MECHANICAL ENGINEERING

Mechanical Engineering

The Department of Mechanical Engineering and Engineering Management offers a four-year Bachelor of Science degree program in Mechanical Engineering. The four-year Bachelor of Science degree program in Mechanical Engineering (ME) is dedicated to the principle of preparing its students for industry and graduate study with the expectation of eventual leadership responsibilities. To that end, its faculty and facilities focus on an emphasis of design and industrial experience, student-faculty-industry cooperative projects, teamwork, the adoption of new technologies and on the hands-on student utilization of laboratories and computing systems. The Mechanical Engineering program maintains professional accreditation by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; Telephone: (410) 347-7700).

The ME program is designed to achieve a balance among the major areas of Machine Design, Electro-Mechanical Systems, and Thermal Systems. Student may choose to specialize within the following areas: Thermal, Design, and Micro-Electro-Mechanical Systems. Descriptions of program objectives and outcomes are publicly posted in the Department and on the Department's webpages.

The Master of Science degree in Mechanical Engineering (MSME) is also available. This degree program is described in the Graduate Bulletin.

Mechanical Engineering B.S. Degree - Required Courses and Recommended Course Sequence

First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>[MTH-111]</td>
<td>Calculus I</td>
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<td>[CHM-117]</td>
<td>Chemistry for Engineers Lab</td>
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<td>[CHM-118]</td>
<td>Chemistry for Engineers</td>
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<tr>
<td>[ME-180]</td>
<td>CADD Lab</td>
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<td>[ENG-101]</td>
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<td>[FYF-101]</td>
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Second Semester

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<tr>
<td>[MTH-112]</td>
<td>Calculus II</td>
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<tr>
<td>[PHY-201]</td>
<td>General Physics I</td>
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<tr>
<td>[PHY-204]</td>
<td>General Physics I Lab</td>
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<tr>
<td>[ME-140]</td>
<td>Scientific Programming</td>
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<tr>
<td>[EGR-200]</td>
<td>Intro. to Materials Science</td>
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Third Semester

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<tr>
<td>[MTH-211]</td>
<td>Intro. to Differential Equations</td>
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<td>[PHY-205]</td>
<td>General Physics II Lab</td>
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<tr>
<td>[EE-211]</td>
<td>Electrical Circuits and Devices</td>
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<td>[EE-283]</td>
<td>Electrical Measurements Lab</td>
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<tr>
<td>[ME-231]</td>
<td>Statics</td>
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Fourth Semester

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<tr>
<td>[EGR-222]</td>
<td>Mechatronics</td>
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<tr>
<td>[ME-232]</td>
<td>Strength of Materials</td>
<td>3</td>
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<tr>
<td>[ME-234]</td>
<td>Dynamics</td>
<td>3</td>
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<tr>
<td>[ME-322]</td>
<td>Engineering Thermodynamics</td>
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<tr>
<td>[MTH-212]</td>
<td>Multivariable Calculus</td>
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<tr>
<td>[ME-175]</td>
<td>Intro. to Manufacturing and Machining</td>
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Fifth Semester

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<tr>
<td>[ME-215]</td>
<td>Intro. to Manufacturing Processes</td>
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<td>[ME-335]</td>
<td>Engineering Modeling &amp; Analysis</td>
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Sixth Semester

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<td>[ME-399]</td>
<td>Cooperative Education* OR ME Technical Elective**</td>
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<tr>
<td>[EGR-201]</td>
<td>Professionalism and Ethics</td>
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<tr>
<td>[ME-323]</td>
<td>Fluid Mechanics Lab</td>
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<tr>
<td>[ME-324]</td>
<td>Heat Transfer</td>
<td>3</td>
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<tr>
<td>[ME-332]</td>
<td>Vibration of Dynamic Systems</td>
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<tr>
<td>[ME-330]</td>
<td>Vibrations Laboratory</td>
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<tr>
<td>[EGR-320]</td>
<td>Engineering Project Management &amp; Analysis</td>
<td>3</td>
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Seventh Semester

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<tr>
<td>[ME-326]</td>
<td>Heat Transfer Lab</td>
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<tr>
<td>[ME-384]</td>
<td>Mechanical Design Lab</td>
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<tr>
<td>[ME-391]</td>
<td>Senior Project I</td>
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<tr>
<td>[ME-317]</td>
<td>Robotics</td>
<td>3</td>
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ME-140. SCIENTIFIC PROGRAMMING
Credits: 3
This course presents an introduction to computer programming with an emphasis on the techniques needed for data analysis and numerical problem solving for scientific and engineering applications. Basic programming idioms are presented including control structures, data types, methods for handling input and output as well as numerical methods such as array computing and vectorization. Emphasis is placed on proper software engineering practice as well as data analysis and presentation.

