DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

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The Department of Mechanical and Industrial Engineering prepares students for careers that allow them to change the world for the better. The challenges of the 21st century for both the U.S. and the world are great, but for engineers, they offer exciting challenges and a world of possibilities. Our programs are aimed at developing creative problem solvers, who learn math, science and fundamentals so that they can apply them in solving the ever-changing problems of tomorrow. Our emphasis on application and learning by doing, all in a small class setting, prepares our graduates to successfully enter the workforce or pursue further education.

Accreditation

The Industrial Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org (https://www.abet.org/), under the commission's General Criteria and Program Criteria for Industrial and Similarly Named Engineering Programs.

The Mechanical Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org (https://www.abet.org/), under the commission's General Criteria and Program Criteria for Mechanical and Similarly Named Engineering Programs.

Bachelor of Science

- Industrial Engineering (http://catalog.qu.edu/engineering/mechanical-industrial/industrial-engineering-bs/)
- Mechanical Engineering (http://catalog.qu.edu/engineering/mechanical-industrial/mechanical-engineering-bs/)

Minors

- Manufacturing (http://catalog.qu.edu/engineering/manufacturing-minor/)

Industrial Engineering (IER)

IER 220. Production Systems (MER 225). 3 Credits.
This course provides an introduction to production systems, classification, general terminology, technical aspects, economics and analysis of manufacturing systems. Students learn the fundamentals of automation and control technologies as well as manufacturing support systems.
Prerequisites: Sophomore status or permission of the instructor.
Offered: Every year, Fall

IER 230. Lean Systems Engineering (MER 235). 3 Credits.
This course provides a comprehensive and hands-on introduction to Lean Systems and its wide applications, with special emphasis on the Toyota Production System.
Corequisites: Take IER 320 or IER 220 or MER 225.
Offered: Every year, Fall

IER 235. Systems Engineering and Management. 3 Credits.
This course discusses the theory and methods used to design, analyze and manage engineered systems. Students review the principles of system life-cycle management including requirements analysis, system design, functional decomposition, configuration management and systems evaluation. Topics of engineering management emphasizing human relationships, motivational theory and human-systems integration also are addressed.
Prerequisites: None
Offered: Every year, Spring

IER 240. Physical Human Factors and the Workplace (MER 245). 1 Credit.
This course analyzes the impacts of the physical factors of the human decision makers on workflow and efficiency. Basic concepts of anthropometry, biomechanics, work physiology, stress and workload as well as work measurement are introduced. Special emphasis is placed on the capabilities and limitations of humans, in human-centered design of systems and products.
Prerequisites: Sophomore status or permission of the instructor.
Offered: Every year, Fall

IER 250. Computer Aided Design. 3 Credits.
Students explore the use of computer methods as an aid to solving engineering problems. Topics include 3D solid modeling, graphical presentation of information, engineering analysis and engineering computer programming. Students learn to apply a variety of engineering-related programs or routines. Students write, document, and use programs of their own in design scenarios. Considerable emphasis is placed on use of the computer as a tool in the engineering design process.
Prerequisites: Take MA 151 and CSC 106 or CSC 110 and MER 110 or MER 110H or ENR 110 and MER 111.
Offered: Every year, Fall and Spring

IER 265. Cognitive Human Factors and the Workplace (MER 265). 2 Credits.
This course analyzes the impacts of the cognitive factors of the human decision makers on workflow and efficiency. Basic concepts of cognition, as well as sensory systems, such as visual and auditory, are introduced, leading to the analysis of design topics, including displays, controls, shiftwork and work-rest schedules. Special emphasis is placed on the capabilities and limitations of humans, in human-centered design of systems and products.
Prerequisites: Sophomore status or permission of the instructor.
Offered: Every year, Fall

IER 280. Data Analytics I. 3 Credits.
The course presents basic techniques of decision making concentrating on both theoretical and modeling aspects. This course integrates the art and science of decision making for single and multiple objective environments to support the decision-making phase of the Systems Decision Process (SDP). The focus of the course is modeling problem structure, uncertainty, risk and preference in the context of decision making.
Corequisites: Take MA 285.
Offered: Every year, Spring

IER 310. Operations Research I (MER 315). 3 Credits.
This course provides a rigorous introduction to the principles of operations research with a focus on linear programming models and simplex method, duality and sensitivity analysis; transportation and assignment problems; network models; integer and nonlinear programming; an introduction to queuing theory and Markov Chains.
Prerequisites: Take one of the following: Take MA 141 or MA 151
Offered: Every year, Fall

