedical Engineering**

*3 credits*

*Fall & Spring Semester*

Mathematical modeling of physiological and other biomedical engineering systems and devices. Basic engineering principles and mathematical tools are covered for rigorous understanding of physiological regulation and control in biosystems.

PREREQUISITE: PHY 207, MTH 311.

**BME320 The Evolution of Technology**

*3 credits*

*Spring Semester*

Organized and taught by an interdisciplinary team, this innovative course is designed for juniors and seniors. An experimental elective, the course uses multimedia to explore the ways in which innovation is driven by the needs of society and individuals, and nurtured by improvements in tools and production. Five broad subject areas will receive special attention: survival, communication, transportation, entertainment and medicine.

PREREQUISITE: JUNIOR STANDING OR HIGHER, OR PERMISSION OF THE INSTRUCTORS.

**BME330 Foundations of Medical Imaging**

*3 credits*

*Fall Semester*

Physical and biological principles of medical imaging, including ultrasound, X-ray, nuclear, magnetic resonance, electrical impedance and optical imaging. Propagation and interaction of ultrasonic waves, light waves, X-ray photons, and nuclear radiation in hard and soft biological tissue. Corequisite: BME 310.

PREREQUISITE: PRE OR CO-REQUISITE: BME 310

**BME335 Biomaterials**

*3 credits*

*Fall & Spring Semester*

Introduction to the field of Biomaterials. Review of materials science for four main types of biomaterials: ceramics, metals, polymers, and composites. Lectures on special topics given by guest lecturers who are active in their specific areas, under supervision of the instructor.

PREREQUISITE: PRE OR CO-REQUISITE: MAE 301

**BME375 Biomechanics I**

*3 credits*

*Fall & Spring Semester*

Application of solid and fluid mechanics to describe the mechanical behavior of human motion, mechanical behavior of soft and hard biological tissues, cells and biofluids. Review of fundamental concepts and techniques of mechanics (stress, strain, constitutive relations). Focus on mechanical properties of specific tissues, including tendon, skin, smooth muscle, heart muscle, cartilage, and bone. Cellular and biofluid mechanics will be presented.

PREREQUISITE: CAE 210.

**BME395 Undergraduate Research in Biomedical Engineering**

*1- 3 credits*

*Fall & Spring Semester & First & Second Summer Session*

Research and/or design projects consisting of an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF INSTRUCTOR

**BME399 Cooperative Education**

*1 credit*

*Fall & Spring Semester & First & Second Summer Session*

Practical application of classroom theory through alternating semester or summer employment with firms offering positions consistent with the student's field of study. May be repeated.

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**BME401 Senior Project I**

*1- 2 credits*

*Fall & Spring Semester*

Planning Phase of an individual or group project for seniors, to be taken during the penultimate semester to graduation.

PREREQUISITE: SENIOR STANDING.

**BME402 Senior Project II**

*1- 2 credits*

*Fall & Spring Semester*

Completion of individual or group project for seniors, to be taken during the final semester before graduation. A total of 3 credits in this 401-402 sequence.

PREREQUISITE: BME 401

**BME440 Biomedical Measurements**

*4 credits*

*Fall & Spring Semester*

Introduction to the principles of measurements in physiological and biological systems, as well as a discussion of measurable parameters, transducers, sensors, signal conditioning, and processing. Laboratory experiments are conducted in parallel with the course.

PREREQUISITE: BIL 150, 151, EEN 307.

**BME460 Introduction to Physiological Fluid Mechanics**

*3 credits*

*Spring Semester*

The role of transport processes in biological systems, mathematical modeling of physiological fluid transport, conservation of mass and momentum rheology of blood flow in large and small vessels, approximation methods for the analysis of complex physiological flow, fluid flow in the circulation and tissue. Basic engineering principles and mathematical tools are covered for rigorous understanding of physiological fluid flow.

PREREQUISITE: PHY 207, CAE 210, MTH 311.

**BME480 Biomedical Instrumentation**

*3 credits*

*Fall & Spring Semester*

Analysis and design of systems and electronic circuitry in medical and biological instrumentation. Treatment of bioelectric potentials electrodes, transducers, high gain-low noise input circuits, timing and switching circuits, biotelemetry, bioelectrodes, and bioelectric systems are discussed. Corequisite: BME 440.

PREREQUISITE: EEN 307. PRE OR COREQUISITE: BME 440

**BME501 Unified Medical Sciences I**

*3 credits*

*Fall Semester*

Treatment of the basic biological and medical elements in physiological systems. The anatomy, physiology, biophysics, biochemistry and certain aspects of clinical medicine are unified with an emphasis on cellular and subcellular systems. Not open to BME undergraduates.

PREREQUISITE: PERMISSION OF COURSE COORDINATOR.

**BME502 Unified Medical Sciences II**

*3 credits*

*Fall Semester*

Treatment of the basic biological and medical elements in physiological systems. The anatomy, physiology, biophysics, biochemistry, and certain aspects of clinical medicine are unified with an emphasis on cardiovascular, renal, digestive, endocrine, and reproductive systems. Not open to BME undergraduates.

PREREQUISITE: PERMISSION OF COURSE COORDINATOR.

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**BME503 Unified Medical Science III**

*3 credits*

*Spring Semester*

Treatment of the basic biological and medical elements in physiological systems. The anatomy, physiology, biophysics, biochemistry, and certain aspects of clinical medicine are unified with an emphasis on neural, sensory, and muscular systems. Not open to BME undergraduates.

PREREQUISITE: PERMISSION OF COURSE COORDINATOR.

**BME506 ProEngineer Applications for Biomedical Engineering**

*1 credit*

*Spring Semester*

Laboratory course for computer based two and three dimensional drawing and design based on ProEngineer. Parametric design, parts, features, assemblies for complex modeling. Applications in biomedical engineering design.

PREREQUISITE: BME 112, EEN 118

**BME507 LabView Applications for Biomedical Engineering**

*1 credit*

*Spring Semester*

Laboratory course for computer based instrumentation and design based on Labview. Virtual instrumentation, data acquisition and display, GPIB instrument control, biomedical applications in biosignal recording, and monitoring are discussed.

PREREQUISITE: BME 112, EEN 118.

**BME511 Clinical Engineering**

*3 credits*

*Offered By Announcement Only*

Clinical engineering concepts, medical instrumentation and systems, patient safety, requirements and regulations for medical devices, hospital organization, accreditation requirements, and related topics are discussed.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**BME512 Regulatory Control of Biomedical Devices**

*3 credits*

*Spring Semester*

Regulatory agencies and requirements, Food and Drug Administration, 510(k) and premarket approval (PMA), international regulatory requirements, ISO 9000 series, CE, UL, product and process validation, quality engineering, quality improvement programs, rapid prototyping, packaging and sterilization, and project management are discussed.

**BME520 Medical Imaging Systems**

*3 credits*

*Offered By Announcement Only*

Engineering and scientific principles of medical imaging systems. The concepts of instrumentation and diagnostic applications of different techniques and systems are presented. Demonstrations or exhibitions of medical systems are given in the visits to clinic and research laboratories. Topics include digital image and image processing fundamentals, radiographic (X-ray, CT), magnetic resonance(MRI) and radio-isotopic (PET) systems, and associated image reconstruction techniques. Basic concepts and simulation of imaging systems are emphasized.

PREREQUISITE: EEN 118, 201, 307, BME 570 (CO-REQUISITE) OR EQUIVALENT.

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**BME521 Medical Imaging Applications**

*3 credits*

*Fall Semester*

Medical applications of imaging systems and image processing techniques. Topics include image fundamentals (resolution, format, and storage), image processing fundamentals (transformation, compression, enhancement, segmentation, registration, and reconstruction), and image analysis fundamentals (calibration, quantification, correlation, linearity and depiction). Course includes dedicated computer laboratory projects and demonstrations given in clinical and research laboratories at the medical campus. Corequisite: BME 570 or equivalent.

PREREQUISITE: EEN 118, 201, 307. COREQUISITE: BME 570 OR EQUIVALENT.

**BME522 Scanning Electron Microscopy in Biomedical Devices**

*3 credits*

*Fall & Spring Semester*

Physics and operating principles of scanning electron microscope (SEM), transmission electron microscope (TEM), and optical light microscope. Biological tissue preparation, storage, fixation and digital image storage. Each student will learn to use the SEM in the design and/or analysis of a biomedical device.

PREREQUISITE: PERMISSION OF INSTRUCTOR

**BME525 Special Problems**

*1- 3 credits*

*Fall & Spring Semester & First & Second Summer Session*

Research and/or design projects consisting of an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: SENIOR OR GRADUATE STANDING; PERMISSION OF INSTRUCTOR.

**BME526 Special Problems**

*1- 3 credits*

*Fall & Spring Semester*

Research and/or design projects consisting of an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF THE INSTRUCTOR.

**BME527 Special Problems**

*1- 3 credits*

*Fall & Spring Semester*

Research and/or design projects consisting of an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF THE INSTRUCTOR.

**BME528 Engineering Hemodynamics**

*3 credits*

*Offered By Announcement Only*

Fluid mechanics of circulation with emphasis given to function of the heart and its valves, systemic circulation including arterial flow, capillary, venous flows, pulmonary circulation including alveolar sheet flow. Particular stress is placed on the modeling of physiological events related to blood flow in cardiovascular devices and prostheses.

PREREQUISITE: MEN 309 OR EQUIVALENT.

**BME529 Special Problems**

*1- 3 credits*

*Fall & Spring Semester & First & Second Summer Session*

Research and/or design projects. Individual investigation of current problems.

Offered by special arrangement only.

PREREQUISITE: PERMISSION OF THE INSTRUCTOR.

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**BME531 Technical Entrepreneurship I**

*1 credit*

*Fall & Spring Semester*

The first half of a two-semester sequence that simulates the work of a product development team to gain experience in technical entrepreneurship. The students propose product ideas, assess those collectively, select a few, form teams, define the product, and perform market analysis. The course is concluded with a business and technical development plan for the team's project. Lectures are presented on a variety of entrepreneurial topics.

PREREQUISITE: JUNIOR OR HIGHER STANDING.

**BME532 Technical Entrepreneurship II**

*2 credits*

*Fall & Spring Semester*

The second half of a two-semester sequence that simulates the work of a product development team to gain experience in technical entrepreneurship. The students complete the development of a working prototype and refine their marketing and business plan based on experience gained during the development phase. Lectures are presented on relevant entrepreneurial topics.

PREREQUISITE: JUNIOR OR HIGHER STANDING.

**BME535 Advanced Biomaterials**

*3 credits*

*Offered By Announcement Only*

Applications of biomaterials in different tissue and organ systems. Relationship between physical and chemical structure of materials and biological system response are discussed as well as choosing, fabricating, and modifying materials for specific biomedical applications.

PREREQUISITE: BME 335 OR PERMISSION OF INSTRUCTOR.

**BME540 Microcomputer-Based Medical Instrumentation**

*3 credits*

*Offered By Announcement Only*

Principles and design of microcomputer-based biomedical instruments, analog and digital signal conversion, microcomputer hardware and software design, algorithm development for medical applications, medical signal processing with microcomputers, software safety in life support systems, and current applications are discussed.

PREREQUISITE: EEN 304 AND 315, OR PERMISSION OF INSTRUCTOR.

**BME541 Medical Electronic Systems Laboratory**

*2 credits*

*Spring Semester*

Laboratory course for BME 540. Design of medical instruments integrated with microcomputers and telemetry devices. Corequisite: BME 540.

PREREQUISITE: COREQUISITE: BME 540.

**BME545 Biomedical Optical Instruments**

*3 credits*

*Fall Semester*

Introduction to geometrical optics, light sources, detectors, and fiber optics with an emphasis on engineering aspects and medical applications. Fiber-optic delivery systems for medical applications, optics of the eye and visual instruments, and optical instruments used in medicine (microscopes, endoscopes, ophthalmic instruments) are discussed. Hands-on sessions in the laboratory are included.

PREREQUISITE: PHY 207, MTH 311 OR PERMISSION OF THE INSTRUCTOR.

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**BME546 Medical Applications of Lasers**

*3 credits*

*Spring Semester*

Review of geometrical optics, fiber optics, wave optics, laser physics, and technology. Medical laser systems, optical properties of tissue, light propagation in tissue, laser-tissue interactions, and surgical applications of lasers are also covered. Hands-on sessions in the laboratory are included.

PREREQUISITE: PHY 207, MTH 311 OR PERMISSION OF THE INSTRUCTOR.

**BME550 Rehabilitation Engineering**

*3 credits*

*Fall Semester*

Principles of rehabilitation engineering with emphasis on currently used assistive devices for ambulation and hand motion. Human neural and muscle physiology, electromyography, functional electrical stimulation, artificial and biological sensors, control, and design aspects of active assistive devices for the active assistive devices for the handicapped are discussed.

PREREQUISITE: EEN 305 OR PERMISSION OF INSTRUCTOR.

**BME560 Biomedical Transport Phenomena**

*3 credits*

*Fall & Spring Semester*

Fundamentals of transport phenomena in biological systems including diffusio, osmosis, convection, electrophoresis, and transport with binding. Applications to cell electrophysiology and drug delivery. Introduction to physiological fluid flow in tissues.

PREREQUISITE: BME 310 OR PERMISSION OF INSTRUCTOR.

**BME565 Principles of Cellular and Tissue Engineering**

*3 credits*

*Fall Semester*

Introduction to cellular and tissue engineering. Current therapeutic approaches for lost/damaged tissue or organ function, tissue engineering strategies to replace/repair tissue or function: infusion of cells, production and delivery of tissue-inducing substances, cells placed on or within biomaterial scaffolds, examples of tissue engineering applications: skin, heart muscle, blood vessels, and blood.

PREREQUISITE: BIL 150, BME 335 OR PERMISSION OF INSTRUCTOR.

**BME570 Introduction to Biosignal Processing**

*3 credits*

*Fall & Spring Semester*

Course topics include quantitative description, analysis, and processing of biophysical and physiological (cardiovascular, neural, sensory, muscular, respiratory and other) signals using computers. Survey of time-frequency representations, correlation, convolution, coherence, filtering, averaging, and classification is also included.

