# MECHANICAL ENGINEERING (ME)

**NOTE: All prerequisites for Mechanical Engineering (ME) courses must be completed with a grade of "C-" or better.**

## Mechanical Engineering (ME) Courses

**ME 1403. Engineering Practice and Graphics. (2-3) 3 Credit Hours. (TCCN = ENGR 1304)**
Prerequisites: MAT 1093 and completion of or concurrent enrollment in WRC 1013. Introduction to engineering practice and engineering graphics: geometric constructions, multi-view drawing, dimensioning, sections, pictorials and auxiliary views. Computer-aided design, generation of mechanical drawings, and design projects. (Formerly ME 1402. Credit cannot be earned for both ME 1402 and ME 1403.) Course Fees: LRE1 $25; STSE $30.

**ME 3113. Measurements and Instrumentation. (2-3) 3 Credit Hours.**
Prerequisites: EE 2213, EGR 2513, PHY 1951, and PHY 1971. Fundamentals of measurement systems theory and laboratory practice. Descriptive statistics, probability distributions, error, uncertainty analysis, technical report writing, and data acquisition. Generally offered: Fall, Spring, Summer. Differential Tuition: $165. Course Fees: L001 $30; DL01 $75.

**ME 3173. Numerical Methods. (2-3) 3 Credit Hours.**
Prerequisite: EGR 3423. Introduction to numerical algorithms to solve science and engineering problems. Construction and derivation of numerical algorithm as well as application limits. Various numerical approaches in finding roots of linear and non-linear functions, regression analysis, interpolation, curve fitting procedures, differentiation, integration, solutions of system of linear algebraic equations, solutions of ordinary differential equations and boundary value problems. (Formerly ME 2173. Credit cannot be earned for both ME 3173 and ME 2173.) Generally offered: Fall, Spring, Summer. Course Fees: LRE1 $25; STSE $30; DL01 $75.

**ME 3183. Python: Big Data in Engineering and Environmental Systems. (3-0) 3 Credit Hours.**
Prerequisite: ME 3173 (or ME 2173 in previous catalogs), or equivalent. Introduction to Python as a programming language and to several modules of Python specific to scientific computing. Understanding physical principles of engineering systems from data using Python platform. The course introduces scientific data analysis including statistical analysis of stochastic processes and numerical methods for big data. Differential Tuition: $165.

**ME 3241. Materials Engineering Laboratory. (0-3) 1 Credit Hour.**
Prerequisite: Concurrent enrollment in or completion of ME 3243. Investigation of the mechanical properties of engineering materials, with emphasis on metals, sample preparation, and metallography. (Formerly ME 3244. Credit cannot be earned for both ME 3244 and ME 3241.) Differential Tuition: $55. Course Fee: L001 $30.

**ME 3243. Materials Engineering. (3-0) 3 Credit Hours.**
Prerequisites: CHE 1103, EGR 2103, and concurrent enrollment in or completion of ME 3241. Fundamentals in atomic structure, microstructures, properties, and mechanical behavior of engineering materials, such as metals, polymers, and ceramics. (Formerly ME 3244. Credit cannot be earned for both ME 3244 or ME 3243 and ME 3241. Prior completion of ME 3244 can be substituted for ME 3243 and ME 3241.) Generally offered: Fall, Spring. Differential Tuition: $165. Course fee: DL01 $75.

**ME 3253. Medical Device Design and Commercialization. (3-0) 3 Credit Hours.**
Prerequisite: ME 3173 (or ME 2173 in previous catalogs), or equivalent. Introduction to medical device development, clinical perspective in approaching design, medical design process, relevant regulatory policies, manufacturing concerns, military medicine, dentistry, medtech entrepreneurship, and medical robotics. The course materials and experiential learning will enable students to examine how the interdependent roles of medical care, engineering, technology, and policy impact device design in contemporary medicine. Differential Tuition: $165.

**ME 3263. Manufacturing Engineering. (3-0) 3 Credit Hours.**
Prerequisites: EGR 2513, ME 3241, and ME 3243 (or ME 3244 in previous catalogs). Manufacturing processes, quality assurance, statistical methods, economic analysis, planning, and communication. (Formerly titled "Materials Processing.") Generally offered: Fall, Spring, Summer. Differential Tuition: $165.