IER 315. Fundamentals of Six Sigma - Black Belt. 3 Credits.
Define-Measure-Analyze-Improve-Control (DMAIC) approach in Six Sigma is an organizational improvement strategy used widely in business applications and Black Belt is the highest belt level among white, yellow, green, and black belts. Students are introduced to the DMAIC steps for improvement of a process and using data-driven measuring, analysis, improvement and controlling techniques to solve the defined problem at Black Belt level. Topics include quality improvement philosophies, modeling process quality, statistical process control, lean techniques, human factors, analysis of data sets, data analytics applications on collected data by using sampling strategies, design of control charts, use of statistical distributions for data analysis and process capability. This course is not for Industrial Engineering majors.
Prerequisites: Take MA 170 EC 272 PS 206 MA 206 MA 285 or another statistics course approved by the instructor. Minimum Grade C-;
Offered: As needed

IER 360. Operations Planning and Control. 3 Credits.
This course focuses on analytical techniques for work scheduling and materials planning in the manufacturing, service and health care industries. The main objective is to develop the ability to use engineering tools for industrial engineering practice in operations and materials management. Topics include forecasting, production and material planning, inventory analysis and scheduling techniques.
Prerequisites: Take MA 285.
Offered: As needed

IER 365. Scheduling in Manufacturing and Health Care with Machine Learning Applications. 3 Credits.
This course introduces students to several scheduling techniques and improvement methodologies utilized in manufacturing and health care. Improvement of manufacturing scheduling by using deterministic optimization modeling for single and parallel machine workflow as well as various shop models such as job shops, flow shops, and open shops are covered. The health care scheduling coverage of the course is based on accessibility to health care systems, scheduling of operations, and wait times of patients. Optimization of health care operations by using mathematical formulation is emphasized. Additionally, machine learning concepts such as supervised learning, unsupervised learning, decision trees, and random forest concepts are covered with applications in manufacturing and health care.
Prerequisites: Take MA 151.
Offered: As needed

IER 370. Industrial Robotics (MER 375). 3 Credits.
Students are introduced to robotics and their use in industrial applications. The topics covered in this course include robotics basic programming, types of robots, drive systems for robots, sensors' use in robotics, robot and computer interaction, improvement and analysis of systems' design using robotics, analysis of systems' design using robotics, and robotics applications in manufacturing, health care and service areas.
Prerequisites: Take CSC 110, CSC 110L, CSC 106 or CSC 109.
Offered: As needed

IER 375. Statistical Process Control. 3 Credits.
The main focus in this course is to understand and implement the Define-Measure-Analyze-Improve-Control (DMAIC) approach in Six Sigma. Therefore, defining a problem for improvement of a process and using data-driven measuring, analysis, improvement and controlling techniques to solve the defined problem are the essentials of this course. Topics include quality improvement philosophies, modeling process quality, statistical process control, control charts for variables and attributes, single- and multivariable regression analysis of data sets, sampling strategies, economic design of charts, use of statistical distributions for data analysis and process capability.
Prerequisites: Take MA 285.
Offered: Every year, Fall

IER 380. Data Analytics II. 2 Credits.
This course focuses on analytical skill development for extracting meaningful information from data sets by using technology. Analytical skills includes linear and non-linear regressions, ANOVA, hypothesis testing, and predictive data analysis. The technological skillset development includes reading, analyzing and interpreting data sets by learning how to use a software package.
Prerequisites: Take IER 280.
Corequisites: Take IER 381.
Offered: As needed

IER 381. Data Analytics and Advanced Programming. 1 Credit.
This course focuses on analytical skill development for extracting meaningful information from data sets by using technology. Analytical skills includes linear and non-linear regressions, ANOVA, hypothesis testing, and predictive data analysis. The technological skillset development includes reading, analyzing and interpreting data sets by learning how to use a software package.
Prerequisites: Take CSC 110, CSC 110L; or CSC 106.
Corequisites: Take IER 380.
Offered: As needed

IER 400. Special Topics in Industrial Engineering. 1-4 Credits.
Prerequisites: None
Offered: As needed