PREREQUISITE: EEN 118, PRE OR CO REQUISITE: BME 440 OR PERMISSION OF INSTRUCTOR

**BME571 Introduction to Biosignal Processing Lab**

*1 credit*

*Fall & Spring Semester*

Laboratory course in conjunction with BME 570 course. Corequisite: BME 570.

PREREQUISITE: COREQUISITE: BME 570.

**BME575 Biomechanics II**

*3 credits*

*Offered By Announcement Only*

Applications of linear and nonlinear viscoelastic concepts to the biomedical characteristics of biological tissues and structures at small and large deformations of blood flow, experimental methods of analysis, artificial organs, and life-support systems.

PREREQUISITE: BME 375.

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**BME581 Radiation Biology and Physics**

*3 credits*

*Fall Semester*

The principles, methods, and results of radiation biology with physics applications in radiation therapy will be introduced in the course. The course will focus on mechanisms of radiation and biological system interaction, biological aspects of the foundation of radiation therapy, and mathematical models for radiobiological analysis. Corequisite or prerequisite: BME 502 or permission of instructor.

PREREQUISITE: PREREQUISITE OR COREQUISITE: BME 502 OR PERMISSION OF THE INSTRUCTOR.

**BME582 Radiation Dosimetry**

*3 credits*

*Spring Semester*

The principles and instrumentation of radiation dosimetry with focus on the applications in radiation therapy will be introduced in this course. The course will emphasize radiation dose computation algorithms and applications in treatment dose planning. The course will also cover a categorized dosimetric analysis of radiation therapy to different clinical conditions.

PREREQUISITE: BME 310, 581.

**BME585 Bioelectromagnetism**

*3 credits*

*Offered By Announcement Only*

Historical review of the discovery of the role of electric, magnetic, and electromagnetic fields in living systems. The survey of electro, magneto, and therapeutic devices are included as well as the interactions between electromagnetic fields and living tissues in both harmful and beneficial ways.

PREREQUISITE: EITHER BME 502 OR 503, OR PERMISSION OF INSTRUCTOR.

**BME586 Dynamic Analysis of Biological Tissues**

*3 credits*

*Offered By Announcement Only*

Dynamic analysis of biological tissues including characterization of viscoelastic properties of biological tissues using a Dynamic Mechanical Analyzer. Lab experiments are included.

PREREQUISITE: BME 375, 335 OR CONSENT OF INSTRUCTOR.

**BME587 Finite Element Analysis for Engineers**

*3 credits*

*Fall & Spring Semester*

Introduction to the finite-element method. Hands-on applications of FEMLAB software to the analysis of structural, thermal, chemical, electro-magnetic, optical, and fluid flow problems.

PREREQUISITE: MTH311 OR PERMISSION OF INSTRUCTOR

**BME590 Special Topics**

*1- 3 credits*

*Fall & Spring Semester & First & Second Summer Session*

Sub-titles describing the topics to be offered will be shown in parentheses in the printed class schedule following the title Special Topics.

PREREQUISITE: JUNIOR OR HIGHER STANDING.

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**CAE100 Introduction to Civil, Architectural, and Environmental Engineering**

*3 credits*

*Second Summer Session*

This introductory course is designed to expose high school students to a variety of specific disciplines within the civil engineering arena to assist them in making informed decisions about possible college majors. The program is designed for the exemplary high school student interested in applied mathematics and science. All students enrolled in this course will gain experience in problem solving, engineering mechanics, computer simulation, and laboratory activity. The course content changes throughout the 3-week duration and includes topics on civil engineering, environmental engineering, and architectural engineering. The students will be provided with an understanding and some hands-on experience on topics relative to the disciplines of civil, architectural, and environmental engineering. Via an introduction to several case histories, the students will be able to understand the challenges associated with the design and construction and importance of the scientific methods in engineering. The laboratory and field trip experiences will deal with bridge building, material testing, water purification, and building systems.

PREREQUISITE: SUMMER SCHOLAR STUDENTS ONLY

**CAE111 Introduction to Engineering I**

*3 credits*

*Fall & Spring Semester*

Use of engineering tools for problem solving. Computer techniques for data acquisition, analysis and presentation, software design, and computer aided drafting are covered. Development of design skills is achieved through several design and building competitions. Introduction to professional ethics and intellectual property rights, MATLAB, AutoCAD, and programming in C++ is also included.

**CAE112 Introduction to Engineering II**

*2 credits*

*Spring Semester*

Hands-on applications of various surveying instruments for leveling, angles and distance measurements, and other engineering applications. Hands on application of Geographic Information Systems, including ArcView and extensions.

PREREQUISITE: CAE 111.

**CAE201 Computer-Aided Drafting and Design**

*2 credits*

*Fall Semester*

The use of AutoCAD and MicroStation software as an aid to drafting and engineering design.

PREREQUISITE: CAE 112.

**CAE210 Mechanics of Solids I**

*3 credits*

*Fall & Spring Semester & First Summer Session*

Vectors, force systems, equilibrium, analysis of frames, machines, trusses for internal forces, friction, centroids, moment of inertia, and shear and bending moment diagrams are discussed.

PREREQUISITE: MTH 110 OR 111; OR COREQUISITE PHY 205; OR PERMISSION OF INSTRUCTOR.

**CAE211 Mechanics of Solids II**

*3 credits*

*Fall & Spring Semester*

Flexural, shear, principal, and torsional stresses are discussed as well as displacements and instability. An introduction to statically indeterminate analysis is also included.

PREREQUISITE: CAE 210.

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**CAE212 Structural Laboratory**

*1 credit*

*Fall & Spring Semester*

Laboratory techniques, tests for tension, compression, shear, bending, and torsion are discussed. Models, similitudes, buckling of columns, and review of current research are also included. Laboratory 3 hours. Corequisite: CAE 211.

PREREQUISITE: CAE210, ENG107, IEN 311. CO-REQUISITE OR PRE-REQUISITE: CAE 211

**CAE213 Behavior of Structural Systems I**

*3 credits*

*Fall Semester*

Design and testing of experimental models of qualitative and quantitative prediction of full scale structural behavior. Investigation of single and multi-story rectangular frames, curved structures and longspan buildings. Application of graphical and analytical techniques to determine basic system layout and preliminary dimensioning of key subsystems and members is also included.

PREREQUISITE: ARC 231.

**CAE240 Environmental Pollution**

*3 credits*

*Spring Semester*

Exploration of contemporary environmental issues. Introduction to engineering approaches for protecting and cleaning up the environment, techniques for assessing the impact of human activity on the environment, strategies for pollution control and implementation of environmental mitigation measures.

PREREQUISITE: SOPHOMORE STANDING.

**CAE310 Structural Analysis**

*3 credits*

*Fall & Spring Semester*

External reactions, normal forces, shear force, bending moments, displacements by Moment-Area, conjugate beam, Castigliano's First Theorem, and Virtual Work methods are discussed. The influence lines and indeterminate analysis by the method of consistent deformations, slope deflection, and moment distributions is also included.

PREREQUISITE: CAE 211.

**CAE313 Behavior of Structural Systems II**

*3 credits*

*Spring Semester*

Overall analysis of simple and multi-story frame structures. Consideration of flat plates, prestressed concrete flat slabs, slab and beam, joist and girder, waffle and space truss systems, columns, wall and rigid frame subsystems under vertical and horizontal loads. Application of structural model analysis to supplant or supplement mathematical analysis is included.

PREREQUISITE: CAE 213.

**CAE320 Design of Concrete Structures**

*3 credits*

*Fall & Spring Semester*

Course topics include design of concrete beams, columns, structural systems one-way slabs, and isolated footings by ultimate design methods.

PREREQUISITE: CAE 310.

**CAE321 Design of Steel Structures**

*3 credits*

*Fall & Spring Semester*

Design of tension, compression, flexural members, and beam columns using load and resistance factor design are discussed. Introduction to design and detailing of welded and bolted connections is also included.

PREREQUISITE: CAE 310.

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**CAE330 Fluid Mechanics**

*3 credits*

*Fall & Spring Semester*

Properties of fluids, gas systems, pressure distribution in static fluids, and hydrostatic forces on plane and curved surfaces are discussed. Kinematics and dynamics of fluid motion, dimensional analysis and similitude, flow in closed conduits, pumps, design of water distribution systems, and an introduction to flow in open channels is also included.

PREREQUISITE: CAE 210, PHY 206.

**CAE340 Introduction to Environmental Engineering**

*3 credits*

*Fall & Spring Semester*

Environmental mass and energy balances, introduction to environmental chemistry, air pollution, water pollution, sustainable solid waste management, risk assessment, and global atmospheric change are discussed.

PREREQUISITE: MTH 112, CHM 111 OR 151 OR PERMISSION OF INSTRUCTOR.

**CAE345 Environmental Laboratory**

*3 credits*

*Fall Semester*

Laboratory-based course focusing on the analysis of environmental samples including water, wastewater, air, and solids. Basic analytical techniques and quality control are also included as well as an introduction to advanced analytical measurements.

PREREQUISITE: CHM 112, CAE 340.

**CAE350 Transportation Engineering I**

*3 credits*

*Fall Semester*

Transportation systems and organizations. Characteristics of driver, vehicles and roads. Basic probability and statistics. Traffic studies and data collection. Signal timing design, basic capacity and analysis. Basic geometric design and route surveying. Highway safety. Sustainable transportation systems.

PREREQUISITE: MTH 211 (CALCULUS III) AND JUNIOR STANDING.

**CAE370 Geotechnical Engineering I**

*3 credits*

*Fall & Spring Semester*

Soil composition and classification, excavation, grading, fill compaction, stress distribution in soils, one-dimensional flow of water through soil, laboratory, and field permeability, effective stress concept, calculation of consolidation, field settlement, bearing capacity, and design and analysis of shallow foundations are discussed.

PREREQUISITE: CAE 211. COREQUISITE: CAE 371.

**CAE371 Geotechnical Laboratory**

*1 credit*

*Fall & Spring Semester*

Evaluation of physical and mechanical properties of soils, and preparation of reports. Three hours.

PREREQUISITE: ENG 107, IEN 311. COREQUISITE: CAE 370.

**CAE380 Electrical and Illumination Systems for Buildings**

*3 credits*

*Spring Semester*

Introduction to lighting and electrical system equipment, calculation procedures, design criteria, code requirements, and basic design for building lighting and electrical systems.

PREREQUISITE: EEN 205.

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**CAE395 Undergraduate Research**

*1- 6 credits*

*Spring Semester*

Designed for the undergraduate student who wishes to engage in research. Not for graduate credit or for baccalaureate graduation credit. Subject and credit to be arranged with the instructor.

PREREQUISITE: PERMISSION OF INSTRUCTOR

**CAE399 Internship**

*1 credit*

*Fall & Spring Semester & First & Second Summer Session*

Practical application of classroom theory through employment with firms offering positions consistent with the student's field of study. Courses may be repeated.

**CAE400 Preparation for FE Exam**

*1 credit*

*Spring Semester*

Review of material in preparation for the Fundamentals of Engineering (FE) examination. For credit only.

PREREQUISITE: SENIOR STANDING.

**CAE402 Professional Engineering Practice**

*3 credits*

*Fall & Spring Semester*

Principles of engineering economics and economic evaluation of engineering projects. A discussion of professional practice issues including the philosophy and methodology of engineering, professional licensure and ethics. Discussion of the business aspects of engineering including business organization, management, contracts and legal issues. Engineering leadership in the formulation of public policy.

PREREQUISITE: SENIOR STANDING.

**CAE403 Senior Design Project**

*3 credits*

*Fall Semester*

Two-semester comprehensive design project based on the knowledge and skills acquired in earlier coursework and incorporating engineering standards and realistic constraints. The faculty coordinator and several practicing engineers/architects provide consultation, guidance, and recommendations on aspects such as problem definition, evaluation of design approaches, design development, and the preparation of construction documents.

PREREQUISITE: SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

**CAE430 Water-Resources Engineering**

*3 credits*

*Fall Semester*

Basic principles of open channel flow. Computation of water surface profiles, hydraulic structures, design of lined and unlined open channels, design of sanitary sewer systems, rainfall characteristics, rainfall abstractions, and calculation of stormwater runoff are discussed. Introduction to hydrology is also included.

PREREQUISITE: CAE 330.

**CAE440 Design of Water Quality Control Systems**

*3 credits*

*Spring Semester*

Principles of domestic wastewater treatment, design of biological and chemical waste treatment processes, design and sizing of small scale treatment units, and design of water treatment processes are discussed. An introduction to industrial waste treatment.

PREREQUISITE: CAE 330, 340 OR PERMISSION OF INSTRUCTOR.

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**CAE450 Transportation Engineering II**

*3 credits*

*Spring Semester*

Transportation system planning and design. Advanced geometric design for highway and railway/transit. Human, vehicle, and environmental factors affecting the design, operation, and safety of transportation systems. Planning and design of both landside/airside aspects of airport facilities. Water port and multi-modal facilities design.

PREREQUISITE: CAE 350.

**CAE460 Construction Management**

*3 credits*

*Spring Semester*

An introduction to the management of construction projects including legal considerations as well as the techniques of management science applied to construction. The course includes engineering methods of cost and time estimating, and exercises in applications of engineering economics, network planning techniques, including CPM and PERT are introduced. The management principles of time and cost control are also explored. Computer application of project management tools are included.

PREREQUISITE: SENIOR LEVEL STANDING.

**CAE470 Foundations and Earth Retaining Systems**

*3 credits*

*Fall Semester*

Natural soil deposits and subsoil exploration. Geotechnical analysis and design of shallow and deep foundations. Theories of lateral earth pressure. Design and analysis of earth-filled retaining systems.

PREREQUISITE: CAE 330, 370, 371; PRE OR CO-REQUISITES CAE 320 OR CAE 321

**CAE480 Building Environmental Systems**

*3 credits*

*Fall Semester*

Design of building environmental systems, including water supply and waste removal, space air diffusion, fans, air supply and waste removal, space air diffusion, fans, air distribution systems, building fire safety, and smoke control. Building automation and control are also included.

PREREQUISITE: CAE 330.

