Mechanical Engineering (MEE)

Course information contained within the Bulletin is accurate at the time of publication in June 2025 but is subject to change. For the most up-to-date course information, please refer to the Course Catalog.

MEE 5106. Automated Data Acquisition and Analysis. 3 Credit Hours.
This course covers the application of experimental techniques and measurement systems used in engineering. Topics include computer-based data acquisition systems for measuring temperature, acceleration, strain, and other mechanical parameters. Students will learn computer interfacing using analog and digital input/output devices, as well as automated data analysis techniques. The course also explores statistical methods, curve fitting, data representation, and uncertainty analysis. Additional topics include machine vision, sampling theory, and aliasing. This online class is offered specifically for students enrolled in the graduate Certificate in Advanced Manufacturing and Robotics program.

Repeatability: This course may not be repeated for additional credits.

MEE 5110. Special Topics. 3 Credit Hours.
Repeatability: This course may be repeated for additional credit.

MEE 5117. Finite Element Analysis. 3 Credit Hours.
Concepts and techniques of finite element and finite difference methods; mesh generation techniques; computer graphics presentation methods. Application to solids, liquids, and gases in the areas of stress, strain, deflection elasticity, heat transfer, fluid flow, and combustion.

Repeatability: This course may not be repeated for additional credits.

MEE 5172. High-Speed Imaging and Analysis for Engineering Applications. 3 Credit Hours.
This course will introduce students to high-speed imaging and analysis techniques widely used in academia, industry, and government to solve complex engineering problems. Students will first learn key digital imaging concepts, followed by the fundamentals of optics, lensing and lighting. Then, they will learn how to process images to track and quantify the motion of points. This will naturally evolve into discussions on techniques including 3D point tracking, Digital Image Correlation (DIC), and Particle Image Velocity (PIV). Students will also be introduced to non-invasive imaging techniques for characterizing transparent flows, namely shadowgraphy and schlieren imaging. Finally, students will utilize software packages to perform digital processing steps such as filtering, pyrometry, correlations, tracking and more.

Repeatability: This course may not be repeated for additional credits.

MEE 5203. Advanced Materials Science. 3 Credit Hours.
Chemical bonding, crystallography, defects and their effects on material properties, nucleation, growth, and microstructure development.

Repeatability: This course may not be repeated for additional credits.

MEE 5205. Microscopy and Microanalysis of Materials. 3 Credit Hours.
This course will cover various Microsopy and Microanalysis techniques which are widely used in research labs and in industries to characterize micro and nano structure and chemical composition of solid matter. Among them are visual light, scanning probe and electron beam microscopy and associated spectroscopy. The primary focus will be on fundamental aspects and experimental methods of Scanning Electron Microscopy (SEM) and associated spectroscopy. The SEM facility will be used for individual student projects. Particular attention will be given to the selection criteria used for choosing the appropriate technique for materials characterization.

Repeatability: This course may not be repeated for additional credits.

MEE 5212. Tribology and Surface Engineering. 3 Credit Hours.
Tribology encompasses the interdisciplinary science and engineering of interacting surfaces in relative motion. Tribology is in every aspect of our lives and has a tremendous impact on manufacturing, energy production and use, transportation vehicles, health care, mining safety and reliability, and space exploration. This course introduces the nature of engineering surfaces, methods of surface characterization, modes of friction and wear, theories of contacts, and lubrication.

Repeatability: This course may not be repeated for additional credits.

MEE 5312. Mechanics of Composite Materials. 3 Credit Hours.
Introduction to the behavior of composite materials and their use in engineering structures: behavior and properties of the constituent fibers and matrices, micromechanical predictions of composite properties, anisotropic elasticity, behavior of composite laminae, classical lamination theory; fracture mechanisms, failure theories; behavior of composite plates and beams.

Repeatability: This course may not be repeated for additional credits.

MEE 5314. Impact and Crashworthiness. 3 Credit Hours.
This course is an advanced course on impact mechanics, impact biomechanics, as well as vehicle crashworthiness standards and accident data analysis. Students will learn about FMVSS and NCAP crash tests, FARS and NASS real world accident databases, and methods to analyze crash and accident data.

Repeatability: This course may not be repeated for additional credits.

MEE 5406. Robots at Work. 3 Credit Hours.
In this course students will explore the application of robotic technology to a broad range of settings with the goal of bettering the lives of individuals and/or society at large. Through this process students will learn about the subsystems powering robotic platforms and the key technologies enabling these subsystems. At the end of this course, students will be able to identify general trends in robotics and determine the key technical and ethical challenges in applying robotic solutions to new problems. This online class is offered specifically for students enrolled in the graduate Certificate in Advanced Manufacturing and Robotics program.

Repeatability: This course may not be repeated for additional credits.