IER 401. Introduction to Engineering Management. 3 Credits.
This course concentrates on the general methodology of managing an engineering project from concept to operational use, with emphasis on the functions, roles, and responsibilities of the engineering manager. Topics include career aspects of engineering management; business factors affecting the engineering projects and the manager; technical engineering project organization, planning, execution, and communications; project life cycle; basic risk analysis; design review; design control assessment; reporting; and reaction to critical problems. Student groups will be working on an engineering project scenario that simulates the development of a computing or engineering project with time, cost, and quality decisions to be made as the engineering project manager during the execution of the project.
Prerequisites: Take MA 170 or MA 285 and Junior Status in Major
Offered: Every year, Fall

IER 402. Engineering Quality Management & Decision Making. 3 Credits.
In this course, students will gain knowledge in the application of quality improvement methodology for project management purposes. Emphasis will be placed on philosophical approaches to quality improvement and quantitative methods taking place in engineering projects. The following topics will be included: Corporate Quality Programs, Applications for Quality Improvement, Measurement Systems Analysis, Experimental Design, Root Cause Analysis, and Design for Quality. The participants will also be introduced to decision-making tools needed to analyze data sets.
Prerequisites: Take IER 401.
Offered: Every year, Spring

IER 410. Designing and Managing the Supply Chain. 3 Credits.
This course provides an introduction to the techniques of supply chain management, focusing on logistics, purchasing and product development processes. The main objective is develop competence in quantitative methods for analyzing and solving supply chain problems in a variety of industries that include manufacturing, services and health care. Topics include supply chain performance, network design, product availability and sustainable supply chain management.
Prerequisites: Take IER 360.
Offered: As needed

IER 420. Industrial Control Systems (MER 425). 3 Credits.
Students explore classical control systems through modern control methods based on state variable models, feedback models, controllers and full-state observers. Students gain experience in computer-aided design and analysis using Matlab.
Prerequisites: Take IER 220 or MER 225.
Offered: As needed

IER 425. Quality Engineering and Inspection Systems. 3 Credits.
The focus of this course is to select and implement quality control solutions for industrial processes. Practical quality control systems are examined for applicability and relevance. Topics include the costs of quality, automated and manual measurement, quality control integration, sampling requirements, ANSI and ISO blueprint reading and geometric dimensioning along with the tolerance calculations. The course demonstrates various systems used in quality control plans and key factors required in developing a quality conscious atmosphere.
Prerequisites: Take IER 230.
Offered: As needed

IER 440. Simulation. 3 Credits.
This course includes a simulation of complex systems with applications in industrial engineering. Topics include modeling and developing custom solutions in one or more high-level computer packages; input distribution modeling; emphasizing examples, applications and cases.
Prerequisites: Take MA 285.
Offered: Every year, Spring

IER 450. Health Care Systems Engineering. 3 Credits.
This course introduces students to health care organizations, including hospitals, clinics, multihospital systems and other facilities as an integrated delivery system. By emphasizing practical application of diverse operations involved in such a system, various quantitative modeling and optimization techniques are discussed and applied to solve problems.
Prerequisites: Take IER 230
Offered: Every year, Spring

IER 460. Facilities Layout and Material Handling. 3 Credits.
The focus of this course is the design of industrial facilities with consideration of work organization and layout. Students study product and process designs as a part of facilities planning, material handling systems, flow systems, departmental planning and layout algorithms, space requirements for facilities, and receiving and shipping principles. The course also covers the engineering techniques used for determining the best location of a brand new facility.
Prerequisites: Take IER 320 or IER 220.
Offered: Every year, Fall

IER 470. Industrial Robotics and Advanced Programming. 3 Credits.
Students continue to develop and advance their robotics knowledge introduced in IER 370 - Industrial Robotics - by adding more to their basic robotics programming knowledge. Participants of this course continue to learn about advanced robotics applications in manufacturing, health care, service and systems design.
Prerequisites: Take IER 370.
Offered: As needed

IER 475. Human Reliability. 1 Credit.
This course focuses on the principles, methods and tools for the analysis, design and evaluation of human decision making within human-centered systems. The impacts of human perceptual and cognitive factors are analyzed, leading to design principles for error-prevention. This course is complementary to IER 265, Cognitive Human Factors and the Workplace. Sophomore status required.
Prerequisites: None
Offered: Every year, Fall

