

# MECHANICAL ENGINEERING (ME)

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## **ME 1670. Introduction to Engineering Graphics and Design. 3 Credit Hours.**

Introduction to engineering graphics and visualization including sketching, line drawing, and solid modeling. Development and interpretation of drawings and specifications for product realization.

## **ME 1801. Special Topics. 1 Credit Hour.**

Special Topics.

## **ME 1XXX. Mechanical Engineering Elective. 1-21 Credit Hours.**

### **ME 2016. Computer Applications. 3 Credit Hours.**

An introduction to the use of computers and MATLAB programming for the solution of mechanical engineering problems. Topics include: sources of error in computing, the use of modular software design, basic numerical methods, and signal processing.

### **ME 2110. Creative Decisions and Design. 3 Credit Hours.**

To learn fundamental techniques for creating, analyzing, synthesizing, and implementing design solutions to open-ended problems with flexibility, adaptability, and creativity through team and individual efforts.

### **ME 2202. Dynamics of Rigid Bodies. 3 Credit Hours.**

Kinematics and dynamics of particles and rigid bodies in one, two, and three dimensions. Work-energy and impulse-momentum concepts.

### **ME 2202R. ME 2202 Recitation. 0 Credit Hours.**

Recitation for ME 2202.

### **ME 2205. Three-dimensional rigid body dynamics. 1 Credit Hour.**

Three-dimensional rigid body dynamics; Newton-Euler methods, inertia properties and principal axes; Euler equations, gyroscopic effects.

### **ME 2698. Undergraduate Research Assistantship. 1-12 Credit Hours.**

Independent research conducted under the guidance of a faculty member.

### **ME 2699. Undergraduate Research. 1-12 Credit Hours.**

Independent research conducted under the guidance of a faculty member.

### **ME 2801. Special Topics. 1 Credit Hour.**

Topics of current interest not offered in the regular course offerings.

### **ME 2803. Special Topics. 3 Credit Hours.**

Topics of current interest not offered in the regular course offerings.

## **ME 2XXX. Mechanical Engineering Elective. 1-21 Credit Hours.**

### **ME 3017. System Dynamics. 3 Credit Hours.**

Dynamic modeling and simulation of systems with mechanical, hydraulic, thermal and/or electrical elements. Frequency response analysis, stability, and feedback control design of dynamic systems. Students cannot receive credit for ME 3017 and AE 3530.

### **ME 3017R. ME 3017 Recitation. 0 Credit Hours.**

Recitation for ME 3017.

### **ME 3057. Experimental Methodology and Technical Writing. 3 Credit Hours.**

Introduction to basic instrumentation and experimental methodology used in mechanical engineering, including calibration, use, precision and accuracy. Consideration errors, precision and accuracy in experimental measurements and technical reports.

### **ME 3141. Cutting-Edge Eng Seminar. 3 Credit Hours.**

Seminar course on advanced engineering technologies directed to a non-technical audience. Distinguished guest speakers.

### **ME 3180. Machine Design. 3 Credit Hours.**

The selection, analysis, and synthesis of springs, joining and fastening methods, bearings, shafts, gears, and other elements. Design of assemblies. Computer-based methods.

### **ME 3210. Design, Materials, and Manufacture. 3 Credit Hours.**

Major manufacturing processes, capabilities, and costs. Interaction between design, materials and manufacturing process selection.

### **ME 3322. Thermodynamics. 3 Credit Hours.**

Introduction to thermodynamics. Thermodynamic properties, energy and mass conservation, entropy and the second law. Second-law analysis of thermodynamic systems, gas cycles, vapor cycles.

### **ME 3322R. ME 3322 Recitation. 0 Credit Hours.**

Recitation for ME 3322.

### **ME 3340. Fluid Mechanics. 3 Credit Hours.**

The fundamentals of fluid mechanics. Topics include fluid statics; control-volume analysis; the Navier-Stokes equations; similitude; viscous, inviscid and turbulent flows; boundary layers.

### **ME 3340R. ME 3340 Recitation. 0 Credit Hours.**

Recitation for ME 3340.

### **ME 3345. Heat Transfer. 3 Credit Hours.**

Introduction to the study of heat transfer, transport coefficients, steady state conduction, transient conduction, radiative heat transfer, and forced and natural convection.

