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