IER 485. System Reliability. 2 Credits.
This course provides an introduction to failure rates, failure risk analysis and system configurations, such as series, parallel and redundant systems. It also discusses design for reliability and optimal maintenance and replacement policies.
Prerequisites: Take MA 285, MA 142 or MA 152.
Offered: Every year, Fall

IER 489. Advanced Independent Study in IE. 1-6 Credits.
This is a tutorial course or an individual project in which the student pursues advanced study in systems engineering or engineering management. The scope of the course is tailored to the desires of the student in consultation with a faculty adviser. Communication skills are developed with both written reports and oral presentations. Requires approval of faculty member.
Prerequisites: None
Offered: Every year, Fall and Spring

IER 490. Engineering Professional Experience. 0-1 Credits.
Students gain at least 240 hours of experience by employing industrial engineering skills in a professional setting. Students must obtain departmental approval and register prior to starting the experience. Prerequisite may be waived with permission of adviser.
Prerequisites: Take ENR 395.
Offered: Every year, All

IER 491. Capstone Project I. **3 Credits.**
This is the first part of a two-semester capstone design experience for senior industrial engineering students. Students apply knowledge gained throughout the curriculum to a significant project. Furthermore, this course aims to strengthen the students' oral and written communication skills as well as teamwork and conflict resolution. Students work in teams to formulate issues and collect data at an external organization before beginning to perform analysis and propose solutions in the subsequent course--IER 498.
Corequisites: Take IER 330 or IER 230; IER 430 or IER 375.
Offered: Every year, Fall

IER 492. Six Sigma - Black Belt Project Exp I. **3 Credits.**
This is the first part of a two-semester Six Sigma - Black Belt project experience for students. Students are introduced to the Define-Measure-Analyze-Improve-Control (DMAIC) steps for improvement of a process and using data-driven measuring, analysis,improvement and controlling techniques to solve the defined problem at Black Belt level of Six Sigma. Topics include quality improvement philosophies,modeling process quality, statistical process control, lean techniques,human factors, analysis of data sets, data analytics applications on collected data by using sampling strategies, design of control charts, use of statistical distributions for data analysis and process capability. Furthermore, this course aims to strengthen the students' oral and written communication skills as well as team work and conflict resolution. Students work in teams to formulate issues and collect data at an external organization before beginning to perform analysis and propose solutions in the subsequent course IER 497.This course is not for Industrial Engineering majors.
Prerequisites: Take MA 170, EC 272, PS 206, MA 206, MA 285 or another statistics course approved by the instructor. Minimum grade C-.
Offered: As needed

IER 497. Six Sigma - Black Belt Project Experience II. **3 Credits.**
This is the second part of a two-semester capstone design experience for industrial engineering students. The purpose of a capstone project is to give senior students the opportunity to apply knowledge gained throughout the curriculum to a significant project. After formulating the problem and commencing data collection in IER 492, the student teams continue their project in IER 497 by completing data collection, performing analysis and modeling, and finally recommending solutions to help address the client issue(s).
Prerequisites: Take IER 492;
Offered: As needed

IER 498. Capstone Project II. **3 Credits.**
This is the second part of a two-semester capstone design experience for industrial engineering students. The purpose of a capstone project is to give senior students the opportunity to apply knowledge gained throughout the curriculum to a significant project. After formulating the problem and commencing data collection in IER 491, the student teams continue their project in IER 498 by completing data collection, performing analysis and modeling, and finally recommending solutions to help address the client issue(s).
Prerequisites: Take IER 491.
Corequisites: Take IER 280 IER 310 IER 360;
Offered: Every year, Spring

Mechanical Engineering (MER)

MER 110. 3D Solid Modeling and Printing for Innovators. **3 Credits.**
This course introduces students to 3D solid modeling, allowing users to develop full solid models in a simulated environment for both design and analysis. 3D modeling software finds worldwide use across many disciplines by students, designers, engineers, inventors, artists, and other professionals to produce simple and complex parts, assemblies, and drawings. One can fabricate the models using 3D printing. Students build their own 3D models and use 3D printing to produce a physical prototype. Students also explore applications for this technology, from the biomedical field to architectural design to fashion, gaining an appreciation for its impact in their own lives. No experience is required.
Prerequisites: None
Offered: Fall and Spring
UC: Breadth Elective