### **ME 3345R. ME 3345 Recitation. 0 Credit Hours.**

Recitation for ME 3345.

### **ME 3700. Introduction to Energy Systems Engineering. 3 Credit Hours.**

Renewable, fossil, and nuclear energy and its conversion into various forms. Electrical grid, energy storage, energy conservation, and mitigation of adverse conversion.

### **ME 3720. Introduction to Fluid and Thermal Engineering. 3 Credit Hours.**

Theory and application, but no exhaustive treatment of fluid mechanics, thermodynamics, and heat transfer in analysis and design of fluid and thermal energy systems.

### **ME 3743. Analysis of Emerging Technologies. 3 Credit Hours.**

Analysis of emerging technologies and their impacts for firm practice, market practice, policy, and society. Credit not allowed for both ME 3743 and MGT 3743 or CS 3743.

### **ME 3744. Managing Product, Service & Technology Development. 3 Credit Hours.**

Analysis of the managerial challenges of the product development process. Credit not allowed for both ME 3744 and MGT 3744.

### **ME 3801. Special Topics. 1 Credit Hour.**

Special Topics.

## **ME 3XXX. Mechanical Engineering Elective. 1-21 Credit Hours.**

### **ME 4011. Internal Combustion Engines. 3 Credit Hours.**

Analysis and design of various types of engines used in transportation systems. Topics include advances in energy efficiency and emissions in automotive applications.

### **ME 4012. Modeling and Control of Motion Systems. 3 Credit Hours.**

Motion systems consisting of mechanical, fluid and electrical components are analyzed, modeled, and controlled. Alternatives are considered for system optimization.

**ME 4013. Hybrid Vehicle Powertrains. 3 Credit Hours.**

Course details fundamentals of hybrid vehicle powertrains, to include architectures (series, parallel, etc.), components, operation, control, modeling & simulation, and design fundamentals.

**ME 4014. Introduction to Automotive Engineering. 3 Credit Hours.**

Introduction to automotive engineering from a systems perspective. Major automotive systems and subsystems are described together with appropriate engineering models necessary for analysis and design.

**ME 4042. Interactive Computer-Aided Design and Computer-Aided Engineering. 3 Credit Hours.**

Principles of geometric modeling and finite-element method; interactive CAD and CAE software tools. CAD and CAE applications in thermal and mechanical design problems. Design projects.

**ME 4056. Mechanical Engineering Systems Laboratory. 3 Credit Hours.**

Measurement and analysis of mechanical, acoustic, manufacturing, thermodynamic, fluid, and heat transfer phenomena. Emphasis on data acquisition, reduction, analysis, and report preparation.

**ME 4171. Environmentally Conscious Design and Manufacturing. 3 Credit Hours.**

Including environmental considerations in engineering design; reducing environmental impact by design; recycling; material selection; de- and remanufacturing; life-cycle considerations, analyses, tradeoffs; ISO 14000.

**ME 4172. Designing Sustainable Engineering Systems. 3 Credit Hours.**

Understanding sustainability in context of market forces, availability of resources, technology, society. Methods for identifying, modeling, and selecting sustainable designs.

**ME 4182. Mechanical Design Engineering. 3 Credit Hours.**

Teams apply a systematic design process to real multidisciplinary problems. Problems selected from a broad spectrum of interest areas, including biomedical, ecological, environmental, mechanical, and thermal.

**ME 4189. Mechanical Vibrations. 3 Credit Hours.**

Single and multi-degree-of-freedom systems as well as continuous systems are analyzed for their vibrational response characteristics using both exact and approximate methods.

**ME 4193. Design and Materials Selection for Tribological Applications. 3 Credit Hours.**

Analysis of tribological aspects of machine components, including friction, lubrication, and wear. Group design project to optimize system tribological performance.

**ME 4214. Mechanical Behavior of Materials. 3 Credit Hours.**

Problems involving resistance of materials to plastic deformation, fracture, fatigue, and creep; mechanical testing; computer-based methods; case studies of failure.

**ME 4215. Manufacturing Process Analysis. 3 Credit Hours.**

First principles based modeling and analysis of manufacturing processes. Process design and optimization.