**CAE481 Mechanical Systems for Buildings**

*3 credits*

*Fall & Spring Semester*

Principles and procedures for the analysis and design of heating, ventilating, and air conditioning (HVAC) systems in buildings. Topics include moist air properties and conditioning processes, heating and cooling load calculations, building energy consumption, thermal comfort, indoor air quality, HVAC systems and component selection.

PREREQUISITE: MAE 303

**CAE510 Structural Mechanics**

*3 credits*

*Offered By Announcement Only*

Analysis of stress and deformation of solids. Application to systems in the elastic and inelastic range. Topics include beams of special geometry and support, stress concentrations, stresses in elastic foundations, torsion, energy methods, failure theories, and brittle fracture.

PREREQUISITE: CAE 310 AND SENIOR STANDING.

**CAE511 Advanced Structural Analysis**

*3 credits*

*Fall Semester*

General methods of indeterminate analysis. Elements of energy method in indeterminate analysis of axial, flexural torsional, and composite members. Basic flexural and stiffness methods and matrix development are also included.

PREREQUISITE: CAE 310.

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**CAE520 Advanced Design of Concrete Structures**

*3 credits*

*Spring Semester*

Design of reinforced concrete flat plates, flat slabs, two-way slabs, long columns, and slab-column connections are discussed. Deflections, crack widths, and background of current ACI Building Code are also included.

PREREQUISITE: CAE 320.

**CAE521 Advanced Design of Steel Structures**

*3 credits*

*Fall Semester*

Steel framing systems, design of members and connections of braced and rigid frames, design for torsion, and design of steel-concrete composite members are discussed.

PREREQUISITE: CAE 321.

**CAE522 Design of Prestressed Concrete Structures**

*3 credits*

*Offered By Announcement Only*

Materials and systems for prestressing, design of prestressed concrete members for flexure and shear, camber, deflection, and crack control are discussed. Design of continuous beams, compression members, two-way concrete floor systems, and the loss of prestress are also included. Prerequisite: CAE 320.

PREREQUISITE: CAE 320.

**CAE523 Design of Masonry Structures**

*3 credits*

*Offered By Announcement Only*

Masonry construction. Design of flexural and compression members, bearing walls, shear walls, diaphragms, and connections of masonry structures. Arches, vaults, and buttresses are also included.

PREREQUISITE: CAE 320.

**CAE524 Design of Bridge Structures**

*3 credits*

*Offered By Announcement Only*

Engineering principles of analysis and design of highway bridges. Topics include load types, failure modes, and design philosophies. Computation of design force envelopes via influence lines. Design of slabs, rolled beam, plate girder, reinforced concrete, and prestressed concrete bridges.

PREREQUISITE: CAE 310, 320, 321 OR PERMISSION OF INSTRUCTOR.

**CAE525 Timber Structural Systems**

*3 credits*

*Offered By Announcement Only*

Engineering properties of timber, design of tension, compression, and flexural members are covered. The design and detail of connections and hardware, and the design of timber systems and heavy timber construction is also included.

PREREQUISITE: CAE 310

**CAE530 Water-Quality Control in Natural Systems**

*3 credits*

*Spring Semester*

Water quality regulations, fate and transport processes, water-quality control in rivers, lakes, wetlands, oceans, and ground water are discussed.

PREREQUISITE: CAE 430. PREREQUISITE OR COREQUISITE: CAE 440.

**CAE531 Surface-Water Hydrology**

*3 credits*

*Offered By Announcement Only*

Rainwater characteristics, abstraction processes, surface-runoff, routing, and water-quality models. Design of stormwater-management systems, evapotranspiration, and regional water-management is also included as well as case studies.

PREREQUISITE: PREREQUISITE OR COREQUISITE: CAE 430.

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**CAE532 Ground-Water Hydrology**

*3 credits*

*Offered By Announcement Only*

Governing equations of ground-water flow. Numerical modeling of ground-water flow. Analytic and semi-analytic solutions to the flow equations. Principle of superposition and method of images. Saltwater intrusion. Ground-water flow in the unsaturated zone. Engineered systems. Introduction to contaminant fate and transport in ground water.

PREREQUISITE: CAE 330.

**CAE540 Environmental Chemistry**

*3 credits*

*Spring Semester*

Kinetics, equilibrium, acid-base, oxidation-reduction, and reaction chemistry applied to water and wastewater engineering.

PREREQUISITE: CHM 112 OR PERMISSION OF INSTRUCTOR.

**CAE541 Environmental Microbiology**

*3 credits*

*Spring Semester*

Classification of microorganisms. Microbial agents of infectious diseases and modes of disease transmission. Control of pathogens through water and waste treatment, food protection, and insect control. Microbial ecology and bioremediation systems. Laboratory exercises in microbiology.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**CAE542 Solid and Hazardous Waste Engineering**

*3 credits*

*Fall Semester*

Solid-waste characteristics, recycling, incineration, hazardous waste characteristics, prevention, and physical and chemical treatment are covered. Design projects are also included.

PREREQUISITE: CAE 340.

**CAE543 Air Pollution Control Engineering**

*3 credits*

*Spring Semester*

Fundamentals of air pollution and air quality; properties and control of particulates, volatile organic compounds, carbon monoxide, sulfur oxides, and nitrogen oxides; motor vehicle emissions; health and aesthetic effects (acid rain, visibility), laws and regulations, meteorology and pollutant transport in the atmosphere; indoor air pollution.

PREREQUISITE: MAE 303 AND CAE330 OR MAE 309 OR PERMISSION OF INSTRUCTOR.

**CAE550 Advanced Highway Design**

*3 credits*

*Fall Semester*

Functional classification and design volumes; Reviews of traffic, vehicle and roadway characteristics; Design controls, criteria and standards; Vertical alignments; Horizontal alignments; Compound curves; Cross sections; Climbing lanes; Earthwork computation; At-grade intersection; Interchange; Design consistency; GeoPak software implementation; Use of traffic simulation software as a design aid.

PREREQUISITE: CAE 450 OR EQUIVALENT.

**CAE551 Urban Traffic Control**

*3 credits*

*Spring Semester*

Traffic control devices; Detection systems; Installation and maintenance; Design of signal timing plans; Performance analysis of signalized intersections; Signal coordination; Actuated controllers; Computer simulation/optimization models; Adaptive traffic control and predictions; Ramp metering.

PREREQUISITE: CAE 450.

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**CAE553 Transportation Systems Planning and Demand Modeling**

*3 credits*

*Offered By Announcement Only*

Transportation demand analysis and forecasting. Sampling techniques, collection and analysis of survey data. Disaggregate and aggregate models. Trip generation, distribution, modal split and assignment. Transportation network equilibrium. Transportation system management.

PREREQUISITE: IEN 311 OR CONSENT OF INSTRUCTOR.

**CAE560 Sustainable Construction**

*3 credits*

*Offered By Announcement Only*

Drivers and foundations of sustainable construction. Principles of sustainable construction: integrated planning and design, life-cycle view of projects, resource selection and optimization, protection of the natural environment, toxics and pollutants elimination, durability and quality. Green building assessment initiatives, green building policies, and code impacts. Evaluation of the environmental impacts of construction operations. Innovative design and construction practices. Economic viability. Subtropical and coastal issue and opportunities. Case studies.

PREREQUISITE: SENIOR STANDING IN ARCHITECTURE OR ENGINEERING AND PERMISSION OF INSTRUCTOR

**CAE570 Advanced Foundation Engineering**

*3 credits*

*Spring Semester*

Rock and soil formation. Subsurface exploration. Advanced design and analysis of shallow and deep foundations. Design and analysis of cofferdams.

PREREQUISITE: CAE 470 OR PERMISSION OF INSTRUCTOR.

**CAE580 Hospital and Health Care Facility Design**

*3 credits*

*First Summer Session*

Planning, design, and construction of modern hospital and health care facilities. Design criteria for functional services, and required structural and patient safety. Design standards. Discussion of construction related topics and problems.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**CAE581 Energy-Efficient Building Design**

*3 credits*

*Offered By Announcement Only*

Concepts and methods of energy-efficient and environmentally-friendly building design. Topics include energy and sustainable design strategies, climate, passive and active solar design, passive cooling systems, day lighting, and computer simulation of energy flows in buildings. A quantitative understanding of energy fundamentals, examples from practice, and design exercises using computer simulation programs are emphasized.

PREREQUISITE: MAE 303 OR PERMISSION OF INSTRUCTOR.

**CAE590 Special Topics**

*1- 3 credits*

*Offered By Announcement Only*

Sub-titles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**CAE591 Special Topics**

*1- 3 credits*

*Offered By Announcement Only*

Sub-titles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

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**CAE592 Special Topics**

*1- 3 credits*

*Offered By Announcement Only*

Sub-titles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**CAE593 Special Topics**

*1- 3 credits*

*Offered By Announcement Only*

Sub-titles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**CAE594 Special Topics**

*1- 3 credits*

*Offered By Announcement Only*

Sub-titles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**CAE595 Special Problems**

*1- 4 credits*

*Offered By Announcement Only*

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

**CAE599 Cooperative Education**

*1 credit*

*Offered By Announcement Only*

Practical application of classroom theory through alternating semester or summer employment with industries offering positions consistent with the student's field of study. Course may be repeated. Periodic reports and conferences are required.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

**ELECTRICAL & COMPUTER ENGINEERING**

**EEN100 Introduction to Electrical and Computer Engineering**

*3 credits*

*First & Second Summer Session*

Introduction to Electrical and Computer Engineering (ECE) for high school students interested in science and technology. The course covers important thematic units of the discipline: electronics, digital design, computer programming and signal processing. Emphasis on hands-on experience in the use of laboratory instrumentation, circuit construction and computer simulation.

PREREQUISITE: UNIVERSITY OF MIAMI SUMMER SCHOLAR STUDENTS ONLY

**EEN111 Introduction to Engineering I**

*3 credits*

*Fall & Spring Semester*

Use of engineering tools and computer techniques for problem solving, data acquisition, analysis, presentation, software design, and computer aided drafting. Development of design skills through several design and building competitions is included as well as an introduction to professional ethics, intellectual property rights, the use of MATLAB, AutoCAD, and programming in C++.

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**EEN112 Introduction to Engineering II**

*2 credits*

*Spring Semester*

Course is designed to provide first-year undergraduate students with an introduction to some key electrical and computer engineering concepts and topics by discussing their roles in some of the commonly used electrical and computer engineering systems. Numerical examples, circuit simulations, and computer programming are introduced through the use of MATLAB, microcontroller programming languages, and PSpice. Hands-on experience are provided through a project where the students design, assemble, program, and test a microcontroller-based mobile robot with a variety of sensing devices. Should be taken as a freshman only; otherwise to be replaced by a technical elective.

PREREQUISITE: EEN 111.

**EEN118 Introduction to Programming**

*3 credits*

*Fall & Spring Semester*

Introduction to computing, problem solving, program design, C++ language fundamentals, and software engineering principles. Software design projects are included.

**EEN201 Electrical Circuit Theory**

*3 credits*

*Fall & Spring Semester & First Summer Session*

Fundamentals of DC-AC circuit laws, including steady state and transient analysis. Lecture, 3 hours.

PREREQUISITE: PREREQUISITE OR COREQUISITE: MTH 112.

**EEN204 Electrical Circuits Laboratory**

*1 credit*

*Fall & Spring Semester & Second Summer Session*

Laboratory work employing the techniques of circuit theory to physical components, devices, and circuits. Use of electronic computing techniques to relate analytical and empirical investigations. Laboratory, 3 hours.

PREREQUISITE: EEN 201.

**EEN205 Principles of Electrical Engineering--I**

*3 credits*

*Fall & Spring Semester*

Fundamentals of DC and AC Circuits and a survey of Electrical Machinery and Electronics. Not open to students with credits in EEN 201. Lecture, 3 hours.

PREREQUISITE: PREREQUISITE OR COREQUISITE: MTH 112.

**EEN218 Intermediate Computer Programming**

*3 credits*

*Fall & Spring Semester*

Principles and practices used in creating interactive Internet sites. Extensive object oriented programming in Java is taught. Use of eXtensible Markup Language (XML) to provide content description. Use of GUI components and graphics to create web based applications.

PREREQUISITE: EEN 118 OR EQUIVALENT.

**EEN301 Electromagnetic Field Theory**

*3 credits*

*Fall Semester*

Vector analysis, static and time-varying fields, Maxwell's equations, propagation of electromagnetic waves, and transmission line theory and applications are discussed.

PREREQUISITE: PHY 207 AND MTH 210.

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**EEN304 Logic Design**

*3 credits*

*Fall & Spring Semester & First Summer Session*

Boolean algebra and its applications in analysis and design of logic circuits.

Introduction to SSI and MSI circuits as building blocks, memory elements, and analysis and synthesis of synchronous and asynchronous sequential systems are discussed.

PREREQUISITE: EEN 118 OR CSC 120.

**EEN305 Electronics I**

*3 credits*

*Fall & Spring Semester & First Summer Session*

Semiconductor physics and devices. Diodes, bipolar-junction transistors (BJT).

Introduction to field-effect transistors (FETs) and Operational Amplifiers. Emphasis on dc and ac analysis of electronic circuits. Use of CAD tools such as PSpice.

PREREQUISITE: EEN 201.

**EEN306 Electronics II**

*3 credits*

*Fall & Spring Semester & Second Summer Session*

Continuation of EEN 305. Emphasis on integrated circuits. Field-effect transistors (FETs). Application of operational amplifiers and other integrated circuits. Frequency response of amplifiers. Use of CAD tools as PSpice.

PREREQUISITE: EEN 305. PRE OR COREQUISITE: EEN 307.

**EEN307 Linear Circuits and Signals**

*3 credits*

*Fall & Spring Semester & First Summer Session*

Second-order transient circuit analysis, Laplace transforms, circuits and waveform analysis using Laplace transform, convolution, fourier series, and integrals are discussed.

PREREQUISITE: EEN 201.

**EEN308 Linear Control Systems**

*3 credits*

*Fall Semester*

Introduction to system theory, transfer function and state variable modeling of linear continuous time systems, root locus, Bode plot, Nyquist criterion, analysis and controller design using root locus and frequency domain techniques, proportional-integral-derivative controllers.