MER 110H. 3D Solid Modeling and Printing for Innovators. **3 Credits.**
This course introduces honors students to 3D solid modeling, allowing users to develop full solid models in a simulated environment for both design and analysis. 3D modeling software finds worldwide use across many disciplines by students, designers, engineers, inventors, artists, and other professionals to produce simple and complex parts, assemblies, and drawings. One can fabricate the models using 3D printing. Students build their own 3D models and use 3D printing to produce a physical prototype. Students also explore applications for this technology, from the biomedical field to architectural design to fashion, gaining an appreciation for its impact in their own lives. No experience is required.
Prerequisites: None
Offered: Fall and Spring
UC: Breadth Elective

MER 111. Introduction to Solidworks. **0 Credits.**
This course provides a bridge from ENR 110 to MER 250. This course covers introductory parts and assembly topics in SolidWorks.
Corequisites: Take ENR 110.
Offered: Every year, All

MER 210. Statics. **3 Credits.**
This course provides a foundation in the principles of statics and mechanics of materials while introducing the engineering design process to prepare students for further engineering studies. Equilibrium principles are used to analyze forces on statically determinate rigid bodies and structures.
Corequisites: Take MA 151 (can be taken previous or concurrent).
Offered: Every year, Spring

MER 210L. Fundamentals of Engineering Mechanics and Design Lab. **1 Credit.**
Students learn and practice hands-on techniques relevant to statics, such as equilibrium, friction, truss analysis and tension/compression. All experimental results obtained in the lab are analyzed in the context of the theoretical framework presented in the course.
Corequisites: Take MER 210.
Offered: As needed

MER 220. Mechanics of Materials. 3 Credits.
Students study the behavior of materials under normal, shear, torsional, bending and combined loads. Loading, geometry, functional environment and material properties of machine or structural elements are used to relate the forces applied to a body to resulting internal forces and deformations in order to evaluate performance. Practical applications involving the design of mechanical and structural elements under various loading conditions are emphasized.
Prerequisites: Take MA 151. Take MER 210, Minimum grade of C-.
Offered: Every year, Fall and Spring

MER 220L. Mechanics of Materials Lab. 1 Credit.
Students learn and practice hands-on techniques relevant to mechanics of materials, such as tension, torsion, and bending. All experimental results obtained in the lab are analyzed in the context of the theoretical framework presented in the course.
Corequisites: Take MER 220.
Offered: Every year, Fall and Spring

MER 221. Dynamics. 3 Credits.
Dynamics examines the motion of particles, systems of particles and rigid bodies under the influence of forces. It focuses on the use of Newton's Second Law, the Work-Energy Principle and the Impulse-Momentum Principle. The course progresses from rectilinear and curvilinear motion of single particles, through vector motion of systems of particles, to general motion of rigid bodies.
Prerequisites: Take MER 210; Minimum grade C-; and PHY 121.
Offered: Every year, Fall and Spring

MER 225. Production Systems (IER 220). 3 Credits.
This course provides an introduction to production systems, classification, general terminology, technical aspects, economics and analysis of manufacturing systems. Students learn the fundamentals of automation and control technologies as well as manufacturing support systems.
Prerequisites: Sophomore status or permission of the instructor.
Offered: Every year, Fall

MER 230. Engineering Materials. 3 Credits.
This course explores the relationship between the microscopic structure and macroscopic properties of materials used in engineering applications. The origin of mechanical and physical properties is studied. Emphasis is placed on an understanding of the fundamental aspects of atomic and microstructural concepts for proper materials selection and enhancement of engineering properties. Materials studied are metals, ceramics, polymers and composites.
Prerequisites: Take MER 220, CHE 110.
Offered: Every year, Fall

MER 230L. Engineering Materials Lab. 1 Credit.
Students learn and practice hands-on techniques relevant to engineering materials, such as measuring mechanical and physical properties and strengthening mechanisms. All experimental results obtained in the lab are analyzed in the context of the theoretical framework presented in the course.
Corequisites: Take MER 230.
Offered: Every year, Fall

MER 235. Lean Systems Engineering (IER 230). 3 Credits.
This course provides a comprehensive and hands-on introduction to Lean Systems and its wide applications, with special emphasis on the Toyota Production System.
Corequisites: Take IER 320 or IER 220 or MER 225.
Offered: Every year, Fall

MER 240. Introduction to Mechanical Engineering Design. 1 Credit.
This course introduces mechanical engineering design as an iterative decision-making process. An engineering design problem reinforces the design process instruction and culminates in a student competition.
Prerequisites: Take MER 250, Minimum grade C-.
Offered: Every year, Spring