**ME 3273. Operations Research. (3-0) 3 Credit Hours.**
Prerequisite: ME 3173 (or ME 2173 in previous catalogs), or equivalent. Introduction to fundamental optimization models and solution methods, including linear programs, the simplex method, duality theory, sensitivity analysis, integer programs, and network flows. Focus on formulating and solving practical operations research problems and the use of optimization software. Differential Tuition: $165.

**ME 3293. Thermodynamics I. (3-0) 3 Credit Hours.**
Prerequisite: EGR 2103 and MAT 1223 (or MAT 1224 in previous catalogs). Heat, work, equations of state, thermodynamics systems, control volume, first and second laws of thermodynamics, applications of the laws of thermodynamics, reversible and irreversible processes, and introduction to basic thermodynamic cycles. Generally offered: Fall, Spring, Summer. Differential Tuition: $165. Course Fee: DL01 $75.

**ME 3323. Mechanical Vibration. (3-0) 3 Credit Hours.**
Prerequisite: EGR 2513 and EGR 3423. Free and forced vibrations, single and multiple degree of freedom systems, damping, matrix methods, time-domain and frequency-domain. Applications in the transmission and control of vibration. Generally offered: Spring. Differential Tuition: $165.

**ME 3513. Mechanism Design. (3-0) 3 Credit Hours.**
Prerequisites: EGR 2513 and ME 1403. Introduction to mechanisms, graphical and linear analytical methods for kinematic synthesis of mechanisms; design of cam follower; gearing fundamentals, ordinary and planetary gear trains; and computer-aided design projects. Differential Tuition: $165.

**ME 3541. Dynamics and Controls Laboratory. (0-3) 1 Credit Hour.**
Prerequisites: ME 3113 and concurrent enrollment in or completion of ME 3543. Investigation of the dynamics and control of physical systems. (Formerly ME 4733. Credit cannot be earned for both ME 4733 and ME 3541.) Differential Tuition: $55.

**ME 3543. Dynamic Systems and Control. (3-0) 3 Credit Hours.**
Prerequisite: EGR 2513, EGR 3423, and concurrent enrollment in or completion of ME 3113. Introduction to modeling and control of dynamic physical systems, analysis and design of control systems for mechanical, electrical, manufacturing, fluid, and thermal systems. (Formerly ME 4522 and ME 4523. Credit cannot be earned for more than one of the following: ME 3543, ME 4522, or ME 4523.) Generally offered: Fall, Spring, Summer. Differential Tuition: $165. Course Fee: DL01 $75.

**ME 3663. Fluid Mechanics. (3-0) 3 Credit Hours.**
Prerequisite: EGR 2513, EGR 3423, and completion of or concurrent enrollment in ME 3293. Fluid properties, fluid statics, integral and differential analysis of fluid flow, viscous laminar and turbulent flow in conduits, dimensional analysis, boundary layer concepts, drag and lift. Generally offered: Fall, Spring, Summer. Differential Tuition: $165. Course Fee: DL01 $75.

**ME 3813. Mechanics of Solids. (3-0) 3 Credit Hours.**
Prerequisite: EGR 2103 and MAT 1223 (or MAT 1224 in previous catalogs). Internal forces and deformations in solids, stress, strain and their relations, torsion, stresses and deflections in beams, and elastic behavior of columns. Generally offered: Fall, Spring, Summer. Differential Tuition: $165. Course Fee: DL01 $75.

**ME 3823. Machine Element Design. (3-0) 3 Credit Hours.**
Prerequisites: ME 1403, ME 3241, ME 3243 (or ME 3244 in previous catalogs), and ME 3813. Introduction to design of machine elements, materials selection, static and fatigue failures, shafts, fasteners, springs, gears, bearings and design projects. (Formerly ME 4423. Credit cannot be earned for both ME 3823 and ME 4423.) Generally offered: Fall, Spring, Summer. Differential Tuition: $165. Course fee: DL01 $75.

**ME 4123. Aerodynamics. (3-0) 3 Credit Hours.**
Prerequisite: ME 3293 and ME 3663. Fundamental principles of Aerodynamics, background review, inviscid incompressible flow, flow over airfoils and finite wings, Panel method, compressible flow and shockwaves including supersonic flow, oblique shock and expansion waves, subsonic compressible flow over airfoils, linearized flows in aerodynamics, concepts in viscous flow, and Computational methods in Aerodynamics. Differential Tuition: $165.