PREREQUISITE: EEN 307, MTH 210, 311.

**EEN310 Introduction to Engineering Probability**

*3 credits*

*Fall & Spring Semester*

Axioms of probability, discrete and continuous random variables, probability density functions. Expectation, conditioning, independence, functions of random variables, characteristic functions, multiple random variables. Sums of random variables, limit theorems, probability bounds, convergence concepts. Introduction to statistical analysis, estimation, and hypothesis testing. Cross-listed with IEN 310.

PREREQUISITE: MTH 112 AND JUNIOR STANDING.

**EEN311 Electronics Laboratory**

*1 credit*

*Fall & Spring Semester & First Summer Session*

Laboratory course in conjunction with courses EEN 305 and 306.

PREREQUISITE: EEN 204. PREREQUISITE OR COREQUISITE: EEN 306.

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**EEN312 Microprocessor**

*0 credit*

*Fall & Spring Semester & Second Summer Session*

Architecture and operation of modern microprocessor based computer systems and microcontrollers. Assembly language and applications with hands on experience.

Lecture, 3 hours; laboratory, 3 hours.

PREREQUISITE: EEN 304.

**EEN315 Digital Design Laboratory**

*1 credit*

*Fall & Spring Semester & First Summer Session*

Familiarization with properties and use of logic gates, flip-flops, digital standard components, and programmable logic devices. Design and implementation of combinational and synchronous digital systems and Computer Aided Engineering (CAE) tools for design and simulation of digital systems are also included.

PREREQUISITE: EEN 304.

**EEN316 Structured Digital Design**

*1 credit*

*Fall & Spring Semester & Second Summer Session*

VHDL ((VHSIC (very high speed integrated circuits) hardware description language)) introduction and syntax. Functional and behavioral models of VHDL for design, testing, and simulation of digital circuits and programmable logic devices. Design and implementation of combinational and sequential digital systems using VHDL is also included.

PREREQUISITE: PREREQUISITE OR COREQUISITE: EEN 315.

**EEN318 Advanced Computer Programming**

*3 credits*

*Spring Semester*

Continuation of the programming sequence. Object oriented programming with C++, emphasizing the skills required of a professional programmer. Essential data structures and algorithms: trees, graphs, hash tables, parsing and text processing. Advanced sorting and data management algorithms. Advanced features of C++; effective programming with C.

PREREQUISITE: EEN 218.

**EEN336 Signals and Systems**

*3 credits*

*Fall Semester*

Continuous and discrete-time transform analysis techniques. Linear time-invariant signals and systems, continuous and discrete-time Fourier transforms, and Z-transform are discussed. Sampling and reconstruction of signals, frequency response, transfer functions, and applications are also included.

PREREQUISITE: EEN 307.

**EEN368 Internet Computing I**

*3 credits*

*Spring Semester*

Principles and practices used in creating interactive Internet sites. Extensive object oriented programming in Java is taught. Use of eXtensible Markup Language (XML) to provide content description. Use of GUI components and graphics to create web based applications.

PREREQUISITE: EEN 218

**EEN399 Cooperative Education**

*1 credit*

*Fall & Spring Semester & First & Second Summer Session*

Practical application of classroom theory through alternating semester or summer employment with firms offering positions consistent with the student's field of study. Course may be repeated.

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**EEN402 Electrical Energy Conversion**

*3 credits*

*Fall Semester*

Introduction to sources of energy; theory of electromechanical energy conversion, covering transformers, DC and AC rotating machines; introduction to photovoltaic energy conversion, wind energy conversion and fuel cells; and associated laboratory experiments.

PREREQUISITE: PREREQUISITE OR COREQUISITE: EEN 307.

**EEN404 Communication Systems**

*3 credits*

*Spring Semester*

Introduction to digital communication, including binary and M-ary baseband and bandpass modulation over additive white Gaussian noise channels. Optimal receivers, pulse shaping for bandlimited channels, synchronization, multiple access.

PREREQUISITE: EEN 336 AND EEN/IEN 310.

**EEN405 Solid-State Electronics**

*3 credits*

*Spring Semester*

Principles of semiconductor electronics, energy bands of semiconductors, Fermi level, carrier distribution, and transport mechanisms are discussed. Application of semiconductor theory to various junction and field effect devices are included.

PREREQUISITE: EEN 301 AND PHY 207.

**EEN414 Computer Organization and Design**

*3 credits*

*Fall & Spring Semester*

Organization and design of computers, hardware description language, instruction set architecture, control unit implementation, microprogramming, memory organization, and high speed arithmetic unit are discussed.

PREREQUISITE: EEN 312

**EEN415 Senior Project I**

*1 credit*

*Fall & Spring Semester*

Topics cover tasks in project planning including scheduling, documentation, communication (written and oral), financial constraints, and ethics. Students are required to present project proposals to serve as the basis for the follow-up course, EEN 416.

PREREQUISITE: SENIOR STANDING.

**EEN416 Senior Project II**

*2 credits*

*Fall & Spring Semester*

The capstone design course for Electrical Engineering majors. An electrical system is designed, implemented, and documented.

PREREQUISITE: EEN 415

**EEN417 Embedded Microprocessor System Design**

*2 credits*

*Fall Semester*

Study of microcomputer system design, scientific methods for quantifying system performance, embedded controller applications using high level languages, and debugging strategies. Lecture, 1 hour; laboratory, 3 hours.

PREREQUISITE: EEN 218, 315, AND 414.

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**EEN418 Senior Project Planning**

*1 credit*

*Fall & Spring Semester*

The creative process of devising a product to meet customers needs including an overview of the design process, analysis of requirements, project planning, scheduling, evaluation, and documentation. Students are required to present project proposals to serve as the basis for the follow-up senior design project.

PREREQUISITE: SENIOR STANDING.

**EEN419 Senior Project**

*2 credits*

*Fall & Spring Semester*

The purpose of this course is to integrate the student's knowledge in hardware, software, and project management. A major digital system is designed, implemented, debugged, and documented.

PREREQUISITE: EEN 418, 417, 454.

**EEN421 Introduction to 3D Computer Modeling and Animation**

*2 credits*

*Fall Semester*

Introduction to the fundamental principles of computer animation with hands-on experience. Focus on 3D modeling, texture mapping, lighting, character animation, inverse kinematics, dynamics, rendering and compositing.

PREREQUISITE: PERMISSION OF THE INSTRUCTOR.

**EEN422 Advanced 3D Character Design and Motion Capture for Computer Games**

*2 credits*

*Spring Semester*

Introduction to game development pipeline, from design, conception, modeling, texture mapping, rigging, motion capture and animation, special effects to level design and the pipeline flow control.

PREREQUISITE: EEN 421.

**EEN424 UNIX Systems and Servers**

*3 credits*

*Fall Semester*

Practical hands-on experience with UNIX systems programming and administration. Programming using shell-scripting languages. File systems features, multiprocessing, inter-process communication, and systems programming fundamentals are discussed.

PREREQUISITE: EEN 218.

**EEN435 Communication Electronics**

*3 credits*

*Offered By Announcement Only*

Design of communication circuits including oscillators, mixers, phase-locked loops, and tuned networks; AM and FM transmitters and receivers.

PREREQUISITE: EEN 306.

**EEN436 Introduction to Digital Signal Processing**

*3 credits*

*Offered By Announcement Only*

Basic principles of digital signal processing are discussed including discrete time systems and signals, z-transform, sampling, frequency response, discrete Fourier transform, Finite and Infinite Impulse Response digital filters, and applications in related fields.

PREREQUISITE: EEN 336.

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**EEN437 Real-Time Digital Signal Processing Laboratory**

*1 credit*

*Fall Semester*

Digital signal processing hardware for real-time operation, software development tools, instruction set, and DSP experiments with audio and speech application are discussed.

PREREQUISITE: PREREQUISITE OR COREQUISITE: EEN 436.

**EEN454 Digital System Design and Testing**

*2 credits*

*Spring Semester*

Functional building blocks and concepts of control and timing in digital design.

Descriptive techniques for digital systems and design for testability.

PREREQUISITE: EEN 316.

**EEN455 Design-for-Testability Laboratory**

*1 credit*

*Fall & Spring Semester*

Project laboratory demonstrating the techniques necessary to design, implement, and debug and test a large system. The process is carried through from conceptual design, implementation, integration, simulation, and synthesis on a FPGA chip.

PREREQUISITE: PREREQUISITE OR COREQUISITE: EEN 454.

**EEN499 Senior-Junior Cooperative Education**

*1- 3 credits*

*Fall & Spring Semester & First & Second Summer Session*

Analysis and design experience obtained in industry or government. Approved project jointly supervised and assessed by department faculty and external partner. Note: A maximum of three credits could be used to satisfy degree requirement as Technical Elective. See Bulletin for more information.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIR

**EEN500 Engineering Analytical Techniques**

*3 credits*

*Offered By Announcement Only*

Complex variables, analytic functions, power series, residue theorem, conformal mappings, series solution, Bessel functions, Legendre polynomials. singular value decomposition, vector, and matrix norms are discussed.

PREREQUISITE: MTH 311.

**EEN502 Engineering Acoustics**

*3 credits*

*Fall Semester*

Introduction to basic principles of acoustics, methods of sound measurement, physiological, psychological acoustics, the acoustics of the major classes of musical instruments and speech, fundamentals of transducers, architectural acoustics, and the effects and control of noise are covered.

PREREQUISITE: EEN 336 OR PERMISSION OF INSTRUCTOR.

**EEN503 Principles of Electro-optics**

*3 credits*

*Fall Semester*

Principles of optics, optical fibers, electro-optics, light wave propagation in anisotropic and periodic media, guided waves, and integrated optics are discussed. Electro-optic devices including sources and detectors, optical fiber communication, and optics for medical and biomedical applications are also covered.

PREREQUISITE: PHY 206, 207 AND EEN 301 OR EQUIVALENT.

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**EEN504 Optics and Fiber Communication**

*3 credits*

*Spring Semester*

Introduction to optics and fiber communication, light propagation in free space and waveguides, imaging, wave phenomena and diffraction, interferometer, spectrometer, holography, fiber coupling, and fiber communication are covered. Lecture, 1 1/2 hours; laboratory, 3 hours.

PREREQUISITE: EEN 301 OR PREREQUISITE OR COREQUISITE: BME 545.

**EEN506 Solid-State Devices**

*3 credits*

*Offered By Announcement Only*

Principles of operation, properties and applications of semiconductor devices, junction, metal-semiconductor, metal-oxide-semiconductor, optoelectronic, bulk-effect, and charge-coupled are covered.

PREREQUISITE: EEN 405 OR PHY 520.

**EEN507 Active Filter Design**

*3 credits*

*Spring Semester*

Active lowpass filter design, gain-tuning and passive-tuning, immittance calculations, high-frequency lowpass filters, frequency and time domain analysis of lowpass, highpass, bandpass, and bandstop filters are discussed. Classical filters and Active filter classification including gain-sensitivity limitations are also included.

PREREQUISITE: EEN 307.

**EEN508 Digital Control Systems**

*3 credits*

*Offered By Announcement Only*

Basic concepts relevant to the analysis and design of digital computer controlled systems. Sampling, z-transform, discrete transfer functions, discrete-time state space modeling, stability, reachability, and observability are discussed. Analysis and design in time and frequency domains, state feedback and observers, optimal control, estimation, and linear quadratic Gaussian design are also included.

PREREQUISITE: EEN 308.

**EEN510 Passive Filter Design**

*3 credits*

*Offered By Announcement Only*

Design of RLC passive filters, properties of positive-real functions, and Brune test are discussed. Design of driving-point and transfer immittances of RC, RL, LC, and RLC one-port and two-port networks are also covered as well as the design of Butterworth, Chebyshev, and elliptic ladder filters.

PREREQUISITE: EEN 307.

**EEN511 Software Engineering**

*3 credits*

*Spring Semester*

Software Development: Specification and analysis, methodologies, management and control. Advanced programming techniques: dynamic programming, fast data retrieval and sorting, enumerators, data structures, and data management. The limits of software engineering, computability and complexity analysis.

PREREQUISITE: EEN 318.

**EEN512 Software Architecture**

*3 credits*

*Spring Semester*

Examination of the building blocks of software systems. Design techniques to meet functional requirements. Component-based designs. Model representations. Analysis of designs for functionality, performance, reliability, reusability, and maintainability.

PREREQUISITE: EEN 318.

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**EEN513 Software Design and Testing**

*3 credits*

*Fall Semester*

Design for testability. Software testing methods, processes, techniques and tools. Formal review techniques. Functional and structured testing methods. Unit-level and system-level testing. Integration, acceptance, regression, performance and stress testing. Verification and validation. Software quality assurance.

PREREQUISITE: EEN 318 AND SENIOR STANDING.

**EEN514 Computer Architecture**

*3 credits*

*Spring Semester & First Summer Session*

Computer data and instruction types, survey of existing architectures, and the interaction between hardware and software sub-systems are discussed. Advanced topics in computer architecture.

PREREQUISITE: EEN 414.

**EEN516 Analog Integrated Circuits**

*3 credits*

*Fall Semester*

Analysis and design of analog integrated circuits with emphasis on MOS technology. Design of operational amplifiers, comparators, sample and hold circuits, and voltage references are discussed. Fundamentals of data converters and CAD methods for analog integrated circuits are also covered.

PREREQUISITE: EEN 306.

**EEN518 Modern Control Theory**

*3 credits*

*Offered By Announcement Only*

State-space modeling of continuous-time systems, stability, reachability, observability, performance, robustness measures in controller design, State feedback and observers are discussed. Optimal control, estimation, and Linear quadratic Gaussian design are also included.

PREREQUISITE: EEN 308.

**EEN519 Design of Computing Languages**

*3 credits*

*Offered By Announcement Only*

Major features of modern programming languages with emphasis on design and software efficiency. Interaction between language design and the design of its compiler are included.

PREREQUISITE: EEN 218.

