MASTER OF ENGINEERING
Online Curriculum

To complete the online program in two years, students typically take two courses per semester, each lasting 14 weeks. Our online program requires a total of 30 credits of coursework.

The curriculum is organized as follows:

CORE CLASSES

EPOM 400: Leadership and Interpersonal Skills

This course uses an experience-based approach to increase understanding of communication, emotional intelligence and behavioral-based communication needs in the work environment. To increase understanding, students will learn to recognize, manage and leverage these in business relationships, as well as in team and group processes, to develop an effective leadership style. Students will work in teams to examine the topics from the perspective of team members and leaders and will formulate strategies to reach desired goals or outcomes.

EPOM 401: Introduction to Business for Engineers

This course provides an introduction to the business environment for practicing engineers. The course emphasizes the interplay between business and engineering in the context of the competitive marketplace (economics), how engineering proposals are evaluated (finance), the relationship between product and customer (marketing), making effective use of micro-disciplinary teams (organizational behavior), and the manufacturing and production process (operations).

EPOM 403: Product and Process Design and Implementation

The course aim is to provide a solid understanding of the many aspects of the engineering design process and the management of technology. The course focuses on the engineering and management activities used to develop and bring to market new products and processes.
Recommended preparation: EPOM 401.

EPOM 405: Applied Engineering Statistics

This course provides an intensive introduction to fundamental concepts, applications and the practice of contemporary engineering statistics. Each topic is introduced through realistic sample problems to be solved first by using standard spreadsheet programs and then using more sophisticated software packages. Primary attention is given to teaching the fundamental concepts underlying standard analysis methods.

EPOM 407: Engineering Economics & Financial Analysis

In this course, money and profit as measures of “goodness” in engineering design are studied. Methods for economic analysis of capital investments are developed and the financial evaluation of machinery, manufacturing processes, buildings, R&D, personnel development, and other long-lived investments are emphasized. Optimization methods and decision analysis techniques are examined to identify economically attractive alternatives. Basic concepts of cost accounting are also covered.

EPOM 409: Master of Engineering Capstone Project

This is the capstone course for the Master of Engineering program, which provides students with the opportunity to integrate the program’s topics through an intensive case study project. Interdisciplinary teams are assigned a major engineering project that covers the stages from design concept through development to final manufacture, including business and engineering decision-making to maximize market penetration. Topics also include safety, environmental issues, ethics, intellectual property, product liability and societal issues.
Recommended preparation: EPOM 401, EPOM 403, EPOM 405 and EPOM 407.

CONCENTRATION IN BIOMEDICAL ENGINEERING

EBME 401D: Biomedical Instrumentation & Signal Processing

Graduate students with various undergraduate backgrounds will learn the fundamental principles of biomedical measurements that integrate instrumentation and signal processing with problem-based hands-on experience.

EBME 406: Polymers in Medicine (Materials)

This course covers the important fundamentals and applications of polymers in medicine and consists of three major components: (i) the blood and soft-tissue reactions to polymer implants; (ii) the structure, characterization and modification of biomedical polymers; and (iii) the application of polymers in a broad range of cardiovascular and extravascular devices. The chemical and physical characteristics of biomedical polymers and the properties required to meet the needs of the intended biological function will be presented. Course includes clinical evaluation, including recent advances and current problems associated with different polymer implants.

EBME 410: Medical Imaging Fundamentals (Imaging)

Physical principles of medical imaging. Imaging devices for x-ray, ultrasound, magnetic resonance, etc. Image quality descriptions. Patient risk.

EBME 421: Bioelectric Phenomena (Neural Engineering)

The goal of this course is to provide working knowledge of the theoretical methods that are used in the fields of electrophysiology and bioelectricity for both neural and cardiac systems. These methods will be applied to describe, from a theoretical and quantitative perspective, the electrical behavior of excitable cells, the methods for recording their activity and the effect of applied electrical and magnetic fields on excitable issues.

EBME 432: Quantitative Analysis of Physiological Systems

Mathematical modeling and simulation of cellular, tissue, and organ systems: respiratory, renal, liver, cardiovascular, neural, and muscular. Dynamic mass transport and reaction processes. Cellular metabolism. Cardiac electrophysiology and regulation. Excitable cells and tissue. Neural system integration, feedback, and control. Prerequisites: graduate status.
Recommended preparation: differential equations, linear algebra, MATLAB.

EBME 440: Translational Research for Biomedical Engineering

Translation of laboratory developments to improve biomedical and clinical research and patient care. Interdisciplinary and team communication. Evaluation of technology and research planning with clinical and engineering perspectives. Discussing clinical situations, shadowing clinicians, attending Grand Rounds and Morbidity-Mortality conferences. Validation study design. Regulatory/oversight organization. Protocol design and informed consent for Institutional Review Board (IRB) approval. NIH requirements for human subject research. Special project reports to produce IRB protocol or NIH-style proposal.