MEE 5411. Introduction to Mobile Robotics. 3 Credit Hours.
Introduction to Mobile Robotics will teach you, through the use of project-based learning, fundamental concepts in mapping, planning, control, and dynamics that are used in mobile robotics. By the end of this course you will be able to program both a ground and aerial robot to autonomously and safely navigate through an obstacle-filled environment. You will work with both simulated and real robots and use both off-the-shelf software and write code from scratch using ROS.

Repeatability: This course may not be repeated for additional credits.

MEE 5412. Modern Dynamics for Robotics. 3 Credit Hours.
This course focuses on the algebraic and differential equations governing the static and dynamic 3D motion of rigid bodies, including vectors, vector differentiation, and dyads. The equations of motion for multibody systems will be derived using Newton-Euler, Lagrange, and Kane's methods. Computational tools for 3D force and motion analysis will be used to simulate physical systems.

Repeatability: This course may not be repeated for additional credits.

MEE 5414. Optimization and Control of Mechanical Systems. 3 Credit Hours.
This course focuses on designing optimal controllers for constrained and unconstrained dynamical systems. Topics include optimization, calculus of variations, dynamic programming, linear optimal control, trajectory optimization, optimal estimation, and model predictive control. Applications of the course concepts in classical problems as well as in modern systems will be discussed through several examples.

Repeatability: This course may not be repeated for additional credits.

MEE 5423. Engineering Acoustics and Continuum-System Vibration. 3 Credit Hours.
This graduate level course introduces the fundamentals of engineering acoustics and will help students establish a deep understanding of the physics of acoustic-wave propagation. Students will also be able to acquire knowledge on computational tools used to study acoustic systems, and explore emerging areas in acoustics including acoustic metamaterial and bio-inspired acoustic sensors.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C in ENGR 5012 (may be taken concurrently)

MEE 5512. Compressible Fluid Dynamics. 3 Credit Hours.
This course introduces students to the subject of high speed gas dynamics. Compressible flows exhibit fundamentally different behavior from those in low speed, constant density fluids. Such flows are found in aerodynamics, combustors, turbines, jets, gas pipelines, and wind tunnel facilities. Students study phenomena associated with supersonic flows, including normal and oblique shocks, expansion fans, and compressible flows with friction and/or heat transfer. An introduction to high temperature and rarified gas dynamics is also included.

Repeatability: This course may not be repeated for additional credits.

MEE 5513. Aerodynamics. 3 Credit Hours.
The forces and moments exerted by moving fluids on solid bodies are of concern in numerous applications. While the performance of flight vehicles is of particular interest, aerodynamics is also a subject of importance in passenger and race car design, wind turbines, structures, sea vessels, etc. Students will study various topics in low speed aerodynamics, including thin airfoil theory and airfoil nomenclature, finite wing theory, high lift and drag reduction devices, separated and vortical flows, and rotating blades. An introduction to transonic flows and computational aerodynamics will also be included. Students will explore Joukowski transformations, the Blasius solution, and vortex lattice methods for lift prediction.

Repeatability: This course may not be repeated for additional credits.

MEE 5574. Heating, Ventilation and Air Conditioning. 3 Credit Hours.
Overview of psychrometric and air conditioning processes, preparation of the energy balance, heat losses due to transmission and ventilation, the effect of solar radiation, heat gains, load calculations and simulations, design of heating, cooling, ventilating, and air conditioning (HVAC) systems, building energy system design, simulation, and control, duct, and piping system design, room air distribution and the air diffuser performance index, ADPI, including CFD analysis.

Course Attributes: SI

Repeatability: This course may not be repeated for additional credits.

MEE 5575. Renewable and Alternative Energy. 3 Credit Hours.
This survey course considers current technologies for renewable and alternative energy, including: different scenarios of producing energy; mechanical heat engines; ocean thermal energy converters; thermoelectricity; solar radiation; biomass; photovoltaic converters; wind energy; and ocean engines. The course will also consider the design of hydrogen-powered systems and of polymer electrolyte-membrane fuel cells.

Course Attributes: SF

Repeatability: This course may not be repeated for additional credits.

MEE 5577. Power Generation and Storage Technologies. 3 Credit Hours.
This course will give an overview of electric power generation technologies including coal, gas, and nuclear power plants, as well as some emerging technologies such as photovoltaic. This course will also discuss technologies used in power transmission and distribution such as overhead power line conductors. Power storage technologies will also be introduced including compressed air, flywheel, hydrogen, and batteries.

Course Attributes: SI

Repeatability: This course may not be repeated for additional credits.

MEE 5578. Fundamentals of Combustion. 3 Credit Hours.
This course is focused on concepts and applications of chemically reacting systems. Topics include heat of reaction, chemical equilibrium, chemical kinetics, chemical mechanisms, coupling chemical and thermal analyses of reacting systems, laminar premixed and diffusion flames, turbulent flames and pollutant emissions.