**ME 4143. Propulsion. (3-0) 3 Credit Hours.**
Prerequisite: ME 3293 and ME 3663. Application of thermodynamics and fluid mechanics to the analysis of problems related to the propulsion of aerospace vehicles. Development of control volume analysis techniques for compressible flow problems, with applications in the design and analysis of rocket nozzles and state-of-the-art propulsion systems like ramjets, scramjets, and detonation cycle systems. Differential Tuition: $165.

**ME 4153. Astrodynamics. (3-0) 3 Credit Hours.**
Prerequisite: ME 3543. Two-body orbital mechanics, introduction to reference frames, orbit elements representation, the solar system as a set of orbiting bodies, orbit determination, orbital maneuvers, interplanetary trajectories, and common orbital perturbations. Differential Tuition: $165.

**ME 4163. Aircraft Performance. (3-0) 3 Credit Hours.**
Prerequisite: ME 3293 and ME 3663. Study of aircraft performance using the governing equations of fluid dynamics, atmospheric properties, and the concepts of lift and drag. Analysis of level flight performance, rates of climb, service and absolute ceilings, range, take-off and landing, and turn performance. Study of longitudinal and lateral stability applied to aircraft. Differential Tuition: $165.

**ME 4173. High Performance Computing. (3-0) 3 Credit Hours.**
Prerequisite: ME 3173 (or ME 2173 in previous catalogs), or equivalent. Introduction to UNIX (login, shell scripts, editors, file permissions), visualization (software tools, data formats), Parallel programming (numerical libraries, Message Passing Interface, Trilinos, GPGPU programming). Differential Tuition: $165.

**ME 4183. Compressible Flow. (3-0) 3 Credit Hours.**
Prerequisites: ME 3293 and ME 3663. Analysis of one-dimensional steady compressible flow, isentropic flow, compressible boundary layers, transition from subsonic to supersonic flow, Fanno and Rayleigh flow, supersonic nozzle design, normal and oblique shock waves, and expansion fans. (Formerly EGR 4183. Credit cannot be earned for both ME 4183 and EGR 4183.) Differential Tuition: $165.

**ME 4243. Intermediate Materials Engineering. (3-0) 3 Credit Hours.**
Prerequisites: ME 3241, ME 3243 (or ME 3244 in previous catalogs), and ME 3813. Selected topics in fabrication and processing of materials; macroscopic and microscopic aspects of the mechanical behavior of metals, ceramics, polymers and composites; Failure mode analysis in materials; optimization of material selection in the design process. Differential Tuition: $165.

**ME 4273. Systems Modeling and Analysis. (3-0) 3 Credit Hours.**
Prerequisite: ME 3173 (or ME 2173 in previous catalogs); and ME 3113. Systems analysis approach to formulating and solving engineering problems. Topics include mathematical modeling, discrete event simulation, and decision analysis. Focus on applying systems modeling methods on practical industrial problems and the use of simulation software. Differential Tuition: $165.

**ME 4293. Thermodynamics II. (3-0) 3 Credit Hours.**
Prerequisite: ME 3293. Energy and (availability) analysis, reactive and nonreactive mixtures, moist air properties, psychometric systems and analysis, vapor and gas power cycles, refrigeration and heat-pump cycles, and thermodynamic relations. Generally offered: Fall, Spring. Differential Tuition: $165.

**ME 4312. Thermal and Fluids Laboratory. (0-6) 2 Credit Hours.**
Prerequisites: ME 3113, ME 4293, and concurrent enrollment in or completion of ME 4313. Investigation of thermal and fluid physical systems, and design of experiments. (Formerly ME 4733. Credit cannot be earned for both ME 4733 and ME 4312.) Differential Tuition: $110.

**ME 4313. Heat Transfer. (3-0) 3 Credit Hours.**
Prerequisite: EGR 3423, ME 3173 (or ME 2173 in previous catalogs), ME 3293, and ME 3663. Generalized potential distribution and gradients, and heat transfer, including transient and steady state conduction, forced and free convection, radiation, and heat exchanger analysis. Generally offered: Fall, Spring. Differential Tuition: $165.

**ME 4323. Thermal Systems Design. (3-0) 3 Credit Hours.**
Prerequisite: ME 4313. Application of thermodynamics, fluid mechanics, heat transfer, and computer methods to the design of thermal energy systems. Differential Tuition: $165.

**ME 4343. Heating, Air Conditioning, and Refrigeration Design. (3-0) 3 Credit Hours.**
Prerequisite: ME 4293. Moist air properties, human comfort, solar radiation, heating/cooling loads, design selection, operation of air conditioning equipment, and duct design. Differential Tuition: $165.