**EEN521 Computer Operating Systems**

*3 credits*

*Fall Semester*

The design and implementation of operating systems. Virtual memory and memory management, resource allocation, device drivers, process creation, control, communications and scheduling, file systems, data protection, security, parallel processing and time-sharing. The class includes a significant operating system implementation project.

PREREQUISITE: EEN 318

**EEN525 Antennas and Propagation**

*3 credits*

*Offered By Announcement Only*

Principles of electromagnetic radiation and diffraction, fundamentals of antennas, wire, loop, and micro-strip antennas, array antennas, beam-forming. propagation characteristics in the mobile and indoor environments, path loss, link budget, fading, and diversity are covered.

PREREQUISITE: EEN 301.

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**EEN532 VLSI Systems**

*3 credits*

*Fall Semester*

Fundamentals of MOS Technology in VLSI. System data, control flow, structures, design, layout, maskmaking, fabrication, packaging, and testing of VLSI chips are discussed. Highly concurrent Very Large Scale Integration computational systems are also covered.

PREREQUISITE: EEN 304 AND 305.

**EEN533 Random Signals and Noise**

*3 credits*

*Fall Semester*

Probability models, Bayes' theorem, Limit theorems of Laplace and Poisson, functions of random variables, Central limit theorem, conditional expectation and estimation, Stochastic processes, stationarity and ergodicity, cross-spectral analysis, filtering, and prediction are discussed.

PREREQUISITE: IEN 310 OR EEN 310.

**EEN534 Communication Networks**

*3 credits*

*Fall Semester*

Principles of digital communications, Local Area Networks (LANs), Wide Area Networks (WANs), Open systems Intercommunication (OSI), Internet reference models, internet architecture and protocols, packet switching and routing, and network performance are discussed.

PREREQUISITE: EEN 310 OR IEN 310.

**EEN536 Digital Signal Processing**

*3 credits*

*Offered By Announcement Only*

Fast Fourier transform, design, implementation, realization of digital filters, finite wordlength effects, decimation, interpolation, multirate signal processing, and Discrete Hilbert transform are covered.

PREREQUISITE: EEN 436.

**EEN537 Principles of Artificial Intelligence**

*3 credits*

*Fall Semester*

Search techniques, game trees, exhaustive vs. cutoff search, natural language processing, augmented transition networks, knowledge representation, cognitive aspects, semantic networks, problem-solving, expert systems, and AI machines are covered.

PREREQUISITE: EEN 218.

**EEN538 Introduction to Digital Image Processing**

*3 credits*

*Fall Semester*

Digital image representation. Image smoothing, sharpening, and transformations. Color image processing. Encoding of digital images. High level image segmentation and description techniques. Processing of image sequences.

PREREQUISITE: EEN 307 AND MTH 210.

**EEN539 Digital Communications**

*3 credits*

*Offered By Announcement Only*

Principles for the analysis and design of digital communications systems. Nyquist sampling, signal space representation, digital modulation techniques and optimal receiver design, ISI channels, error control coding, convolutional codes, Viterbi decoder, and wireless applications.

PREREQUISITE: EEN 404

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**EEN540 Digital Speech and Audio Processing**

*3 credits*

*Spring Semester*

Introduction to human speech production, hearing, and perception. Digital speech and audio signal analysis in time and frequency, speech and audio coding, speech synthesis and recognition, language modeling, design of systems for human-machine interaction are also covered.

PREREQUISITE: EEN 436 OR CONSENT OF INSTRUCTOR.

**EEN542 Digital Integrated Circuits**

*3 credits*

*Spring Semester*

Design and operation of state-of-the art digital integrated circuits. Circuit simulation methods using CAD programs, various TTL, CMOS, ECL, and I<sup>2</sup>L families are discussed.

PREREQUISITE: EEN 304, 306.

**EEN546 Reliable Digital System Design**

*3 credits*

*Offered By Announcement Only*

Topics include descriptive technique for digital systems, synchronizer failure and metastability estimation, design for testability, and estimating digital system reliability. Computer-Aided Engineering (CAE) tools are also covered. Not open to students with credit in EEN 454. Offered only for Graduate students.

PREREQUISITE: EEN 316.

**EEN548 Machine Learning**

*3 credits*

*Offered By Announcement Only*

Fundamentals of intelligent system design and strategies of learning capability simulation. Selected case studies of learning systems for engineering applications are included.

PREREQUISITE: EEN 218 AND MTH 309 OR PERMISSION OF INSTRUCTOR.

**EEN552 Power Electronics**

*3 credits*

*Fall Semester*

Analysis and design of solid-state power electronic circuits including DC/DC, AC/DC and DC/AC converters, controller design, power electronics applications, and associated laboratory experiments.

PREREQUISITE: EEN 306, EEN 311

**EEN553 Neural Networks**

*3 credits*

*Offered By Announcement Only*

Artificial neural network algorithms and structures, learning process, perceptron, least-mean-square algorithms, multilayer perceptron, error back-propagation, radial-basis function networks, the Hopfield network, and self-organizing systems are discussed.

PREREQUISITE: IEN 310 OR EEN 310.

**EEN555 Microwave Transistor Amplifier Design**

*3 credits*

*Fall Semester*

Analysis and design of transistor amplifiers and oscillators at microwave frequencies. Scattering parameter methods, stability considerations, matching networks, and narrowband and broadband techniques are discussed. Computer aided design methods for microwave transistor amplifiers are also included.

PREREQUISITE: EEN 306.

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**EEN562 Wireless and Cellular Communication**

*3 credits*

*Fall Semester*

Wireless Channel Characterization: path loss, shadowing, fading, frequency-selective channels, Doppler spread, and delay spread. Diversity techniques: frequency, time and space diversity. Multiple Antenna Systems: space-time coding, beamforming and layered space-time system. Digital Modulation: adaptive modulations and Orthogonal Frequency Division Multiplexing (OFDM). Cellular Concept: frequency reuse, co-channel interference and handoff. Multiple Access Methods: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and random access. CDMA: spreading codes, RAKE receiver, multiuser detection and power control.

PREREQUISITE: EEN 404.

**EEN563 Wireless Communication Lab**

*1 credit*

*Offered By Announcement Only*

Computer simulation of path loss, shadowing and fading in wireless channels, performance of various digital modulation methods in both Gaussian and wireless channels, diversity methods, equalization methods including zero-forcing, minimum mean-square error (MMSE) and decision-feedback equalization (DFE), co-channel interfacing in cellular systems, space-time coding. Orthogonal Frequency Division Multiplexing (OFDM) systems, spreading codes for Code Division Multiple Access (CDMA) systems, and matched-filter receiver and multiuser detector for CDMA systems. Measurement of wireless signals in various environments.

PREREQUISITE: PREREQUISITE OR COREQUISITE: EEN 562.

**EEN564 Wireless Networks**

*3 credits*

*Spring Semester*

Introduction of wireless channels and network. Introduction of medium access control: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and Carrier Sense Multiple Access. Wireless data networks: IEEE 802.11 (WiFi), IEEE 802.16 (WiMax) and Bluetooth. Wireless network layer: mobile IP and mobile ad-hoc networks. Wireless transport layer: mobile TCP. Wireless Cellular systems: network structure and call processing of GSM and CDMA systems.

PREREQUISITE: EEN 534 OR 575 OR PERMISSION OF THE INSTRUCTOR

**EEN565 Introduction to Information Theory and Coding**

*3 credits*

*Offered By Announcement Only*

Entropy, conditional entropy, mutual information, source coding, Huffman code arithmetic code, channels and channel capacity, error detection, error correction, and Hamming codes are discussed. An introduction to linear block codes and cyclic codes is included.

PREREQUISITE: IEN 310 OR EEN 310.

**EEN567 Database Design and Management**

*3 credits*

*Spring Semester*

Database systems design, modeling, implementation, management methodologies, and techniques. Different database systems are addressed including relational, object-oriented, object-relational, and distributed database systems. Internet (WWW) technology, data warehousing, and online analytical processing applications of database management systems and hands-on experience with commercial database systems is also included.

PREREQUISITE: EEN 218

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**EEN568 Internet Computing II**

*3 credits*

*Fall Semester*

Java programming for client/server networking, multi-threading, database connectivity, and servlets. Principles and practices used for accessing back-end databases through web applications. Use of eXtensible Markup Language (XML) for processing.

PREREQUISITE: EEN 368.

**EEN570 Network Client-Server Programming**

*3 credits*

*Spring Semester*

Introduction to server-client systems and programming. Advanced server-client design and implementation based on distributed component object model in Windows and UNIX.

PREREQUISITE: EEN 218 OR EQUIVALENT.

**EEN571 Interactive Multimedia Computing**

*3 credits*

*Spring Semester*

Multimedia fundamentals including hardware, software, standards, concepts and issues, compression, decompression, user interface design, query by content and multimedia indexing are discussed.

PREREQUISITE: EEN 318

**EEN572 Object-Oriented and Distributed Database Management Systems**

*3 credits*

*Offered By Announcement Only*

Object-Oriented modeling concepts in languages and database systems. Object-Oriented database systems. Semantic data models, nested-relational, object-relational databases. Distributed database system. Federated Databases. Application to engineering design problems.

PREREQUISITE: EEN 567 OR EQUIVALENT.

**EEN573 Network Computing**

*3 credits*

*Spring Semester*

Internet and Intranet architecture: scalability, language independence, and high availability. High performance computing: clustering and performance analysis. Integration through standards: object management model, reference object model, and Interface Definition Language (IDL). Directory services.

PREREQUISITE: EEN 368 AND 567.

**EEN574 Agent Technology**

*3 credits*

*Offered By Announcement Only*

Agent definition and applications, agent modeling, theories, agent representation using KIF (Knowledge Interchange Format), agent behavior, ethical and emotional agents, agent communication languages (KQML (Knowledge Query and Manipulation Language)), agent development environments and tools, agent systems (cooperative agents, interface agents, information agents, learning agents, believable agents, agents for workgroups, mobile agents), and agent case studies are covered.

PREREQUISITE: EEN 537 OR EQUIVALENT.

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**EEN575 Data Network Design and Management**

*3 credits*

*Spring Semester*

Networking fundamentals and current technologies. Data network planning, analysis, design, and management techniques. Different network technologies are addressed and contrasted in terms of topology, performance, and scope of real applications. Network management systems are investigated including fault, configuration, security, and performance management. Network management information bases, protocols, and hands-on experience with network equipment and network management systems are also included.

PREREQUISITE: EEN 310 OR IEN 310.

**EEN576 Internet and Intranet Security**

*3 credits*

*Fall Semester*

Security issues and applications for securing internet and intranet-based information exchange. Secure information models, security tools, security services, security protocols, electronic commerce, virtual private networks, firewalls, and security versus cost tradeoffs are covered.

PREREQUISITE: EEN 368.

**EEN577 Data Mining**

*3 credits*

*Offered By Announcement Only*

Introduction to the general principles of inferring useful knowledge from large data sets. Data mining algorithms, including inferring rules, linear regression, decision trees, association rules, and predictive models. Evaluation of data mining algorithms, including training, testing, prediction, comparison, cost, and cross-validation. Data mining applications.

PREREQUISITE: EEN 567 OR EQUIVALENT.

**EEN578 E-Commerce Technology**

*3 credits*

*Offered By Announcement Only*

Tools and techniques providing the foundation for the design, implementation, and deployment of e-commerce systems. Search engines, information retrieval for e-commerce, e-commerce interfacing design, and e-commerce systems case studies are also included.

PREREQUISITE: EEN 368

**EEN579 Mobile Computing**

*3 credits*

*Offered By Announcement Only*

Mobile computing and proxy architectures, mobile web protocols, mobile user interfaces, applications, systems-ware adaptations, mobile databases, transactions, data synchronization, privacy, authentication, and security are covered.

PREREQUISITE: EEN 368.

**EEN580 Electrical and Computer Engineering Internship**

*1- 3 credits*

*Fall & Spring Semester*

Analysis, design, and research experience obtained at an operating and recognized industry. Approved project jointly supervised and assessed by departmental faculty and industrial partner.

PREREQUISITE: PERMISSION OF ADVISOR.

**EEN581 Special Problems**

*1- 3 credits*

*Fall Semester*

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

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**EEN582 Special Problems**

*1- 3 credits*

*Spring Semester*

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

**EEN583 Special Problems**

*1- 3 credits*

*First Summer Session*

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

**EEN584 Special Problems**

*1- 3 credits*

*Second Summer Session*

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

**EEN585 Special Problems**

*1- 3 credits*

*Offered By Announcement Only*

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

**EEN586 Multimedia Networking**

*3 credits*

*Fall Semester*

Fundamentals of Multimedia networking. Current techniques in multimedia delivery over networks. Quality of service provisioning for multimedia networking applications. Stored video streaming. Multicasting. Multimedia transport and delivery services. Emerging protocols, applications and standards.

PREREQUISITE: EEN 534 OR 575.

**EEN587 Multimedia Databases**

*1- 3 credits*

*Fall Semester*

Introduction to the fundamental concepts and techniques pertinent to multimedia databases. Introduction to a variety of techniques and emerging innovative solutions to represent, store, index, retrieve, integrate, and manipulate data in various media type(s) to construct multimedia databases.

PREREQUISITE: EEN 567 OR PERMISSION OF INSTRUCTOR. PREREQUISITE OR COREQUISITE: EEN 571.

**EEN590 Special Topics in Information Technology**

*1- 3 credits*

*Offered By Announcement Only*

Lecture courses in selected areas of specialization within Information Technology.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**EEN591 Special Topics in Information Technology**

*1- 3 credits*

*Offered By Announcement Only*

Lecture courses in selected areas of specialization within Information Technology.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**EEN592 Special Topics in Audio Engineering**

*1- 3 credits*

*Offered By Announcement Only*

Lecture courses in selected areas of specialization within Audio Engineering.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

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**EEN593 Special Topics in Audio Engineering**

*1- 3 credits*

*Offered By Announcement Only*

Lecture courses in selected areas of specialization within Audio Engineering.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**EEN594 Special Topics in Computer Engineering**

*1- 3 credits*

*Offered By Announcement Only*

Lecture courses in selected areas of specialization within Computer Engineering.