Repeatability: This course may not be repeated for additional credits.

MEE 5600. Graduate Seminar. 0 Credit Hours.
Required seminar for mechanical engineering graduate students for scientific and professional development. These seminars include speakers from academic and professional backgrounds. Students will be graded on participation of at least 70% of the bi-weekly seminars throughout the duration of the semester.

Repeatability: This course may be repeated for additional credit.

MEE 5606. Applied Manufacturing Engineering. 3 Credit Hours.
This applied course provides an overview of existing and emerging manufacturing technologies. Topics include advanced processing methods for metals, alloys, ceramics, and polymers, as well as powder metallurgy and composite manufacturing. The course also considers additive manufacturing and explores micro- and nano-fabrication techniques. This online class is offered specifically for students enrolled in the graduate-level Certificate in Advanced Manufacturing and Robotics program.

Repeatability: This course may not be repeated for additional credits.

MEE 5643. Manufacturing Engineering. 3 Credit Hours.
This course will provide an overview of existing and emerging manufacturing technologies in the modern society. Topics include state-of-the-art processing methods for metals and alloys, ceramics and powder metallurgy, polymers and composites, additive manufacturing of a wide range of solid materials, as well as micro- and nano- fabrications.

Repeatability: This course may not be repeated for additional credits.

MEE 5731. Cardiovascular Fluid Dynamics. 3 Credit Hours.
Mechanics of blood circulation, fluid mechanics of the heart, blood flow in arteries, unsteady flow in veins, current concepts in circulatory assist devices, biofluidics, and other selected topics.

Repeatability: This course may not be repeated for additional credits.

MEE 5733. Viscoelasticity. 3 Credit Hours.
Rate dependent deformation of materials, creep and relaxation, viscoelastic constitutive models, large deformations, and other selected topics.

Repeatability: This course may not be repeated for additional credits.

MEE 8110. Special Topics. 3 Credit Hours.
Repeatability: This course may be repeated for additional credit.

MEE 8315. Fracture Mechanics. 3 Credit Hours.
This course will cover essential topics of fracture mechanics such as elastic stress intensity factor and Griffith energy balance, determination of the elastic field at a sharp crack tip via eigenfunction expansion methods, elastic-plastic crack tip fields, J integrals analysis, fatigue crack growth, and experimental determination of fracture toughness. Emphasis will be given to calculation of stress intensity factors using modern numerical methods, determination of critical crack sizes, and prediction of fatigue crack propagation rate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ENGR 5314 and MEE 5203.

MEE 8411. Probabilistic Robotics. 3 Credit Hours.
This course will introduce students to various techniques for probabilistic state estimation and discuss their application to problems such as robot localization, navigation, mapping, and multi-object tracking. The course will provide students with a problem-oriented introduction to the material, and it may also cover related material form machine learning and computer vision. Students will conduct a final project on a subject of their choice.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in (MEE 5411, ECE 5033, or CIS 5526)

MEE 9182. Independent Study I. 3 Credit Hours.
Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by MS/MSE students and once by Ph.D. students.

Repeatability: This course may be repeated for additional credit.

MEE 9282. Independent Study II. 3 Credit Hours.
Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by Ph.D. students.

Repeatability: This course may be repeated for additional credit.

MEE 9991. Directed Research. 1 to 6 Credit Hour.
Under the guidance of a faculty member, the student will conduct independent research on a selected topic in engineering.

Repeatability: This course may be repeated for additional credit.

MEE 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.
This course is intended for Ph.D. students who have completed their coursework but who have not yet passed both the Ph.D. Preliminary Examination.

Repeatability: This course may be repeated for additional credit.

MEE 9995. Project. 1 to 3 Credit Hour.
A project assigned with the approval of the Mechanical Engineering Graduate Committee and conducted under the supervision of a graduate faculty advisor. An oral presentation in an open seminar and a written report are required to complete the independent project. Projects related to industrial applications are encouraged. For non-thesis students only.

Repeatability: This course may be repeated for additional credit.

MEE 9996. Thesis. 1 to 3 Credit Hour.
Master's thesis. May be taken twice.

Repeatability: This course may be repeated for additional credit.

MEE 9998. Pre-Dissertation Research. 1 to 6 Credit Hour.
This course is intended for Ph.D. students who have passed both the Preliminary and Qualifying Examinations but who have not been elevated to candidacy.

Repeatability: This course may be repeated for additional credit.

MEE 9999. Dissertation Research. 1 to 6 Credit Hour.
This course is intended only for those students who have achieved Ph.D. Candidacy status. A minimum of 6 semester hours is required for graduation.

Repeatability: This course may be repeated for additional credit.