EBME 451: Cellular and Molecular Physiology

This course covers cellular and molecular basics for graduate students with little or no prior biology background. The emphasis of EBME 451 is on the molecular and cellular mechanisms underlying physiological processes. Structure-function relationships will be addressed throughout the course. The primary goal of the course is to develop an understanding of the principles of the physiological processes at the molecular and cellular level and to promote independent thinking and the ability to solve unfamiliar problems.

CONCENTRATION IN BIOMEDICAL ENGINEERING (CONT.)

EBME 471: Principles of Medical Device Design and Innovation

Translational research leading to medical device innovation is highly interdisciplinary, requiring a systematic, structured approach to bringing new medical technologies to market. This course provides the fundamental principles of the biodesign innovation process, providing the student the essential tools to (A) identify unmet clinical needs, (B) create innovative medical device concepts that respond to a primary unmet need, and (C) understand the process for translating these concepts into the market. In short, the student learns the fundamental principles for the process of "identify, invent, implement" in the field of biodesign.

CONCENTRATION IN ENGINEERING INNOVATION, MANAGEMENT AND LEADERSHIP

EPOM 410: Intellectual Property Management and Opportunity Assessment

The goal of this course is to address issues relating to the commercialization of scientific inventions by exposing graduate students to the challenges and opportunities encountered when attempting to develop meaningful intellectual property from the point of early discovery to the clinic and market. Specifically, this course seeks to provide students with the ability to value a given technological advancement or invention holistically, focusing on issues that extend beyond scientific efficacy and include patient and practitioner value propositions, legal and intellectual property protection, business modeling, potential market impacts, market competition, and ethical, social, and healthcare practitioner acceptance.

EPOM 4X2: Innovation—the Confluence of Creativity, Design and Need-based Opportunity

TBA

EPOM 4X3: Technology Commercialization—Aligning Development Requirements to Value Creation Activities

TBA

EPOM 4X4: Innovation, Strategy and Leadership—Contemporary Approaches to Future Growth

TBA

CONCENTRATION IN SYSTEMS & CONTROL ENGINEERING

EECS 401: Digital Signal Processing

Characterization of discrete-time signals and systems. Fourier analysis: the Discrete-time Fourier Transform, the Discrete-time Fourier series, the Discrete Fourier Transform and the Fast Fourier Transform. Continuous-time signal sampling and signal reconstruction. Digital filter design: infinite impulse response filters, finite impulse response filters, filter realization and quantization effects. Random signals: discrete correlation sequences and power density spectra, response of linear systems. Recommended preparation: undergraduate signals and systems course.

EECS 404: Digital Control Systems

Data acquisition (theory and practice), digital control of sampled data systems, stability tests, system simulation digital filter structure, finite word length effects, limit cycles, state-variable feedback and state estimation. PLC systems and programming.

EECS 408: Introduction to Linear Systems

Analysis and design of linear feedback systems using state-space techniques. Review of matrix theory, linearization, transition maps and variations of constants formula, structural properties of state-space models, controllability and observability, realization theory, pole assignment and stabilization, linear quadratic regulator problems, observers, and the separation theorem. Recommended preparation: undergraduate control course or EECS 304.

EECS 413: Nonlinear Systems 1

This course will provide an introduction to techniques used for the analysis of nonlinear dynamic systems. Topics will include existence and uniqueness of solutions, phase plane analysis of two-dimensional systems including Poincare-Bendixson, describing functions for single-input single-output systems, averaging methods, bifurcation theory, stability and an introduction to the study of complicated dynamics and chaos.

EECS 416: Convex Optimization for Engineering

This course will focus on the development of the working knowledge and skills to recognize, formulate and solve convex optimization problems that are so prevalent in engineering. Applications in control systems; parameter and state estimation; signal processing; communications and networks; circuit design; data modeling and analysis; data mining including clustering and classification; and combinatorial and global optimization will be highlighted. New reliable and efficient methods, particularly those based on interior-point methods and other special methods to solve convex optimization problems will be emphasized. Implementation issues will also be underscored.
Recommended preparation: discrete math or MATH 201 or equivalent.

EECS 421: Optimization of Dynamic Systems

Fundamentals of dynamic optimization with applications to control. Variational treatment of control problems and the Maximum Principle. Structures of optimal systems; regulators, terminal controllers, time-optimal controllers. Sufficient conditions for optimality. Singular controls. Computational aspects. Selected applications.
Recommended preparation: EECS 406i.

CONCENTRATION IN SYSTEMS & CONTROL ENGINEERING (CONT.)