ME-175. INTRODUCTION TO MANUFACTURING & MACHINING
Credits: 1
Familiarizing with traditional machining processes and measuring equipment used in manufacturing. Hands-on experience with traditional and numerical control (NC) machines; various manufacturing processes and fundamentals of metrology.

ME-180. CADD LAB
Credits: 1
An introduction to the symbolic and visual languages used in the various engineering fields. The use of the computer in design and drafting and familiarization with various software packages in the CADD (Computer Aided Design and Drafting) laboratory. Blueprint reading and printed circuit layouts. Emphasis will also be placed on the representation and interpretation of data in graphical form as well as the fundamentals of 2-dimensional and 3-dimensional graphic formats.

ME-215. INTRODUCTION TO MANUFACTURING PROCESSES
Credits: 3
An introduction to manufacturing which examines traditional processes such as metal forming and casting and advanced manufacturing processes associated with thin film deposition, microfabrication and piezoelectric devices. Quality assurance and quality control issues in manufacturing.

ME-231. STATICS
Credits: 3
Statics of particles, including resolution of forces into components, vector sums, and concurrent force systems. Statics of rigid bodies and the study of moments. Equilibrium of bodies in two- and three-dimensions and determination of reactions. Analysis of trusses and frames. Determination of centroids and moments of inertia. Kinematics of particles, including displacement, velocity, and acceleration.

ME-232. STRENGTH OF MATERIALS
Credits: 3
Analysis of statically determinate and indeterminate structural systems; computation of reactions, shears, moments, and deflections of beams, trusses, and frames. Bending and torsion of slender bars; buckling and plastic behavior.

ME-234. DYNAMICS
Credits: 3
This course continues the development of Newtonian mechanics with application to the motion of free bodies and mechanisms. Topics include rectilinear motion, vector calculus, particle motion, inertial and rotating reference frames, rigid body motion, rotational dynamics, linear and rotational momentum, work and kinetic energy, virtual work and collision.

ME-236. COMPUTER AIDED DESIGN
Credits: 3
An introduction to the use of computer aided design software in the design and drafting process. Emphasis will be placed on the use of software packages in the design of mechanical systems and structures.

ME-237. ENGINEERING DRAWING
Credits: 3
This course covers the principles of engineering drawing and the use of drawing instruments. Students will learn to produce and read engineering drawings, including the use of industry-standard drafting software.

ME-238. ENGINEERING PROBLEM SOLVING
Credits: 3
This course focuses on developing problem-solving skills in an engineering context. Students will learn to apply analytical and creative thinking to solve complex engineering problems.

ME-239. ENGINEERING DESIGN
Credits: 3
This course introduces the principles of engineering design. Students will learn to use design tools and techniques to create and evaluate engineering solutions.

ME-240. ENGINEERING MANAGEMENT
Credits: 3
This course covers the fundamentals of engineering management, including project management, cost estimation, and quality control.

ME-241. ENGINEERING ECONOMICS
Credits: 3
This course focuses on the application of economic principles to engineering problems. Students will learn to analyze and evaluate engineering projects from a financial perspective.

ME-242. ENGINEERING REGULATORY COMPLIANCE
Credits: 3
This course covers the legal and regulatory requirements that impact engineering projects. Students will learn about compliance with laws and regulations related to engineering practice.

ME-243. ENGINEERING INNOVATION AND IMPACT
Credits: 3
This course explores the role of engineering in driving innovation and societal impact. Students will learn to assess and evaluate the ethical and social implications of engineering projects.

ME-244. ENGINEERING PROFESSIONAL PRACTICE
Credits: 3
This course provides an overview of the professional practice of engineering, including ethical considerations, professional societies, and documentation.

ME-245. ENGINEERING COMMUNICATION AND ETHICS
Credits: 3
This course focuses on the development of effective communication and ethical decision-making skills in the engineering profession. Students will learn to communicate technical information and make ethical decisions in engineering contexts.

ME-246. ENGINEERING POLICY AND REGULATION
Credits: 3
This course covers the development and impact of engineering policies and regulations. Students will learn about the political and legal processes that shape engineering practice.

ME-247. ENGINEERING PRACTICUM
Credits: 3
This course provides practical experience in the engineering profession through a supervised internship or cooperative education placement. Students will apply their knowledge and skills in a real-world engineering setting.

ME-248. ENGINEERING PRACTICE AND RESPONSIBILITIES
Credits: 3
This course covers the legal and ethical responsibilities of engineers in their professional practice. Students will learn about laws and regulations that govern engineering practice.