MER 245. Physical Human Factors (IER 240). 1 Credit.
This course analyzes the impacts of the physical factors of the human decision makers on workflow and efficiency. Basic concepts of anthropometry, biomechanics, work physiology, stress and workload as well as work measurement are introduced. Special emphasis is placed on the capabilities and limitations of humans, in human-centered design of systems and products. Sophomore status required.
Prerequisites: Sophomore status or permission of the instructor.
Offered: Every year, Fall

MER 250. Computer Aided Design. 3 Credits.
Students explore the use of computer methods as an aid to solving engineering problems. Topics include 3D solid modeling, graphical presentation of information, engineering analysis and engineering computer programming. Students learn to apply a variety of engineering-related programs or routines. Students write, document, and use programs of their own in design scenarios. Considerable emphasis is placed on use of the computer as a tool in the engineering design process.
Prerequisites: Take MA 151 and CSC 106 or CSC 110 and MER 110 or MER 110H or ENR 110 and MER 111.
Offered: Every year, Fall and Spring

MER 265. Cognitive Human Factors and the Workplace (IER 265). 2 Credits.
This course analyzes the impacts of the cognitive factors of the human decision makers on workflow and efficiency. Basic concepts of cognition, as well as sensory systems, such as visual and auditory, are introduced, leading to the analysis of design topics, including displays, controls, shiftwork and work-rest schedules. Special emphasis is placed on the capabilities and limitations of humans, in human-centered design of systems and products. Sophomore status required.
Prerequisites: Sophomore status or permission of the instructor.
Offered: Every year, Fall

MER 310. Fluid Mechanics. 3 Credits.
This course focuses on fluid mechanics while introducing and integrating corresponding topics of thermodynamics. Properties of fluids and hydrostatics as well as conservation principles for mass, energy and linear momentum are covered. Principles are applied to incompressible flow in pipes, external flows, Bernoulli's equation, dimensional analysis, Navier-Stokes, boundary layer development, lift and drag. Laboratory exercises are incorporated into classroom work.
Prerequisites: Take MA 251, PHY 121 and MER 210.
Corequisites: Take MA 365 or MA 265.
Offered: Every year, Fall

MER 315. Operations Research I (IER 310). 3 Credits.
This course provides a rigorous introduction to the principles of operations research with a focus on linear programming models and simplex method, duality and sensitivity analysis; transportation and assignment problems; network models; integer and nonlinear programming; an introduction to queuing theory and Markov Chains
Prerequisites: Take MA 153; or MA 151 and MA 229; or MA 141 and MA 229; or MA 142; or MA 152;
Offered: Every year, Fall

MER 320. Thermodynamics. 3 Credits.
This course focuses on thermodynamics. It applies conservation principles for mass, energy and linear momentum as well as the second law of thermodynamics. Principles are applied to power generation systems, refrigeration cycles and total air conditioning. Thermodynamic principles also are applied to the automotive system to examine engine performance (Otto and Diesel cycles) and to high performance aircraft to examine the Brayton cycle.
Prerequisites: Take CHE 110 and MA 151.
Offered: Every year, Spring

MER 330. Introduction to Circuits. 3 Credits.
Students are introduced to DC circuit analysis, DC circuit design and AC circuit analysis. The course also includes electrical engineering topics required to prepare students for the Fundamentals of Engineering examination as a part of professional licensure. Students learn the language, tools and problem-solving techniques used in basic electrical circuit analysis.
Corequisites: Take PHY 122
Offered: Every year, Fall and Spring

MER 330L. Introduction to Circuits Lab. 1 Credit.
Students learn and practice hands-on techniques relevant to circuit analysis, such as bread board prototyping, voltage and current measurements, soldering, and basic data acquisition. All experimental results obtained in the lab are analyzed in the context of the theoretical framework presented in the course.
Corequisites: Take MER 330.
Offered: Every year, Fall and Spring

MER 340. Manufacturing/Machine Component Design. 3 Credits.
This course introduces machine component design and manufacturing, relating fundamental engineering science to machine components. It covers load, stress and strain analyses, and fatigue. The course progresses to the study of machine component design, including mechanical components such as linkages, fasteners, springs, bearings, gears and shafts.
Prerequisites: Take MER 220, MER 221 MER 250; Minimum grade C-.
Offered: Every year, Fall and Spring