**ME 4373. Separation Processes. (3-0) 3 Credit Hours.**
Prerequisite: ME 4293. Rate- and equilibrium-controlled separation, mass transfer, phase equilibrium, distillation, and extraction. Differential Tuition: $165.

**ME 4503. Lean Manufacturing and Enterprise Engineering. (3-0) 3 Credit Hours.**
Prerequisite: ME 3263. Concepts and applications of Lean Systems applied to manufacturing and non-manufacturing environments. Topics include lean fundamentals and various tools and methodologies for transformation of companies and organizations into globally competitive enterprises. Team project on Value Streaming Mapping analysis of processes in real settings is required. Differential Tuition: $165.

**ME 4543. Mechatronics. (2-3) 3 Credit Hours.**
Prerequisite: ME 3113. Modeling and analysis of electrical (resistors, capacitors, inductors, diodes, transistors, operational amplifiers, combinational logic and sequential logic) and mechanical systems (spring mass damper), data acquisition and measurements, sensors, actuators, and micro-controller programming. A lab component with emphasis on building electrical circuits, data acquisition using LabVIEW, and integration of sensors, actuators, and micro-controller programming (Arduino) to create a mechatronics system. Generally offered: Fall, Spring. Differential Tuition: $165. Course Fees: L001 $30; DL01 $75.

**ME 4553. Automotive Vehicle Dynamics. (3-0) 3 Credit Hours.**
Prerequisite: EGR 2513 and EGR 3423. Dynamics and control of automotive systems, handling, tires, suspension, steering, and aerodynamic forces. Differential Tuition: $165.

**ME 4563. Computer Integrated Manufacturing. (3-0) 3 Credit Hours.**
Prerequisite: ME 3263. Fundamental concepts and models related to computer-aided design, computer-aided process planning, computer-aided manufacturing, production planning and scheduling, and manufacturing execution systems. Laboratory work includes computer-aided applications and programming of automated production equipment. Differential Tuition: $165.

**ME 4573. Facilities Planning and Design. (3-0) 3 Credit Hours.**
Prerequisite: ME 3263. Product, process, and schedule design, flow, space, and activity relationships, material handling, layout planning models and design algorithms, and warehouse operations. Differential Tuition: $165.

**ME 4583. Enterprise Process Engineering. (3-0) 3 Credit Hours.**
Prerequisite: ME 3263. Fundamental concepts, methodologies, and tools for the design, engineering and continuous improvement of enterprises. Topics include Six Sigma for process design and improvement, lean manufacturing fundamentals, value-stream mapping, performance evaluation, and other contemporary enterprise process engineering approaches. Generally offered: Fall. Differential Tuition: $165. Course fee: DL01 $75.

**ME 4593. Alternative Energy Sources. (3-0) 3 Credit Hours.**
Prerequisite: ME 3173 (or ME 2173 in previous catalogs), ME 3113, ME 3663, and ME 4293. Nuclear, geothermal, solar, biomass, wind, and hydrogen energy sources. Resources, production, utilization, economics, sustainability, and environmental considerations. (Formerly ME 3593. Credit cannot be earned for both ME 3593 and ME 4593.) Differential Tuition: $165.

**ME 4603. Finite Element Analysis. (3-0) 3 Credit Hours.**
Prerequisite: EGR 3423, ME 3173 (or ME 2173 in previous catalogs), and ME 3823. Finite element method fundamentals, advanced geometric modeling of mechanical components and systems, and finite element modeling of components. Differential Tuition: $165.

**ME 4613. Power Plant System Design. (3-0) 3 Credit Hours.**
Prerequisite: ME 4293. Application of thermodynamics and fluid mechanics to the design of vapor and gas-turbine power plant systems including boilers, condensers, turbines, pumps, compressors, and cooling towers. Differential Tuition: $165.

**ME 4623. Internal Combustion Engines. (3-0) 3 Credit Hours.**
Prerequisite: ME 4293. Application of thermodynamic cycles in design, analysis, and modeling of internal combustion engines including spark-ignition and compression-ignition cycles, thermochemistry, fuels, combustion, emissions, and pollution. Differential Tuition: $165.

**ME 4643. Pressure Vessel and Piping Design. (3-0) 3 Credit Hours.**
Prerequisites: ME 3663 and ME 3813. ASME Section XIII Boiler and Pressure Vessel code, inspection, maintenance, repair, and modification of pressure vessels. Piping design and construction. Differential Tuition: $165.