PREREQUISITE: PERMISSION OF INSTRUCTOR - 1 COUPON

**EEN595 Special Topics in Computer Engineering**

*1- 3 credits*

*Offered By Announcement Only*

Lecture courses in selected areas of specialization within Computer Engineering.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**EEN596 Special Topics in Computer Engineering**

*1- 3 credits*

*Offered By Announcement Only*

Lecture courses in selected areas of specialization within Computer Engineering.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**EEN597 Special Topics in Electrical Engineering**

*1- 3 credits*

*Offered By Announcement Only*

Lecture courses in selected areas of specialization within Electrical Engineering.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**EEN598 Special Topics in Electrical Engineering**

*1- 3 credits*

*Offered By Announcement Only*

Lecture courses in selected areas of specialization within Electrical Engineering.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**EEN599 Special Topics in Electrical Engineering**

*1- 3 credits*

*Offered By Announcement Only*

Lecture courses in selected areas of specialization within Electrical Engineering.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**INDUSTRIAL ENGINEERING**

**IEN100 Introduction to Industrial Engineering**

*1 credit*

*First & Second Summer Session*

This introductory course is designed to expose high school students to a variety of specific disciplines within the industrial engineering arena to assist them in making informed decisions about possible college majors. The program is designed for the exemplary high school student interested in applied mathematics and science. All students enrolled in this course will gain experience in problem solving, engineering mechanics, computer simulation, and laboratory activity. The course content changes throughout the 3-week duration and includes topics on methods analysis, time studies, engineering financial analysis, energy conservation, human factors engineering, and ergonomics. The students will be provided with an understanding and some hands-on experience on topics relative to the discipline of industrial engineering. Via an introduction to several case histories, the students will be able to understand the challenges associated with the desing of systems and processes within different industries and importance of the scientific methods in engineering. The laboratory and field trip experiences will deal with amanufacturing processes, biomechanics analysis, simulation, energy conservation, and supply chain processes. Summer Scholar Students only.

PREREQUISITE: SUMMER SCHOLAR STUDENTS ONLY.

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**INDUSTRIAL ENGINEERING**

**IEN111 Introduction to Engineering I**

*3 credits*

*Fall & Spring Semester*

Use of engineering tools and computer techniques for problem solving, data acquisition, analysis, presentation, software design, and computer aided drafting. Development of design skills through several design and building competitions. Introduction to professional ethics, intellectual property, ethics, intellectual property rights, and an introduction to use of MATLAB, AutoCAD, and programming in C++.

**IEN112 Introduction to Engineering II**

*2 credits*

*Spring Semester*

Continuation of IEN 111. An overview of Industrial Engineering concepts and issues important to the design and operation of industrial and service systems. Students will learn the use of software tools developed to enhance the Industrial Engineer's ability such as database management, high level programming languages, electronic spreadsheets, and computer graphics.

PREREQUISITE: IEN 111.

**IEN201 Methods Analysis and Project Management**

*3 credits*

*Fall Semester*

Design of improved methods for doing work based on effective human effort. Time standardization of productive operations by work measurement, predetermined time systems, and activity sampling are discussed. Introduction to project management concepts and the use of Microsoft Project software.

PREREQUISITE: IEN 111 OR PERMISSION OF INSTRUCTOR.

**IEN306 Manufacturing Processes**

*3 credits*

*Fall Semester*

Basic and applied sciences in processing of materials. Effects of processing on the manufactured parts, selection of processing methods, and their relation with material properties. Contemporary and non-traditional processes used in manufacturing are also covered.

PREREQUISITE: CHM 151 AND PHY 205.

**IEN310 Introduction to Engineering Probability**

*3 credits*

*Fall & Spring Semester*

Axioms of probability, discrete and continuous random variables, probability density functions, cumulative distribution function, expectation, conditioning, independence, functions of random variables, multiple random variables, sums of random variables, introduction to statistical analysis, estimation, and hypothesis testing. Cross-listed with EEN 310.

PREREQUISITE: (MTH 112 OR EQUIVALENT) AND JUNIOR STANDING.

**IEN311 Applied Probability and Statistics**

*3 credits*

*Fall & Spring Semester*

Descriptive statistics, basic probability and distribution theory, point and interval estimation, testing hypothesis, simple linear regression, correlation, and quality control charts are discussed. Examples are drawn from various disciplines. Cross-listed with MAS 311.

PREREQUISITE: PREREQUISITE OR COREQUISITE: MTH 112 OR 132.

**IEN312 Applied Statistical Methods**

*3 credits*

*Spring Semester*

Linear regression, multiple regression, analysis of variance, and design of experiments are discussed. Cross-listed with MAS 312.

PREREQUISITE: IEN 310 (EEN 310) OR IEN 311 (MAS 311) OR EQUIVALENT.

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**IEN320 Entrepreneurship for Engineers**

*3 credits*

*Offered By Announcement Only*

Entrepreneurship as it affects engineering students. How to identify business opportunities, how to obtain financing and sustain a business, and how to take charge of the individual's entrepreneurial goals are covered.

**IEN351 Industrial Safety Engineering**

*3 credits*

*Fall Semester*

Basic principles of accident prevention and safety engineering approach to the design of mechanical equipment, facilities, and manufacturing processes. Analysis and design of fire prevention procedures and accident control procedures in industry are included.

PREREQUISITE: JUNIOR STANDING OR PERMISSION OF INSTRUCTOR.

**IEN360 Productivity Engineering**

*3 credits*

*Spring Semester*

Definitions and scope of productivity engineering and management. The productivity cycle. Productivity measurement, evaluation, improvement--discussion and examples. Productivity planning and improvement through the application of industrial and systems engineering techniques. Discussion of individual techniques with examples. Application potential of the course in real life situations.

PREREQUISITE: MTH 112 OR EQUIVALENT.

**IEN361 Industrial Cost Analysis**

*3 credits*

*Spring Semester*

Analysis of financial statements and cost factors in manufacturing and service systems. Cost accounting methods, job order costing and process costing approaches. Deterministic and probabilistic estimates of cost.

PREREQUISITE: MTH 112 OR EQUIVALENT

**IEN380 Engineering Economy**

*3 credits*

*Fall Semester*

Engineering Economy Fundamentals. Interest and money-time relationship, methods of making economic decisions, risk and uncertainty, sensitivity analysis, selections among multiple alternatives, depreciation, benefit-cost analysis, replacement studies, minimum cost analysis, and related topics.

PREREQUISITE: MTH 112 OR EQUIVALENT.

**IEN399 Internship**

*1 credit*

*Fall & Spring Semester & First & Second Summer Session*

Practical application of classroom theory through employment with firms offering positions consistent with the student's field of study. Course may be repeated.

**IEN406 Computer-Aided Manufacturing**

*3 credits*

*Spring Semester*

A comprehensive view of manufacturing with a focus on design, automation, and the use of computers in manufacturing. The topics include computer-aided design, communications, programmable logic controllers, CNC machining, industrial robots, process planning, and computer-integrated manufacturing. Laboratory projects are an integral part of the course.

PREREQUISITE: IEN 306.

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**IEN407 Product Design for Manufacturing**

*3 credits*

*Spring Semester*

The different phases of engineering design process. Guided Iteration Methodology for product design. Topics include design for manufacturing (DFM), best practices of product realization, solid modeling using SolidWorks, quality in design, issues in patents, liability and ethics. Engineering design specifications, evaluation methods for design alternatives.

PREREQUISITE: IEN 306.

**IEN441 Deterministic Models in Operations Research**

*3 credits*

*Fall Semester*

Introduction to deterministic mathematical models with applications to operational problems. Topics include the methodology of operations research, mathematical programming, game theory, network flow-theory, and dynamic programming. Cross-listed with MAS 441.

PREREQUISITE: MTH 210.

**IEN442 Stochastic Models in Operations Research**

*3 credits*

*Spring Semester*

Probabilistic models in operations research. Topics include probabilistic inventory models, queuing theory, Markov chains, and probabilistic dynamic programming. Cross-listed with MAS 442.

PREREQUISITE: (IEN 310 (EEN 310) OR IEN 311 (MAS 311)) AND IEN 441 (MAS 441).

**IEN462 Production Systems Design**

*3 credits*

*Offered By Announcement Only*

Recent advances in design and manufacturing including concurrent engineering, design for manufacturability, robust design - Taguchi methods, computer integrated manufacturing, integrated production control, Just-in-Time production systems, group technology, focused factories, flexible manufacturing systems, and agile manufacturing.

PREREQUISITE: IEN 310 (EEN 310) OR IEN 311 (MAS 311).

**IEN465 Production and Inventory Control**

*3 credits*

*Fall Semester*

Production and inventory management techniques such as forecasting methods, inventory control subject to both known and uncertain demand, aggregate planning, introduction to scheduling, materials requirement planning (MRP), just-in-time (JIT) manufacturing, and introduction to scheduling are covered.

PREREQUISITE: IEN 310 (EEN 310) OR IEN 311 (MAS 311).

**IEN470 Engineering Professionalism**

*3 credits*

*Offered By Announcement Only*

Engineering design and configuration management, product warranties and safety, environmental responsibilities, ethics, professionalism, proposal preparation, contracts, execution, project scheduling, engineering economic analysis including present value, net present value, depreciation methods, costs, and financial statements are covered.

PREREQUISITE: JUNIOR STANDING OR PERMISSION OF INSTRUCTOR.

**IEN490 Undergraduate Research**

*1- 3 credits*

*Fall Semester*

Research projects. Individual investigation of current problems

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**INDUSTRIAL ENGINEERING**

**IEN494 Senior Project**

*3 credits*

*Fall & Spring Semester*

Integration of Industrial Engineering principles and techniques in the design and improvement of production and service systems. Course includes preparation of project proposal, data collection, analysis, reporting, and formal presentations.

PREREQUISITE: SENIOR STANDING.

**IEN501 Manufacturing Analysis and Design I**

*3 credits*

*Offered By Announcement Only*

Analysis of Production Systems stressing diagnosis of problems associated with work measurement, manufacturing methodologies, and their interaction with cost factors.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**IEN502 Manufacturing Analysis and Design II**

*3 credits*

*Offered By Announcement Only*

Analysis of production systems stressing diagnosis of problems of quality and production control, utilizing quantitative techniques and analytical methods.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**IEN505 Robotics**

*3 credits*

*Fall Semester*

Fundamentals of robotics including kinematics and dynamics, trajectory planning, sensors and actuators, robotic vision, and case studies. Building your own robot is an integral part of hands-on laboratory exercises. Matlab controltoolbox and image analysis toolbox will be extensively used for design and analysis.

PREREQUISITE: IEN 306 OR PERMISSION OF INSTRUCTOR.

**IEN507 Design of Manufacturing Systems**

*3 credits*

*Spring Semester*

State-of-the-art techniques and tools relevant to the design, analysis, and control of modern manufacturing systems. Topics include modeling of manufacturing systems, tools for manufacturing system analysis, manufacturing system planning and scheduling, and lean manufacturing systems.

PREREQUISITE: IEN 465 OR PERMISSION OF INSTRUCTOR.

**IEN509 Automated Assembly**

*3 credits*

*Fall Semester*

Fundamentals of automated assembly including parts transfer systems and feeders, parts orientation and grasping techniques, product design for automated assembly (DFA), assembly robots, and performance and economics of assembly systems.

PREREQUISITE: IEN 406 OR PERMISSION OF INSTRUCTOR.

**IEN512 Statistical Quality Control and Quality Management**

*3 credits*

*Fall Semester*

Principles and practices of quality control in industry. Engineering and administrative aspects of quality control programs, process control, and acceptance sampling. Application of quantitative methods to the design and evaluation of engineering and industrial systems and processes are discussed as well as concepts of Total Quality Management.

PREREQUISITE: IEN 311 (MAS 311) OR IEN 312 (MAS 312).

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**IEN513 Quality Management in Service Organizations**

*3 credits*

*Fall Semester*

Course examines the issues of quality and productivity management in the service sector. Topics covered include the development and use of questionnaires, service industry applications of quality such as in banking, insurance, healthcare, transportation, government, public utilities, and retail trade.

PREREQUISITE: SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

**IEN524 Decision Support Systems in Industrial Engineering**

*3 credits*

*Spring Semester*

Theory and application of decision support systems in industrial engineering. Topics include the study of model-based, data-based, knowledge-based, and communication-based decision support systems. Emphasis is placed on the selection process of the appropriate systems for various decision problems in industrial environments.

PREREQUISITE: SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

**IEN547 Computer Simulation Systems**

*3 credits*

*Spring Semester*

Computer simulation and the development of simulation models. Application of discrete and continuous system simulation languages to systems studies is also included.

PREREQUISITE: IEN 442 (MAS 442) OR PERMISSION OF INSTRUCTOR.

**IEN551 Accident Prevention Systems**

*3 credits*

*Spring Semester*

Introduction to the basic principles of accident prevention and how to apply the safety engineering approach to the design of industrial accident prevention systems.

PREREQUISITE: IEN 351 OR PERMISSION OF INSTRUCTOR.

**IEN557 Ergonomics and Human Factors Engineering**

*3 credits*

*Fall Semester*

The study of human capacities and limitations with emphasis on human performance in system design. Topics include design of displays and controls, workload, job design, human information processing, anthropometry, workplace design, biomechanics, task analysis, and research techniques in human factors engineering. Lecture, 3 hours.

PREREQUISITE: IEN 312 (MAS 312) OR PERMISSION OF INSTRUCTOR.

**IEN558 Industrial Hygiene I**

*3 credits*

*Fall Semester*

Recognition of occupational chemical health hazards. Evaluation methods and analytical procedures used to determine level of exposure to chemical and toxic hazards. Control measures and compliance with OSHA requirements with special emphasis on industrial ventilation, and other methods of control are included.

PREREQUISITE: ((CHM 111 OR 151) AND SENIOR STANDING) OR PERMISSION OF INSTRUCTOR.

**IEN559 Industrial Hygiene II**

*3 credits*

*Spring Semester*

Recognition of physical occupational health hazards and evaluation methods and instruments used in measuring exposure levels with special emphasis on physical hazards. Protective measures and compliance with OSHA requirements is also included. Lecture, 3 hours.