MER 340L. Manufacturing/Machine Component Design Lab. 1 Credit.
Working primarily in the machine shop, this laboratory provides experiential learning in the context of manufacturing. Students learn techniques, use tools and operate machines used in a manufacturing environment under appropriate supervision. A series of measurement and fabrication exercises culminate in the team-oriented design and manufacture of a mechanical engineering product.
Corequisites: Take MER 250 Must be of Junior Standing;
Offered: Every year, Fall

MER 350. Mechanical Engineering Design. 3 Credits.
This course is the first in a two-course sequence which integrates all previously acquired knowledge and skills. Students begin their major design experience project, applying the mechanical engineering design process to a real-world engineering problem addressing social, political, economic, technical, global and environmental issues. Students continue their project in MER 498.
Prerequisites: Take MER 240 MER 340 MER 340L MER 330 MER 330L Minimum grade C-.
Corequisites: Take MER 230
Offered: Every year, Fall

MER 360. Heat Transfer. 3 Credits.
The three modes of heat transfer--conduction, convection and radiation--are studied in detail, and these concepts are applied to analyze various engineering systems. The principles of conduction, and convection are applied to the analysis of heat exchangers and all three modes of heat transfer are applied together to study scenarios of multi-mode heat transfer.
Prerequisites: Take MER 320 MER 310;.
Offered: Every year, Fall

MER 375. Industrial Robotics (IER 370). 3 Credits.
Students are introduced to robotics and their use in industrial applications. The topics covered in this course include robotics basic programming, types of robots, drive systems for robots, sensors' use in robotics, robot and computer interaction, improvement and analysis of systems' design using robotics, analysis of systems' design using robotics, and robotics applications in manufacturing, health care and service areas.
Prerequisites: Take CSC 110, CSC 110L, CSC 106 or CSC 109.
Offered: As needed

MER 380. Advanced Solid Modeling. 3 Credits.
This course will cover 3D mechanical parametric solid modeling and assembly creation utilizing SolidWorks. Creation of 3D models for machining/manufacturing and assemblies will be emphasized, leading to the SolidWorks certification exam.
Prerequisites: Take MER 250.
Offered: Every year, Spring

MER 387. Introduction to Applied Aerodynamics. 3 Credits.
The fundamental laws of fluid mechanics are used to develop the characteristic forces and moments generated by the flow about aerodynamic bodies. Lift, drag and aerodynamic moments are studied for airfoils (2D) and finite wings (3D) in the subsonic flow regime. Aircraft performance and design parameters are developed in both the classroom and laboratory sessions. The laboratory sessions include low-speed wind tunnel testing.
Prerequisites: Take MER 221, MER 310.
Corequisites: Take MER 320.
Offered: Every year, Spring

MER 388. Helicopter Aeronautics. 3 Credits.
This course examines the aerodynamics of helicopter flight in relation to hover, translating and partial power flight. Theory and experimental results are used to predict aircraft performance. The course analyzes the dynamic response of the rotor system and the performance aspects of the vehicle as a whole. This is followed by a design workshop, during which students complete the initial sizing of a helicopter to meet specific mission requirements. The course includes a laboratory examining rotor power and thrust utilizing a whirl stand apparatus, and one field trip to a commercial helicopter company.
Prerequisites: Take MER 210, MER 250, MER 310.
Offered: Every year, Spring

MER 399. Special Topics. 1-3 Credits.
Prerequisites: None
Offered: As needed

MER 399H. Special Topics. 1-3 Credits.
Prerequisites: None
Offered: As needed

MER 425. Industrial Control Systems (IER 420). 3 Credits.
Students explore classical control systems through modern control methods based on state variable models, feedback models, controllers and full-state observers. Students gain experience in computer-aided design and analysis using Matlab.
Prerequisites: Take IER 220 or MER 225.
Offered: As needed

MER 450. Environmentally Conscious Design and Manufacturing. 3 Credits.
Students learn to identify, quantify and reduce environmental impacts caused by products. Impact reduction methods form the course's core subject matter. Such methods include: design for recycling, design for remanufacture, life cycle assessment, biomimetics and others. The course also provides an overview of motivational legislation from North America and Europe. Through lecture, discussion, assignments, case studies, and a semester project, students achieve a critical understanding of the role environmental issues play in mechanical engineering.
Prerequisites: Take MER 340.
Offered: Every year, Fall

