

# MECHANICAL ENGINEERING

## Mechanical Engineering

The Department of Mechanical & Electrical Engineering offers a four-year Bachelor of Science degree program in Mechanical Engineering. The BS ME program prepares its students for industry and graduate study with the expectation of eventual leadership responsibilities. To that end, its faculty and facilities emphasize design and industrial experience, student-faculty-industry cooperative projects, teamwork, the adoption of new technologies, and the hands-on student utilization of laboratories and computing systems. The Mechanical Engineering program maintains professional accreditation by the Engineering Accreditation Commission of ABET (ABET, 415 North Charles Street, Baltimore, MD 21201; 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. 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, including a BS/MS 4+1 option to achieve the MS in one additional year. The MSME degree program is described in the Graduate Bulletin. The MSME 4+1 option is described in the "Special Programs" sections of the Undergraduate and Graduate Bulletins.

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

### First Semester

[[MTH-111]] Calculus I	4
[[CHM-117]] Chemistry Lab for Engineers	1
[[CHM-118]] Chemistry for Engineers	3
[[ME-180]] CADD Lab	1
[[ENG-101]] Composition	4
[[FYF-101]] First-Year Foundations	3
	<b>16</b>

### Second Semester

[[MTH-112]] Calculus II	4
[[PHY-201]] General Physics I	3
[[PHY-204]] General Physics I Lab	1
[[ME-140]] Scientific Programming	3
[[EGR-200]] Materials Science	3

Distribution Requirement	3
	<b>17</b>

### Third Semester

[[MTH-211]] Introduction to Ordinary Differential Equations	4
[[PHY-202]] General Physics II	3
[[PHY-205]] General Physics II Lab	1
[[EE-211]] Electrical Circuits and Devices	3
[[EE-283]] Electrical Engineering Lab	1
[[ME-231]] Statics	3
Distribution Requirement	3
	<b>18</b>

### Fourth Semester

[[EGR-222]] Mechatronics	3
[[ME-232]] Strength of Materials	3
[[ME-234]] Dynamics	3
[[ME-322]] Thermodynamics	3
[[MTH-212]] Multivariable Calculus	4
[[ME-175]] Machining	1
	<b>17</b>

### Fifth Semester

[[ME-321]] Fluid Mechanics	3
[[ME-215]] Manufacturing Processes	3
[[ME-335]] Finite Element Methods	4
[[ME-333]] Machine Design	3
Distribution Requirement	3
	<b>16</b>

### Sixth Semester

[[ME-399]] Cooperative Education* OR ME Technical Elective**	3
[[EGR-201]] Professionalism and Ethics	1
[[ME-323]] Fluid Mechanics Lab	1
[[ME-324]] Heat Transfer	3
[[ME-332]] Vibrations	3
[[ME-330]] Vibrations Laboratory	1

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[[EGM-320]] Engineering Project Management	3
Distribution Requirement	3
	<b>18</b>

### Seventh Semester

[[ME-326]] Heat Transfer Laboratory	1
Science Elective***	3
[[ME-384]] Mechanical Design Laboratory	3
[[ME-391]] Senior Projects I	1
[[ME-317]] Robotics	3
Distribution Requirement	3
	<b>14</b>

### Eighth Semester

ME Technical Elective**	3
[[ME-392]] Senior Projects II	2
Technical Elective**	3
Free Elective****	3
Distribution Requirement	3
	<b>14</b>

\*Consult with the Cooperative Education Coordinator to determine availability and proper scheduling of the Cooperative Education experience.

\*\*Technical electives: Two (2) courses must be advisor-approved ME courses at the 200 level or above. One (1) course may be chosen from any advisor-approved math, science, or engineering course numbered 200 or above.

\*\*\*Science elective from approved list.

\*\*\*\*Free elective may be chosen from any course numbered 101 or above.

## ME. MECHANICAL ENGINEERING

### 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.

[Click here for course fees.](#)

#### Co-Requisites

[[MTH-111]] concurrent or before

### ME-175. 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.

[Click here for course fees.](#)

### 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.

[Click here for course fees.](#)

### ME-215. 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.

#### Pre-Requisites

[[ME-232]]

### 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.

#### Pre-Requisites

[[PHY-201]]

#### Co-Requisites

[[MTH-112]] concurrent or before

[[ME-180]] concurrent or before

### 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.

#### Pre-Requisites

[[ME-231]], [[ME-180]], [[MTH-112]], and [[EGR-200]] or [[CHM-115]].

**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.

**Pre-Requisites**

[[ME-231]], [[ME-180]], [[MTH-112]]

**ME-312. MANUFACTURING SYSTEM ENGINEERING**

**Credits:** 3

Fundamentals of manufacturing processes and systems. Analytical models of manufacturing processes including metal removal rate, tool wear, setup and tool change times. Analysis and optimization of manufacturing productivity and throughput. Automation and computer control of manufacturing processes.