ME-249. ENGINEERING PRACTICE AND ETHICS
Credits: 3
This course focuses on the ethical and professional responsibilities of engineers in their practice. Students will learn about ethical decision-making in engineering contexts.

ME-250. ENGINEERING PRACTICE AND INNOVATION
Credits: 3
This course explores the role of engineering in driving innovation and societal impact. Students will learn to assess and evaluate the ethical and social implications of engineering projects.

ME-251. ENGINEERING PRACTICE AND POLICY
Credits: 3
This course covers the role of engineering in policy-making and the impact of policy on engineering. Students will learn about the political processes that shape engineering practice.

ME-252. ENGINEERING PRACTICE AND REGULATION
Credits: 3
This course focuses on the legal and Regulatory requirements that impact engineering projects. Students will learn about compliance with laws and regulations related to engineering practice.
ME-298. TOPICS IN MECHANICAL ENGINEERING  
Credits: 1-3  
Selected topics in the field of mechanical engineering.  

Pre-Requisites  
Sophomore standing and permission of the instructor.  

ME-312. MANUFACTURING SYSTEM ENGINEERING  
Credits: 3  

Pre-Requisites  
Junior standing in mechanical engineering.  

ME-314. INVERSE PROBLEMS IN MECHANICS  
Credits: 3  
Inverse problems are very common in engineering where the outputs are known but the inputs are unknown. This course will show how to properly setup a well-posed inverse problem, how to solve matrix inverses, and conduct hands on experiments by creating strain gage based force transducers.  

Pre-Requisites  
[[ME-333]]  

ME-317. ROBOTICS  
Credits: 3  
The analysis and design of robots. Class covers the mechanical principles governing the kinematics of robotics. Course topics include forward kinematics and the determination of the closed form kinematic inversion, as well as workspace and trajectory generation. Class also covers the formation and computation of the manipulator Jacobian matrix.  

Pre-Requisites  
[[EGR-222]] and [[ME-234]]  

ME-321. FLUID MECHANICS  
Credits: 3  
Thermodynamics and dynamic principles applied to fluid behavior and to ideal, viscous and compressible fluids under internal and external flow conditions.  

Pre-Requisites  
[[ME-231]]  

Co-Requisites  
[[ME-322]] concurrent or before  

ME-323. FLUID MECHANICS LABORATORY  
Credits: 1  
Experiments with and analysis of basic fluid phenomena, hydrostatic pressure, Bernoulli theorem, laminar and turbulent flow, pipe friction, and drag coefficient.  

Click here for course fees.  

Co-Requisites  
[[ME-321]] concurrent or before  

ME-324. HEAT TRANSFER  
Credits: 3  
Fundamental principles of heat transmission by conduction, convection, and radiation; application of the laws of thermodynamics; application of these principles to the solution of engineering problems.  

Pre-Requisites  
[[ME-321]] and [[MTH-211]]  

ME-325. ENERGY SYSTEMS  
Credits: 3  
Fundamental principles of energy transmission and energy conversion. Comprehension of the physical systems in which the conversion of energy is accomplished. Primary factors necessary in the design and performance analysis of energy systems.  

Pre-Requisites  
[[ME-322]].  

ME-326. HEAT TRANSFER LABORATORY  
Credits: 1  
Basic heat transfer modes are demonstrated experimentally. This includes conduction, convection, and radiation of heat as well as fin and heat exchanger.  

Click here for course fees.  

Pre-Requisites  
[[ME-321]]  

Co-Requisites  
[[ME-324]] concurrent or before  

ME-328. COMBUSTION ENGINES  
Credits: 3  
Investigation and analysis of internal and external combustion engines with respect to automotive applications. Consideration of fuels, carburetion, combustion, detonation, design factors, exhaust emissions and alternative power plants.  

Pre-Requisites  
[[ME-322]]
ME-330. VIBRATIONS LABORATORY  
Credits: 1  
Fees: 115  
Experiments that complement vibration theories in ME 332, including spring and damper elements, underdamped vibration, torsional pendulum, resonance, transient and steady-state behaviors, base excitation, rotating unbalance, impulse response, and modal testing.  
Click here for course fee.  

Pre-Requisites  
[[ME-234]], [[MTH-211]]  
Co-Requisites  
[[ME-332]] concurrent or before

ME-332. VIBRATION OF DYNAMIC SYSTEMS  
Credits: 3  
An introductory course in mechanical vibration dealing with free and forced vibration of single and multi-degrees of freedom for linear and nonlinear systems.

Pre-Requisites  
[[ME-234]], [[MTH-211]]

ME-333. MACHINE DESIGN I  
Credits: 3  
The first course of a two-course sequence in design of machine elements dealing with theories of deformation and failure, strength and endurance limit, fluctuating stresses, and design under axial, bending, torsional, and combined stresses. A study of column buckling, fasteners, and gears.  