MER 460. Mechanical Measurement and Data Acquisition. 3 Credits.
In this course, students learn how to perform computer-based measurements of various mechanical phenomena such as displacement, temperature, force, strain, torque, pressure, flow, vibration and acceleration. This is a hands-on course that starts with the basics of sensors and transducers, and walks the students through signal conditioning electronics, instrumentation, data acquisition and signal analysis. A significant portion of this course focuses on LabVIEW, an industry-standard graphical programming language that is widely used for data acquisition and analysis.
Prerequisites: Take CSC 110, CSC 110L or CSC 106; and MER 330, MER 330L.
Offered: Every year, Fall

MER 470. Dynamic Modeling and Control. 3 Credits.
This course covers dynamic modeling and control of linear systems. It includes an overview of classical control theory as the foundation for control applications in mechanical, electrical and aeronautical systems. Mathematical models are developed for various physical systems, and represented in time-domain, Laplace domain, and State-Space. Control system analysis and design techniques are studied within the context of transient and steady-state response.
Prerequisites: Take MER 221, MER 330, MER 330L, MER 250; and MA 265 or MA 365.
Offered: Every year, Spring

MER 470L. Dynamic Modeling and Controls Lab. 1 Credit.
Laboratory exercises include electronic instrumentation of sensors and actuators and microcontroller-based control-system implementations (open-loop and closed-loop). In addition, students learn to simulate dynamic models and controllers using MATLAB and Simulink and perform experimental validation of simulated models.
Prerequisites: Take MER 330L.
Corequisites: Take MER 470.
Offered: Every year, Spring

MER 475. Mechatronics. 3 Credits.
This course presents an introduction to the field of mechatronics. Mechatronics combines elements of mechanics, electric circuits, programming and engineering design in order to create useful electro-mechanical and robotic devices. This is a hands-on, project-based course where students learn basic electronic and programming techniques to integrate various sensors, motors and actuators into moving mechanical platforms.
Prerequisites: Take CSC 110 or CSC 109 or CSC 106; and MER 330 MER 330L, MER 340, MER 340L.
Offered: As needed

MER 489. Advanced Study in Mechanical Engineering. 1-3 Credits.
The student pursues advanced study of a topic in mechanical engineering on an individual or small-group basis, independent of a formal classroom setting. Similar to graduate level research, the scope of the selected project is tailored to the interests of the student, based on resources and in consultation with a faculty adviser. To develop research skills, the student is integral in all phases of project completion by defining objectives, studying fundamentals and background material, outlining the approach, conducting analysis and communicating results. Requires permission of the instructor.
Prerequisites: None
Offered: Every year, Fall and Spring

MER 490. Engineering Professional Experience. 0-1 Credits.
Students gain experience by employing engineering skills in a professional setting under the guidance of practicing engineers. Students must obtain departmental approval and register prior to starting the experience.
Prerequisites: Take ENR 395 or permission of instructor.
Offered: Every year, All

MER 491. Biomedical Engineering. 3 Credits.
In this introductory course to biomedical engineering, students analyze biomedical implantable and prosthetic devices and explore topics such as biocompatibility, biomechanical properties of biological tissue, device design, as well as factors that go into medical device development and testing. Hands on labs are incorporated into the course to provide a more in-depth immersion into specific course topics. This course focuses on developing lifelong learning skills and service learning. As part of this focus area, students develop a STEM activity to teach a biomedical engineering topic to elementary students.
Prerequisites: Take MER 220, and CSC 106.
Offered: Every year, Spring

MER 498. ME Major Design Experience. 3 Credits.
This course integrates math, science and engineering principles using a comprehensive engineering design project. Open-ended, client-based design problems emphasize a multidisciplinary approach to total system design. Design teams develop product specifications, generate alternatives, make practical engineering approximations, perform appropriate analysis to support technical feasibility, and make decisions leading to designs that meet stated requirements. System integration, computer-aided design, maintainability and fabrication techniques are addressed.
Prerequisites: Take MER 350.
Offered: Every year, Spring

MER 499. Senior Design Project II. 3 Credits.
A two-semester, six credit capstone design experience for mechanical engineering students involving analysis and synthesis of unstructured problems in practical settings. Students work in teams to formulate issues, propose solutions, and communicate results in formal written and oral presentations.
Prerequisites: Take MER 340.
Offered: Every year, Spring