**Pre-Requisites**

Instructor permission.

**ME-314. INVERSE PROBLEMS**

**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. [Click here for course fee.](#)

**Pre-Requisites**

[[ME-333]] or instructor permission.

**ME-315. PROGRAMMABLE LOGIC CONTROLLERS**

**Credits:** 3

Introduction to the fundamental concepts and design of programmable logic controllers and systems with emphasis on programmable logic controllers, ladder logic programming, and advanced PLC applications. [Click here for course fee.](#)

**Pre-Requisites**

Instructor permission.

**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. [Click here for course fee.](#)

**Pre-Requisites**

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

**Co-Requisites**

[[MTH-212]] concurrent or before

**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-322. THERMODYNAMICS**

**Credits:** 3

The fundamental concepts and laws of thermodynamics, thermodynamic properties of perfect and real gases, vapors, solids, and liquids. Applications of thermodynamics to power and refrigeration cycles and flow processes. Development of thermodynamic relationships and equations of state. Review of the first and second laws of physics. Reversibility and irreversibility.

**Pre-Requisites**

[[MTH-112]]

**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-322]] 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]] or instructor permission.

### **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]] or instructor permission.

### **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. VIBRATIONS**

**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**

**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. FINITE ELEMENT METHODS**

**Credits:** 4

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-336. SOLID MECHANICS**

**Credits:** 3

This course is an introduction to continuum mechanics, variational methods, including vectors and tensors, state of stress and compatibility equation, plain stress and strain. Energy Principles and virtual work will be discussed.

#### **Pre-Requisites**

[[ME-232]] or instructor permission.

### **ME-337. MICRO-ELECTRO-MECHANICAL SYSTEMS**

**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**

Instructor permission.

### **ME-338. ADVANCED MACHINE DESIGN**

**Credits:** 3

An advanced course in machine design topics that expands upon the concepts of Machine Design ([[ME-333]]). 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]] or instructor permission.

**ME-340. HEATING, VENTILATION AND AIR CONDITIONING**

**Credits:** 3

Introduction of fundamentals of HVAC design and construction. Study of the psychometric process and fundamental calculations and layout of HVAC systems. Calculations of heat loss and heat gain in commercial and residential structures.

**Pre-Requisites**

[[ME-322]] or instructor permission.

**ME-342. ADVANCED MATERIALS SCIENCE**

**Credits:** 3

This course introduces advanced materials for engineers, emphasizing the fundamentals of manufacturing/structure/property/function relationships and applications. Topics include materials selection for machine design components in micro- and nano-scales, biomaterials, nano-composites, and optimized materials for nano-sensors and actuator systems.

**Pre-Requisites**

[[EGR-200]] or instructor permission.

**ME-343. ADDITIVE MANUFACTURING**

**Credits:** 3

An introduction to additive manufacturing, also known as 3-D printing, which is a process of building 3-D objects from a digital file. Emphasis will be placed on both existing and emerging additive manufacturing processes in the context of design, modeling, materials, processing, and applications. This course provides hands-on experience and implements active learning strategies.

[Click here for course fees.](#)

**Pre-Requisites**

[[ME-333]] or instructor permission.

**ME-347. THIN FILM MANUFACTURING**

**Credits:** 3

This course explores the principles of micro-devices manufacturing by thin film deposition processing methods. Vacuum deposition technologies such as physical vapor deposition and the electron beam evaporation process will be covered for conductors, resistors, and dielectric thin film depositions. Sol-Gel chemical thin film processing of oxides and piezoelectric materials along with direct circuit manufacturing by photo seeding and electro-less copper deposition will be covered.

[Click here for course fees.](#)

**Pre-Requisites**

Instructor permission.

**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), sheet metal, and modal analysis.

[Click here for course fee.](#)

**Pre-Requisites**

[[ME-180]] or instructor permission.

**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]] and [[ME-335]]

**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 or departmental permission.

**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-396. INDEPENDENT RESEARCH**

**Credits:** 1-3

Independent study and research for advanced students in the field of mechanical engineering under the direction of a faculty member. A research paper and/or design project and/or conference presentation may be required.

**Pre-Requisites**

Instructor permission.

**ME-397. SEMINAR**

**Credits:** 1-3

Presentations and discussions of selected topics.

**Pre-Requisites**

Instructor permission.

**ME-398. TOPICS IN MECHANICAL ENGINEERING**

**Credits:** 1-3

Selected topics in the field of mechanical engineering.

[Click here for course fees.](#)

**Pre-Requisites**

Instructor permission.

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### **ME-399. COOPERATIVE EDUCATION**

**Credits:** 0-6

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 biweekly reports, a final report and present to an audience of peers and faculty. The co-op option for credit can only be taken one time for either 3 or 6 credits.

**Pre-Requisites**

Instructor permission.