EECS 468: Power System Analysis

This course introduces the steady-state modeling and analysis of electric power systems. The course discusses the modeling of essential power system network components such as transformers and transmission lines. The course also discusses important steady-state analysis of three-phase power system network, such as the power flow and economic operation studies. Through the use of PowerWorld Simulator education software, further understanding and knowledge can be gained on the operational characteristics of AC power systems. Special topics concerning new grid technologies will be discussed towards the semester end. The course is co-offered with undergraduate course EECS 367.
Prerequisite: EECS 245 Electronic Circuits or equivalent.

CONCENTRATION IN MECHANICAL ENGINEERING

EMAE 450: Advanced Engineering Analysis

This course aims to equip students with tools for solving mathematical problems commonly encountered in mechanical engineering. The goals are to enable the student to properly categorize the problem in a variety of ways, to identify appropriate approaches to solving the problem and to choose effective numerical solution methods. The course covers analytical and computational approaches to linear and nonlinear problems in both discrete and continuous systems. Computational approaches include direct methods such as finite difference methods and approximation methods based on a variational approach, such as finite elements. The course is built around specific examples from solid mechanics, dynamics, vibrations, heat transfer and fluid mechanics, represented by initial value problems, eigenvalue problems and boundary value problems.

EMAE 456: Micro-Electro-Mechanical Systems and Biomanufacturing

Microscale technologies have enabled advanced capabilities for researchers in unexplored territories of cells in biology and medicine. Biological (or Biomedical) Micro-Electro-Mechanical Systems (BioMEMS) involve the fundamentals of mechanics, electronics and advanced microfabrication technologies with specific emphasis on biological applications. BioMEMS is an interdisciplinary research area, which brings together multiple disciplines, including mechanical engineering, biomedical engineering, chemical engineering, materials science, electrical engineering, clinical sciences, medicine, and biology. BioMEMS based technologies have found real-world applications in tissue engineering, implantable microdevices, proteomics, genomics, molecular biology, and point-of-care platforms. This course aims to: (1) introduce the need for miniaturized systems in biology and medicine and the fundamental design and microfabrication concepts, (2) introduce the basics of microscale manipulation of cells and biological agents employing the fundamentals of microscale behaviors of fluids and mechanical systems, and (3) expose the students to applications of BioMEMS and on-chip technologies in biology and medicine with clinical impact.

EMAE 460: Theory and Design of Fluid Power Machinery

This course focuses on fluid mechanic and thermodynamic aspects of the design of fluid power machinery. Examples and applications of theoretical and design analyses are drawn from axial and radial flow turbomachinery, positive displacement devices and their components.

EMAE 480: Fatigue of Materials

This course addresses the fundamental and applied aspects of fatigue in metals, polymers and ceramics. Topics include behavior of materials in stress and strain cycling, methods of computing cyclic stress and strain, and cumulative fatigue damage under complex loading. The application of linear elastic fracture mechanics to fatigue crack propagation is explored, as are mechanisms of fatigue crack initiation and propagation, and mechanistic and probabilistic approaches to fatigue life prediction. The course also uses case histories to illustrate fatigue failures and identify practical approaches to mitigate fatigue and prolong life.

CONCENTRATION IN MECHANICAL ENGINEERING (CONT.)

EMAE 481: Advanced Dynamics 1

The purpose of this course is to broaden a student's expertise in dynamics beyond the level of a typical undergraduate course. In this course, particle and rigid body kinematics and dynamics will be developed for two- and three-dimensional motion. In addition to reviewing Newtonian mechanics, Lagrange's equations will be introduced and applied to constrained and unconstrained systems. Concepts of virtual work, which are needed for the development of Lagrange's equations, will also be introduced in this course. Newton's and Lagrange's equations will be applied to a range of systems, including mechanisms, gyroscopes and vehicles.

EMAE 487: Vibration Problems in Engineering

The primary goal of this course is to introduce the student to the fundamentals of vibration engineering with the theory, computational aspects, and applications of vibrations for typical problems, including the emphasis of computer techniques of analysis. Topics include free and forced-vibration problems in single and multi-degree of freedom, damped and undamped linear systems, vibration isolation and absorbers, modal analysis and approximate solutions, introduction to vibration of continuous media, and noise problems.

EMAE 494: Energy Systems

This course is a cutting-edge, interdisciplinary, graduate-level course focused at the nexus of advanced energy and innovation. The energy market is dynamic, complex and a system of sub-systems with multiple paths to market. Key technology developments are influencing progress towards a drastically different energy future. The high cost of capital associated with bringing a new technology to market increases perceived risks. To successfully embed advanced energy technology you have to be able to effectively navigate the market and reduce the risks associated with adopting a new technology. This course helps close the gap between energy research and industry by providing students a process for managing innovation, an understanding of the complex and dynamic energy market and hands-on experience building a business through the creation of E-teams who ultimately pitch their business ideas to investors.