PREREQUISITE: ((CHM 111 OR 151) AND SENIOR STANDING) OR PERMISSION OF INSTRUCTOR.

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**IEN565 Design of Integrated Manufacturing Systems**

*3 credits*

*Offered By Announcement Only*

The design of integrated manufacturing systems including concepts of production planning and control, forecasting techniques, inventory systems, production planning and scheduling methods, material requirement planning, plant layout and facility location, design principles of material handling, new trends in batch, and discrete-parts are discussed.

PREREQUISITE: SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

**IEN568 Materials Handling and Facilities Planning**

*3 credits*

*Spring Semester*

Analysis and design of production and service facilities, emphasis on material handling requirements. Capacity requirements, facility location, layout, storage systems and warehousing are discussed.

PREREQUISITE: SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

**IEN570 Engineering Management**

*3 credits*

*Spring Semester*

Integrating engineering discipline into the social and economic considerations of managing systems. Tools and techniques used by engineering managers including engineering project life cycle, role playing, communication, decision-making in engineering management, and managing change in engineering organizations are discussed.

PREREQUISITE: IEN 311 (MAS 311) OR IEN 312 (MAS 312) OR PERMISSION OF INSTRUCTOR.

**IEN571 Engineering Entrepreneurship**

*3 credits*

*Spring Semester*

The conversion of technological know-how and engineering theories into business enterprises. The role of technology in creating wealth, connecting technology with market, the role and characteristics of entrepreneurs, starting a business and the business plan, innovation, industrial and service organizations, and the new business environment.

PREREQUISITE: SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

**IEN572 Management of Technology**

*3 credits*

*Fall Semester & Second Summer Session*

Engineering, Science and Management Principles contributing to the development of a successful framework for Managing technology within an organization, nationally, or internationally. The process of technological innovations, technological planning and forecasting, and socio-economic changes.

PREREQUISITE: SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

**IEN590 Special Topics in Industrial Engineering**

*1- 3 credits*

*Offered By Announcement Only*

Sub-titles describing the topics are shown in parentheses in the class schedule, following the title "Special Topics".

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**IEN591 Dean's Seminar: Entrepreneurship**

*1 credit*

*Offered By Announcement Only*

Weekly seminar given by guest speakers on topics including process of management, marketing, planning, R & D, financing, taxation, governmental regulations, and international commerce.

PREREQUISITE: PERMISSION OF INSTRUCTOR.

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**IEN594 Master's Capstone Design Project**

*3 credits*

*Fall Semester*

A capstone design project for students in the five-year BSIE/MSIE program. Integration of Industrial Engineering principles and techniques in the design and improvement of production and service systems is emphasized. Offered for students in this program only.

PREREQUISITE: METHODS ANALYSIS, APPLIED PROBABILITY AND STATISTICS AND SENIOR STANDING.

**IEN595 Special Problems**

*1- 3 credits*

*Offered By Announcement Only*

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

**IEN596 Special Problems**

*1- 3 credits*

*Offered By Announcement Only*

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

**IEN599 Cooperative Education**

*1 credit*

*Offered By Announcement Only*

Practical application of classroom theory through alternating semester or summer employment with industries offering positions consistent with the student's field of study. Course may be repeated. Periodic reports and conferences are required.

**MECHANICAL & AEROSPACE ENGINEERING**

**MAE100 Introduction to Mechanical and Aerospace Engineering**

*3 credits*

*Fall Semester*

Basic principles of automobile engines and engine efficiency. Introduction to robots and controls. Basic concepts of solar engineering and solar energy utilization. Principles of fuel cells and hydrogen energy. Introduction to aerospace engineering including the aspects of aerodynamics, propulsion and flight dynamics. Introduction to Aerodynamics of air planes and rockets.

PREREQUISITE: SUMMER SCHOLAR STUDENTS ONLY

**MAE111 Introduction to Engineering I**

*3 credits*

*Fall & Spring Semester*

Use of engineering tools and computer techniques for problem solving. Data acquisition, analysis, presentation, software design, and computer aided drafting are covered. Development of design skills through several design and building competitions. Introduction to professional ethics and intellectual property rights. Introduction to use of MATLAB, AutoCAD, and programming in C++.

**MAE112 Introduction to Engineering II**

*2 credits*

*Fall & Spring Semester*

Introduction to engineering design and the design process. Course topics include safety, reliability, human and environmental factors, economic analysis, and cost estimation. Professional ethics, product liability, solid modeling, machine shop orientation, and practice are also included. Group design projects.

PREREQUISITE: MAE 111.

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**MAE119 Energy and Environment**

*3 credits*

*Fall Semester*

Conventional energy systems; environmental problems caused by energy carriers and energy consumption; the greenhouse effect, acid rain, and pollution; need for cleaner energy sources; environmental and other characteristics of unconventional energy sources; synthetic energy carriers and their environmental characteristics; possible solutions to energy available and related environmental problems; solar-hydrogen energy system.

PREREQUISITE: FRESHMAN STANDING.

**MAE202 Dynamics**

*3 credits*

*Fall & Spring Semester*

Discussion of motion description and analysis, application of Newton's laws, energy, and momentum principles to mechanical systems. Introduction to mechanical vibrations. Corequisite: PHY 205.

PREREQUISITE: CAE 210. COREQUISITE: PHY 205.

**MAE207 Mechanics of Solids II**

*3 credits*

*Fall & Spring Semester*

Discussion of displacements, instability, flexural, shear, torsional, and principle stresses. Introduction to statically indeterminate analysis.

PREREQUISITE: CAE 210.

**MAE241 Measurements Laboratory**

*3 credits*

*Spring Semester*

Introduction to experimental mechanical engineering. Basic principles of measurement, data interpretation, and uncertainty analysis are covered. Laboratory exercises in mechanical engineering areas are included. Corequisite: EEN 201 or 205.

PREREQUISITE: MAE 207, IEN 311, ENG 107. COREQUISITE: EEN 201 OR 205.

**MAE301 Engineering Materials Science**

*3 credits*

*Fall & Spring Semester & First Summer Session*

Introduction to the physics and chemistry of the solid state including the structure and properties of metals, polymers, and ceramics. Corequisite: PHY 207.

PREREQUISITE: CHM 111 OR 151. COREQUISITE: PHY 207.

**MAE302 Mechanical Behavior of Materials**

*3 credits*

*Fall Semester*

Application of metallurgy and mechanics to the study of the plastic deformation and fracture of metals, ceramics, and plastics. Lecture, 2 hours; laboratory, 3 hours.

PREREQUISITE: MAE 207.

**MAE303 Thermodynamics I**

*3 credits*

*Fall & Spring Semester & First Summer Session*

Thermodynamic properties of materials; the first and second laws of thermodynamics; application to thermodynamic processes; introduction to heat transfer.

PREREQUISITE: PHY 206, MTH 112 OR 132.

**MAE304 Kinematic Design**

*3 credits*

*Spring Semester*

Fundamentals of kinematic analysis and design of motion of linkages, cams, and gears are discussed. Analysis of forces in linkages, cams and gears is also included.

PREREQUISITE: MAE 202.

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**MAE308 Thermodynamics II**

*3 credits*

*Spring Semester*

Course topics include cycle irreversibility, availability of energy, power and refrigeration cycles, behavior of mixtures and solutions, chemical thermodynamics, and compressible fluids.

PREREQUISITE: MAE 303.

**MAE309 Fluid Mechanics**

*3 credits*

*Fall & Spring Semester & First Summer Session*

Course topics include fluid statics, fluid flow concepts, dynamics of inviscid and viscous fluids, closed and open channel flow, and compressibility effects.

PREREQUISITE: CAE 210, PHY 206.

**MAE310 Heat Transfer**

*3 credits*

*Fall & Spring Semester*

Application of elementary methods of solution to heat transfer problems involving steady and unsteady state conduction, radiation, and convection. Introduction of meaningful experimental data is also included.

PREREQUISITE: MAE 303.

**MAE311 Mass Transfer I**

*3 credits*

*Offered By Announcement Only*

Introduction to mass transfer phenomena and mass transfer operations in gas-liquid systems. Derivation and application of mass transfer rate equations and simultaneous heat and mass transfer phenomena are also included.

PREREQUISITE: MAE 303, 309.

**MAE341 Mechanical Design I**

*3 credits*

*Fall Semester*

Concepts and software for kinematics, solid modeling, and project management. Fundamentals of mechanical design: stresses in and failure of mechanical elements. Individual and group design projects.

PREREQUISITE: MAE 202, 207.

**MAE342 Mechanical Design II**

*3 credits*

*Spring Semester*

Review of the design process and creativity in design. Topics include design and reliability gears, shafts, etc. Individual and group design projects are included.

PREREQUISITE: MAE 341.

**MAE351 Mechanics Laboratory**

*2 credits*

*Spring Semester*

Exercises in the experimental determination of the mechanical properties of materials and the static and dynamic characteristics of mechanical and structural elements. Lecture, 1 hour; laboratory, 3 hours.

PREREQUISITE: MAE 202.

**MAE362 Computer Analysis of Mechanical and Aerospace Engineering Problems**

*3 credits*

*Spring Semester*

Exploration of physical systems behavior using discrete models. Topics include numerical analysis, solid modeling, and software evaluation. Students solve engineering problems using student-developed and existing software. Corequisite: MAE 310.

PREREQUISITE: MAE 111, 341 AND MTH 211. COREQUISITE: MAE 310.

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**MAE371 Aerodynamics**

*3 credits*

*Spring Semester*

Course discusses the history of flight. Topics include fundamental variables, the atmosphere, basic equations, their approximations, compressibility, viscosity, flow regimes potential flow, and aerodynamics of airfoil and wing.

PREREQUISITE: MAE 309.

**MAE399 Cooperative Education**

*1 credit*

*Fall & Spring Semester & First & Second Summer Session*

Practical application of classroom theory through alternating semester or summer employment with firms offering positions consistent with the student's field of study. Course may be repeated.

**MAE404 Experimental Engineering Laboratory**

*2 credits*

*Fall Semester*

Experimental analysis of problems in fluid mechanics, thermodynamics, and other areas of engineering. Lecture, 1 hour; laboratory, 3 hours.

PREREQUISITE: MAE 303, 309, 310.

**MAE405 Thermal Environmental Engineering**

*3 credits*

*Fall Semester*

An extension of basic thermodynamics to the design of engineering systems exposed to various thermal environments. Topics include fundamentals of air conditioning, special refrigeration systems, solar radiation, and thermal analysis of engineering components.

PREREQUISITE: PREREQUISITE OR COREQUISITE: MAE 308, 310.

**MAE408 Heating, Ventilating, and Air Conditioning**

*3 credits*

*Spring Semester*

Principles and procedures for the analysis and design of heating, ventilating and air conditioning (HVAC) systems, including moist air properties and conditioning processes, heating and cooling load calculations, building energy consumption, thermal comfort, and indoor air quality. Not available for students having taken MAE 405.

PREREQUISITE: MAE 303.

**MAE410 Engineering Administration**

*2 credits*

*Fall Semester*

Course topics include engineering economics, cost determination, legal phases of engineering, and engineering procedures. Lecture, 2 hours.

PREREQUISITE: IEN 311 AND JUNIOR STANDING.

**MAE412 System Dynamics**

*3 credits*

*Fall Semester*

Course topics include dynamic modeling of mechanical and thermo-fluid systems. Laplace transforms, transfer functions, energy concepts, causality, linearity, linear graph models, energy transducing system elements, frequency domain methods.

PREREQUISITE: EEN 201 OR 205, MAE 202, 309.

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**MAE415 Automatic Control**

*3 credits*

*Spring Semester*

Introduction to system theory, transfer functions, and state space modeling of physical systems. Course topics include stability, analysis and design of PID, Lead/Lag, other forms of controllers in time and frequency domains, root locus Bode diagrams, gain and phase margins, Nichols chart, Nyquist criterion, and systems with time delay.

PREREQUISITE: SENIOR STANDING

**MAE420 Applied Thermodynamics**

*3 credits*

*Spring Semester*

Cycle irreversibility; energy. Power and refrigeration cycles. Behavior of mixtures and solutions. Chemical thermodynamics, including combustion fundamentals. Compressible fluids. Advanced energy systems.

PREREQUISITE: MAE 303.

**MAE441 Design of Fluid and Thermal Systems**

*3 credits*

*Fall & Spring Semester*

Course topics include thermal and fluid systems design fundamentals, piping systems, selection of pumps, piping system design practices, classification of heat exchangers. Basic design methods of heat exchange equipment is also included.

PREREQUISITE: MAE 309, 310.

**MAE442 Capstone Design Project-I**

*1 credit*

*Fall & Spring Semester*

Lectures and classroom discussions cover (i) legal, ethical, and societal responsibilities of engineers, (ii) design factors such as product safety, reliability, life cycle costs, and manufacturability, and (iii) other aspects such as global market, contemporary issues, and continuous learning process. Students are required to select group design projects from the breadth of mechanical engineering activity and present project to serve as the basis for MAE 443.

PREREQUISITE: SENIOR STANDING IN MECHANICAL ENGINEERING.

**MAE443 Capstone Design Project-II**

*2 credits*

*Fall & Spring Semester*

Continuation of the Capstone Design Project-I course. A mechanical system is designed, implemented, documented, and presented.

PREREQUISITE: MAE 442.

**MAE444 Capstone Aerospace Design Project-I**

*1 credit*

*Fall & Spring Semester*

Lectures and classroom discussions cover (i) legal, ethical and societal responsibilities of engineers, (ii) design factors such as product safety, reliability, life cycle costs and manufacturability, and (iii) other aspects such as global market, contemporary issues and continuous learning process. Students are required to select group design projects from the breadth of aerospace engineering activity and present project proposals to serve as the basis for MAE 445.

PREREQUISITE: SENIOR STANDING IN AEROSPACE ENGINEERING.

**MAE445 Capstone Aerospace Design Project-II**

*2 credits*

*Fall & Spring Semester*

Continuation of the Capstone Aerospace Design Project-I course. An aerospace system/subsystem is designed, implemented, documented and presented.

PREREQUISITE: MAE 444.

