MECHANICAL ENGINEERING (MER)

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. Concepts of stress and strain are introduced under axial
loading.
Prerequisites: Take MER 210.
Offered: Every year, Spring

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.
Offered: Every year, Spring

MER 220. Mechanics of Materials. 3 Credits.
Students study the behavior of materials under normal, shear, torsional,
bending and combined loads. Stress, strain, creep, corrosion, fatigue and
material properties are explored. Relationships between the microscopic
structure and macroscopic properties of engineering materials are
examined. Loading, geometry, functional environment and material
properties of machine or structural parts 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 and
environmental conditions are emphasized.
Prerequisites: Take MER 210.
Offered: Every year, Fall

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

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.
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 and 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 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 153 and MA 154.
Corequisites: Take MA 229 or CSC 110 or CSC 106 or CSC 109.
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 and PHY 121.
Corequisites: Take MA 365 or MA 265.
Offered: Every year, Fall

MER 320. Thermodynamics. 3 Credits.
This course focuses on thermodynamics, while incorporating and
building upon fluid mechanics topics covered in MER 310. 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. Laboratory exercises
are incorporated into classroom work. This class includes completion of
a comprehensive, out-of-class design and analysis project.
Prerequisites: Take CHE 110.
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.
Prerequisites: Take MA 241 or MA 251.
Corequisites: Take PHY 122
Offered: Every year, 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, 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 loads, 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.
Offered: Every year, 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 340.
Offered: Every year, Spring

MER 350. Mechanical Engineering Design. 3 Credits.
This course introduces mechanical engineering design as an interactive decision-making process. An engineering design problem reinforces the design process instruction and culminates in a student competition. Students begin their major design experience project, applying the mechanical engineering design process to a real-world engineering problem addressing social, political, economic and technical issues. Students continue their project with MER 498.
Prerequisites: Take MER 250 MER 340 MER 340L MER 330 MER 330L.
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 and design of heat exchangers, and all three modes of heat transfer are applied together to study scenarios of multimode heat transfer.
Prerequisites: Take MER 320.
Offered: Every year, Fall

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. 3 Credits.
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, 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 472. Energy Conversion Systems. 3 Credits.
This course provides an overview and examines the historical evolution of both classical and state-of-the-art energy conversion technology. It includes advanced analysis of energy conversion hardware, air conditioning and refrigeration as well as fossil fuel combustion processes using concepts of energy. Major methods of direct energy conversion are covered, including thermoelectricity, photovoltaics, thermionics, magnetohydrodynamics, and fuel cells. The current state of national and world energy is presented, and alternatives including renewable energy and a hydrogen economy are explored with reference to economic, political, environmental and technological factors.
Prerequisites: Take MER 330.
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 electromechanical 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 106; and MER 330 MER 330L MER 340 MER 340L.
Offered: As needed

MER 481. Aircraft Performance/Static Stability. 3 Credits.
The course applies the principles developed in applied aerodynamics to develop the equations of motion for a rigid aircraft in steady state level flight, maneuvering flight, and during takeoff and landing. These equations are analyzed to determine such performance characteristics as maximum range, endurance, turning rate, climb rate, etc. Piston-prop, turbo-prop and jet aircraft are considered. The equations of motion are then analyzed to develop static stability criteria and investigate steady state control characteristics.
Prerequisites: Take MER 330 MER 387.
Offered: Every year, Fall

MER 486. Vibration Engineering. 3 Credits.
In this course, students develop a foundation in the analysis and design of free and forced single and multidegree-of-freedom systems. Applications include modeling, damping, resonance, force transmissibility, vibration absorbers, matrix formulation and modal analysis. Emphasis is placed on vibrations examples from several engineering fields. Out-of-class design problems provide students with the opportunity to apply principles taught in the classroom to realistic problems encountered by practicing engineers. In-class demonstrations supplement the theory development.
Prerequisites: Take MER 221.
Offered: Every year, Spring

MER 489. Advanced Study in Mechanical Engineering. 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.
Offered: Every year, Fall and Spring

MER 490. Engineering Professional Experience. 1 Credit.
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.
Offered: Every year, Spring

MER 492. Power Trains and Vehicle Dynamics. 3 Credits.
This course provides an introduction in ground vehicle theory with emphasis on analysis, testing and evaluation of automotive power trains and dynamic systems to understand the underlying principles affecting vehicle design. Clutches, transmissions (manual and automatic), differentials, wheels and tires, as well as braking, steering and suspension systems are studied in detail to include their effect on vehicular or other system performance. High-speed, tracked vehicle application of the above systems also is covered. Theory is verified with hands-on experience in the laboratory. Component design problems are interspersed throughout the course.
Prerequisites: Take MER 221 MER 320.
Offered: Every year, Fall

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