**ME 4653. Oil and Gas Engineering and Reservoir Geomechanics. (3-0) 3 Credit Hours.**
Prerequisites: ME 3663 and ME 3813. Introduction to the oil and gas industry, Measurement; deformation mechanisms in rock; rock fracture description and analysis; wellbore stresses and failure; wellbore stability analysis; fault stability analysis; depletion-induced reservoir deformation; and hydraulic fracturing. Differential Tuition: $165.

**ME 4683. Corrosion Engineering. (3-0) 3 Credit Hours.**
Prerequisites: ME 3241 and ME 3243 (or ME 3244 in previous catalogs). Principles of electrochemistry, fundamentals of the environmental degradation of materials, corrosion thermodynamics and kinetics, corrosion phenomenology, and corrosion control and prevention. Differential Tuition: $165. Course fee: DL01 $75.

**ME 4723. Reliability and Quality Control in Engineering Design. (3-0) 3 Credit Hours.**
Prerequisite: ME 3113. Introduction to statistical methods in reliability and probabilistic engineering design methodology, statistical quality control and inspection, life prediction and testing, and design optimization. Generally offered: Fall. Differential Tuition: $165. Course fee: DL01 $75.

**ME 4773. Robotics. (3-0) 3 Credit Hours.**
Prerequisite: EGR 2513; and ME 3173 (or ME 2173 in previous catalogs). Kinematics, dynamics, planning and control of mobile robots and manipulators. Special topics may include legged robots, soft robots, climbing robots, advanced control methods, image processing, computer vision, estimation. A LEGO-based laboratory with emphasis on prototyping robotic systems for practical applications. Differential Tuition: $165.

**ME 4801. Manufacturing Practices Laboratory. (0-3) 1 Credit Hour.**
Prerequisite: Concurrent enrollment in, or completion of, ME 3263. Use of measurement tools, saw, drill, mill, lathe, and welder. Differential Tuition: $55.

**ME 4812. Senior Design I. (2-0) 2 Credit Hours.**
Prerequisites: ME 3113, ME 3263, ME 3543, ME 3663, ME 3823, and ME 4293; completion of or concurrent enrollment in ME 4313, ME 4801, ME 4312, and EGR 3713 or ME 4543 required. Design project proposals, computer-aided synthesis, analysis, and modeling of an open-ended problem development and presentation of conceptual designs. Industrial cooperation is encouraged. This course, as well as ME 4313, ME 4543, ME 4801, and ME 3541, must be completed with a grade of "C-" or better to serve as prerequisites for ME 4813. (Formerly ME 4811 and ME 4803. Credit cannot be earned for more than one of the following: ME 4812, ME 4803, or ME 4811.) Differential Tuition: $110. Course fee: DL01 $50.

**ME 4813. Senior Design II. (2-3) 3 Credit Hours.**
Prerequisites: ME 3541, ME 4312, ME 4313, ME 4801, ME 4812, and EGR 3713 or ME 4543. Development of a working design of an instructor-approved design project using computer-aided synthesis, analysis, modeling, and optimization methods. Industrial cooperation encouraged. Considerations of safety, reliability, environmental, and economic constraints, and ethical and social impacts. Generally offered: Fall, Spring. Differential Tuition: $165. Course Fees: L001 $30; DL01 $75.

**ME 4911. Independent Study. (0-0) 1 Credit Hour.**
Prerequisite: Permission in writing (form available) from the instructor, the Department Chair, and Dean of the College. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor's degree. Differential Tuition: $55.

**ME 4913. Independent Study. (0-0) 3 Credit Hours.**
Prerequisite: Permission in writing (form available) from the instructor, the Department Chair, and Dean of the College. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor's degree. Differential Tuition: $165.

**ME 4953. Special Studies in Mechanical Engineering. (3-0) 3 Credit Hours.**
Prerequisite: Will depend on the topic and must be identified before the course is scheduled; the minimum prerequisite must be ME 3173 (or ME 2173 in previous catalogs), or a higher-level engineering course depending on the topic. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring. Differential Tuition: $165. Course Fee: DL01 $75.

**ME 4963. Mechanical Engineering Applications to Biomedical Systems. (3-0) 3 Credit Hours.**
Prerequisites: EGR 2513, ME 3663, and ME 3813. Applications of dynamics, solid mechanics and fluid mechanics to biomedical systems. (Formerly titled Bioengineering.) Differential Tuition: $165.