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**MAE446 Aircraft Design**

*3 credits*

*Fall Semester*

Concepts of aircraft design emphasizing on design layout including the airfoil geometry selection, propulsion integration, configuration layout, payload and landing gear system. Corequisite: MAE 471.

PREREQUISITE: PRE- OR CO-REQUISITE: MAE 471

**MAE470 Introduction to Aerospace Structures**

*3 credits*

*Spring Semester*

Course topics include mechanics of thin-walled aerospace structures, load analysis, virtual work, energy principles, stability of aerostructures, and finite element methods.

PREREQUISITE: MAE 207.

**MAE471 Flight Dynamics**

*3 credits*

*Fall Semester*

Course topics include aerodynamic performance, stability, control, propulsion systems, and structures. Case Studies of Aerospace Systems are also included.

PREREQUISITE: MAE 371.

**MAE472 Design of Aerospace Structures**

*3 credits*

*Fall Semester*

Design Philosophy and principles of aerospace structures. Detailed design of wing box structure, fuselage, landing gear mechanism, fasteners and structural joints.

Application of composite materials.

PREREQUISITE: MAE 470.

**MAE490 Undergraduate Research**

*1- 3 credits*

*Fall & Spring Semester & First & Second Summer Session*

Research Projects. Individual investigation of current problems.

PREREQUISITE: PERMISSION OF THE INSTRUCTOR

**MAE501 Methods of Engineering Analysis**

*3 credits*

*Fall Semester*

Analysis of engineering systems in equilibrium and motion. Examples considered from mechanical, electrical, thermal and fluids engineering. Mathematical theory and computer methods for obtaining numerical solutions are developed for various cases involving discrete and continuous systems. Lecture, 3 hours.

PREREQUISITE: MAE 412, MTH 311 OR PERMISSION OF THE INSTRUCTOR.

**MAE502 Vibrations**

*3 credits*

*Fall Semester*

Basic theory of free and forced vibrations of mechanical systems with and without damping. Applications to systems with one and several degrees of freedom are included.

PREREQUISITE: MAE 202, 207, 412 OR PERMISSION OF INSTRUCTOR.

**MAE503 Internal Combustion Engines**

*3 credits*

*Fall Semester*

Course discusses engine types, characteristics, and operation. Topics include performance factors, fuel combustion, power cycles, knock and engine variables, exhaust emissions, fuel metering, compressors, and turbines.

PREREQUISITE: MAE 303, SENIOR STANDING, OR PERMISSION OF INSTRUCTOR.

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**MAE505 Design for Manufacturability**

*3 credits*

*Fall Semester*

Manufacturing concerns at design stage. Design theory and methodology. Statistical considerations in geometric dimensioning, tolerances, reliability-based design, and quality control. Producibility, design for assembly, and value engineering. Life cycle costs and optimum design using nonlinear programming and Taguchi approaches. Hands on projects on machine tools.

PREREQUISITE: MAE 341 AND 342 OR CONSENT OF INSTRUCTOR.

**MAE506 Nuclear Engineering**

*3 credits*

*Offered By Announcement Only*

Course topics include a review of neutron physics, chain reactions, reactor theory, steady state operation, and reactor kinetics. Control, long term reactivity changes, materials, heat transfer, and shielding are also included. Lecture, 3 hours.

PREREQUISITE: SENIOR STANDING IN MECHANICAL AND AEROSPACE ENGINEERING OR PERMISSION OF INSTRUCTOR.

**MAE507 Advanced Mechanics of Solids**

*3 credits*

*Spring Semester*

Courses discusses the basic elements of elasticity, plasticity, and viscoelasticity.

Application to mechanical systems at rest and in motion are included.

PREREQUISITE: MAE 202, 207, SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

**MAE508 Intermediate Heat Transfer**

*3 credits*

*Spring Semester*

Course discusses steady and unsteady heat transfer by conduction, convective heat transfer in laminar and turbulent fluid flow, natural convection, and heat transfer by radiation.

PREREQUISITE: MAE 310.

**MAE509 Hydrogen Energy**

*3 credits*

*Fall Semester*

Evaluation of new energy sources, need for an intermediary system, hydrogen energy system, hydrogen as energy carrier, hydrogen production methods, hydrogen storage and distribution, utilization of hydrogen by residential, commercial, transportation, and industrial sectors are discussed as well as environmental, safety, and economical considerations.

PREREQUISITE: SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

**MAE510 Fundamentals of Solar Energy Utilization**

*3 credits*

*Spring Semester*

Fundamentals basic to the design and performance analysis of thermal systems for the capture and utilization of Solar Energy.

PREREQUISITE: MAE 303, MTH 211 AND PHY 207.

**MAE511 Engineering Fracture Mechanics**

*3 credits*

*Offered By Announcement Only*

Course addresses the consequence of fracture including some illustrative applications of fracture mechanics, Griffith's fracture theory, review of relevant results from solid mechanics, the three basic modes of fracture, stress intensity factor, introduction to elasto-plastic and dynamic fracture, fatigue crack propagation, fracture and non-destructive evaluation procedures.

PREREQUISITE: MAE 207, SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

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**MAE512 Intermediate Fluid Mechanics**

*3 credits*

*Fall Semester*

Course topics include conservation of mass, momentum, and energy, potential flow, viscous laminar and turbulent flows, the Reynolds analogy, and Boundary-layer approximations. Gas dynamics are also discussed.

PREREQUISITE: MAE 309.

**MAE513 Kinematics for Robotics**

*3 credits*

*Offered By Announcement Only*

Geometry of unconstrained plane motion with applications to linkage design. Topics include type and number synthesis, introduction to 3-D mechanism with applications to robotics, graphical, analytical, and computer techniques, including the use of analysis software.

PREREQUISITE: MAE 202, SENIOR STANDING, OR PERMISSION OF INSTRUCTOR.

**MAE514 Advanced Internal Combustion Engines Experimental Studies**

*3 credits*

*Spring Semester*

Experimental mechanical engineering as it pertains to internal combustion engines. The principal measurements necessary to analyze the operation of an internal combustion engine are covered. Emphasis is placed on experiment planning, data interpretation, and error analysis.

PREREQUISITE: MAE 503 OR PERMISSION OF INSTRUCTOR.

**MAE516 Introduction to Composite Materials**

*3 credits*

*Offered By Announcement Only*

Course provides an introduction to composite materials and terminology. Topics include advantages offered by composite materials, current aerospace, automotive, and bio-mechanics applications, experimental results, analytical models, and effects of impact and fatigue loads. The environment's impact on composite materials' performance and design procedures are discussed. Case studies examining composite materials as efficient replacements are also included.

PREREQUISITE: MAE 207, SENIOR STANDING, OR PERMISSION OF INSTRUCTOR.

**MAE517 CAD Applications Using Interactive Computer Graphics**

*3 credits*

*Offered By Announcement Only*

Computer methods and graphics in the engineering design process. Introduction to available engineering analysis codes, principles of computer graphics, and interactive graphical methods in problem solving. Mathematics for 2-D and 3-D graphical manipulation. Programming project work is required.

PREREQUISITE: SENIOR STANDING OR PERMISSION OF INSTRUCTOR.

**MAE518 Chemical and Process Engineering A**

*3 credits*

*Offered By Announcement Only*

Course analyzes single and multi-stage concentration processes in the liquid-solid systems such as crystallization and drying. Processes apart from equilibrium, controlled diffusion, mathematical treatment, and equipment design are also discussed.

PREREQUISITE: MAE 310, 311. COREQUISITE: MAE 508.

**MAE519 Chemical and Process Engineering B**

*3 credits*

*Offered By Announcement Only*

Stagewise equilibrium separation processes in liquid-liquid systems such as distillation, rectification, absorption, and extraction. Application of phase equilibria and balance equations, mathematical treatment, and equipment design.

PREREQUISITE: MAE 310, 311, 308.

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**MAE520 Air Pollution**

*3 credits*

*Spring Semester*

Course topics include fundamentals of air pollution, air quality, properties of air pollutants, effect of pollutants on the environment, analysis and modeling, diffusion of pollutants, and air pollution control.

PREREQUISITE: MAE 303, 309/CAE 330 OR PERMISSION OF INSTRUCTOR.

**MAE521 Exhaust Emission Control**

*3 credits*

*Spring Semester*

Course topics include automotive emissions, air pollution, combustion of homogeneous mixtures, emission control systems, Federal emission standards, and emission instrumentation and measurement. Lecture, 2 hours; Laboratory, 3 hours.

PREREQUISITE: SENIOR ENGINEERING STANDING OR PERMISSION OF INSTRUCTOR.

**MAE538 Computer-Aided Air Conditioning Design and Energy Management**

*3 credits*

*Offered By Announcement Only*

Course topics include equipment and components, air conditioning system, all-air systems, air-and-water systems, all water systems, heat recovery systems, cogeneration systems, heat pump systems, central heating and cooling, energy management, and computer applications.

PREREQUISITE: MAE 405 OR 408 OR PERMISSION OF INSTRUCTOR.

**MAE539 Heating, Ventilating and Air Conditioning System Design**

*3 credits*

*Fall Semester*

Course topics include basic HVAC systems, multizone systems, dual-duct systems, terminal reheat systems, variable air volume systems, induction and induction reheat systems, special applications, hydronic systems, unitary and heat pump systems, hydronic heat recovery systems, cooling and heating load calculation duct and piping design, overall system design, and integration.

PREREQUISITE: MAE 405 OR 408 OR PERMISSION OF INSTRUCTOR.

**MAE540 Energy Conversion**

*3 credits*

*Spring Semester*

Course topics include energy conversion, utilization, present and projected consumption of energy, thermodynamic principles, nuclear energy, fission and fusion reactions, hydroelectric power, and solar energy. Alternative energy sources, the hydrogen economy, and the energy-environment-economy system are also discussed.

PREREQUISITE: SENIOR STANDING IN MECHANICAL AND AEROSPACE ENGINEERING OR PERMISSION OF INSTRUCTOR.

**MAE541 Two-Phase Flow Fundamentals and Design**

*3 credits*

*Offered By Announcement Only*

Course topics include two-phase flow fundamentals for thermal design, heat transfer, pressure drop analysis of two-phase flows in tube and around tube bundles, heat transfer design correlations in boiling, evaporation, and condensation. Classifications of heat vapor generation and vapor condensation, heat exchangers for air-conditioning and refrigeration, enhancement of boiling, condensation, evaporation heat transfer, and fouling of heat exchangers are also discussed. Design examples are included.

PREREQUISITE: MAE 303 AND 310 OR PERMISSION OF INSTRUCTOR.

**University of Miami Bulletin, 2009-2010**  
**Undergraduate Course Listing**  
**COLLEGE OF ENGINEERING**  
**MECHANICAL & AEROSPACE ENGINEERING**

**MAE550 Product Safety Engineering**

*3 credits*

*Offered By Announcement Only*

Product safety for the designer and the design review process. Topics include hazard analysis of products including use of regulatory and voluntary standards and analytical tools such as fault tree analysis. Constraints imposed by product liability law, design techniques, and process requirements to minimize hazards are also discussed.

PREREQUISITE: SENIOR STANDING IN ENGINEERING OR PERMISSION OF INSTRUCTOR.

**MAE551 Special Problems**

*1- 3 credits*

*Fall & Spring Semester & First & Second Summer Session*

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

**MAE552 Special Problems**

*1- 3 credits*

*Fall & Spring Semester & First & Second Summer Session*

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.

**MAE570 Aero Propulsion**

*3 credits*

*Fall Semester*

Definition of the atmosphere, propulsion basics, rocket fundamentals, turbine fundamentals, gas turbine cycles, component matching, math and computer models, aircraft missions, cycle section, reliability, and durability are analyzed.

PREREQUISITE: MAE 303, 309.

**MAE571 Introduction to Aerospace Control**

*3 credits*

*Spring Semester*

Course topics include modeling of Aerospace systems, properties of state space realizations, coordinate transforms solution of state equations, controllability, observability, equivalent realizations, model reduction, stability, optimal control, and estimation.

PREREQUISITE: MAE 415 OR PERMISSION OF INSTRUCTOR

**MAE590 Special Topics**

*1- 4 credits*

*Fall Semester*

Subtitles describing the topics will be shown in parentheses in the class schedule, following the "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**MAE591 Special Topics**

*1- 4 credits*

*Offered By Announcement Only*

Subtitles describing the topics will be shown in parentheses in the class schedule, following the "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**MAE592 Special Topics**

*1- 4 credits*

*Offered By Announcement Only*

Subtitles describing the topics will be shown in parentheses in the class schedule, following the "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**University of Miami Bulletin, 2009-2010**  
**Undergraduate Course Listing**  
**COLLEGE OF ENGINEERING**  
**MECHANICAL & AEROSPACE ENGINEERING**

**MAE593 Special Topics**

*1- 4 credits*

*Offered By Announcement Only*

Subtitles describing the topics will be shown in parentheses in the class schedule, following the "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**MAE594 Special Topics**

*1- 4 credits*

*Offered By Announcement Only*

Subtitles describing the topics will be shown in parentheses in the class schedule, following the "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**MAE595 Special Topics**

*1- 4 credits*

*Offered By Announcement Only*

Subtitles describing the topics will be shown in parentheses in the class schedule, following the "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**MAE596 Special Topics**

*1- 4 credits*

*Offered By Announcement Only*

Subtitles describing the topics will be shown in parentheses in the class schedule, following the "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**MAE597 Special Topics**

*1- 4 credits*

*Offered By Announcement Only*

Subtitles describing the topics will be shown in parentheses in the class schedule, following the "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**MAE598 Special Topics**

*1- 4 credits*

*Offered By Announcement Only*

Subtitles describing the topics will be shown in parentheses in the class schedule, following the "Special Topics."

PREREQUISITE: PERMISSION OF INSTRUCTOR.

**MAE599 Cooperative Education**

*1 credit*

*Fall & Spring Semester & First & Second Summer Session*

Practical application of classroom theory through alternating semester or summer employment with industries offering positions consistent with the student's field of study. Course may be repeated. Periodic reports and conferences are required.

PREREQUISITE: PERMISSION OF DEPARTMENT CHAIRMAN.