Pre-Requisites  
[[ME-232]]

ME-335. ENGINEERING MODELING AND ANALYSIS  
Credits: 3  
Introduction to finite element method for static and dynamic modeling and analysis of engineering systems. Finite element formulation and computer modeling techniques for stress, plane strain, beams, axisymmetric solids, heat conduction, and fluid flow problems. Solution of finite element equation and post processing of results for further use in the design problem.  
Click here for course fee.  

Pre-Requisites  
[[ME-232]]  
Co-Requisites  
[[MTH-211]] concurrent or before

ME-337. MICRO-ELECTRO-MECHANICAL SYSTEMS ENGINEERING  
Credits: 3  
This course explores the principles of MEMS by understanding materials properties, micro-machining, sensor and actuator principles. The student will learn that MEMS are integrated micro-devices combining mechanical and electrical systems, which convert physical properties to electrical signals and, consequently, detection. This course provides the theoretical and exercises the hands-on experience by fabricating a micro-pressure sensor.  
Click here for course fees.  

Pre-Requisites  
Junior standing in engineering

ME-338. MACHINE DESIGN II  
Credits: 3  
An advanced course in machine design topics that expands upon the concepts of Machine Design I. This course goes into more detail of the basic machine fundamentals introduced previously such as levers, belts, pulleys, gears, cams and power screws. Emphasis is also placed on 3D printing and the future of additive manufacturing.  

Pre-Requisites  
[[ME-333]]

ME-340. HEATING, VENTILATION AND AIR CONDITIONING  
Credits: 3  

Pre-Requisites  
[[ME-322]]

ME-380. ADVANCED CADD  
Credits: 3  
An advanced course in Computer-Aided Drafting and Design (CADD) using SolidWorks. This course will introduce topics such as advanced modeling, advanced assemblies, Finite Element Analysis (FEA), and sheet metal.  
Pre-Requisites  
[[ME-180]], [[ME-335]]

ME-384. MECHANICAL DESIGN LABORATORY  
Credits: 3  
A laboratory for the development of open-ended problems in mechanical systems. Emphasis on experimental performance, data collection, evaluations, analysis, and design. This course provides hands-on experience with strain gauge application, measurement techniques, and analysis of topics in mechanical engineering.  
Click here for course fees.  

Pre-Requisites  
[[ME-333]]

ME-391. SENIOR PROJECTS I  
Credits: 1  
Design and development of selected projects in the field of mechanical engineering under the direction of a staff member. Technical as well as economic factors will be considered in the design. A detailed progress report is required.  
Click here for course fees.  

Pre-Requisites  
Senior standing in mechanical engineering, [[EGM-320]]
ME-392. SENIOR PROJECTS II
Credits: 2
Design and development of selected projects in the various fields of mechanical engineering under the direction of a staff member. Technical as well as economic factors will be considered in the design. A professional paper and detailed progress reports are required. This is a continuation of [ME-391]. An open-forum presentation and discussion of the professional paper are required.
Click here for course fees.

Pre-Requisites
[ME-391]

ME-395. INDEPENDENT RESEARCH
Credits: 1 - 3
Independent study and research for advanced students in the field of mechanical engineering under the direction of a staff member. A research paper at a level significantly beyond a term paper is required.

Pre-Requisites
Senior standing in mechanical engineering and approval of the department chairperson is required.

ME-396. INDEPENDENT RESEARCH
Credits: 1 - 3
Independent study and research for advanced students in the field of mechanical engineering under the direction of a staff member. A research paper at a level significantly beyond a term paper is required.

Pre-Requisites
Senior standing in mechanical engineering and approval of the department chairperson is required.

ME-397. SEMINAR
Credits: 1-3
Presentations and discussions of selected topics.

Pre-Requisites
Junior or Senior standing in mechanical engineering or special departmental permission.

ME-398. TOPICS IN MECHANICAL ENGINEERING
Credits: 1-3
Click here for course fees.

Pre-Requisites
Junior or senior standing in mechanical engineering.

ME-399. COOPERATIVE EDUCATION
Credits: 1-6
Professional cooperative education placement in a private or public organization related to the student’s academic objectives and career goals. In addition to their work experiences, students are required to submit weekly reaction papers and an academic project to a Faculty Coordinator in the student’s discipline. See the Cooperative Education section of this bulletin for placement procedures. Requirements: minimum junior standing in Engineering; 2.0 cumulative GPA; consent of the academic advisor; and approval of placement by the department chairperson. The co-op option for credit can only be taken one time for either 3 or 6 credits.