**ME 4315. Energy Systems Analysis and Design. 3 Credit Hours.**

Integrated concepts, laws, and methodologies from thermal sciences are used to analyze, model, and design energy systems and to predict system performance for fixed designs.

**ME 4321. Refrigeration and Air Conditioning. 3 Credit Hours.**

Application of thermodynamics principles to analysis and design of refrigeration and air conditioning systems, absorption and heat-driven systems, gas-vapor mixture psychrometrics, load estimates, delivery, and control.

**ME 4324. Power Generation Technology. 3 Credit Hours.**

Technology review and application of engineering sciences and economics to the analysis and design of power generation systems. Fossil, nuclear, and renewable energy systems are considered.

**ME 4325. Introduction to Fuel Cell Systems. 3 Credit Hours.**

Fuel cell systems are explained and analyzed, including single cells and stacks, and balance-of-plant fundamentals, with emphasis upon prevalent fuel cell types and their applications.

**ME 4330. Heat and Mass Exchangers. 3 Credit Hours.**

Heat transfer, fluid flow, and thermodynamics principles applied to the analysis and design of heat and mass exchangers, periodic regenerators, and cooling towers.

**ME 4332. Renewable Energy Systems. 3 Credit Hours.**

Renewable and efficient energy systems are introduced. Various energy conversion and storage technologies are explained and analyzed, along with their respective advantages and limitations.

**ME 4340. Applied Fluid Mechanics. 3 Credit Hours.**

Advanced study in three areas of fluid mechanics. Topics may be chosen from turbomachinery, flow measurement, compressible flow, applied aerodynamics, and others.

**ME 4342. Computational Fluid Dynamics. 3 Credit Hours.**

An introduction to computational fluid dynamics (CFD) in mechanical engineering. The theory and numerical techniques of CFD. Modern CFD software including grid generation and flow visualization tools will be used. Projects with complex fluid-flow systems.

**ME 4405. Fundamentals of Mechatronics. 3 Credit Hours.**

Focuses on fundamentals of microcontrollers, analog and digital electronics, sensors, actuators and their applications to modern mechatronics systems and intelligent manufacturing. Knowledge gained from lectures will be used to complete lab exercises. Credit will not be awarded for both ME 4405 and ME 6405 or ME 4405 and ME 4777.

**ME 4451. Robotics. 3 Credit Hours.**

Mathematical modeling, simulation, and control of robotic systems with mechanical and sensory elements.

**ME 4452. Control of Dynamic Systems. 3 Credit Hours.**

Modeling and simulation of dynamic systems in frequency and time domains. Feedback control analysis and design methods including root-locus, frequency response, and pole-placement. Introduction to digital control systems. Credit not allowed for both ME 4452 and ME 3015. Credit not allowed for both ME 4452 and AE 3531.

**ME 4698. Undergraduate Research Assistantship. 1-12 Credit Hours.**

Independent research conducted under the guidance of a faculty member.

**ME 4699. Undergraduate Research. 1-12 Credit Hours.**

Independent research conducted under the guidance of a faculty member.

**ME 4701. Wind Engineering. 3 Credit Hours.**

An introductory course on wind energy and its potential; modeling and design of wind turbines; analysis of the economic benefits of wind turbine systems. Credit not allowed for both ME 4701 and AE 4701.

**ME 4720. Pulp and Paper Manufacturing. 3 Credit Hours.**

The course provides comprehensive foundational knowledge of the industry enabling the student to understand the role of diverse manufacturing operations and to strategically plan improvements. Cross-listed with ChBE 4720.

**ME 4723. Interdisciplinary Capstone Design. 3 Credit Hours.**

Seniors will work in teams to apply a systematic design process to real multi-disciplinary problems. Problems selected from a broad spectrum of interest areas, including biomedical, environmental, mechanical, industrial design, electrical and thermal/fluids. Projects must be based on the knowledge and skills acquired in earlier course work, and incorporate appropriate engineering standards and multiple realistic constraints. Emphasis is placed on the design process, the technical aspects of the design, and on reducing the proposed design to practice. The course consists of faculty and guest lectures, prototyping in design studios, and a multi-disciplinary design project.

**ME 4725. Probabilistic Risk Assessment. 3 Credit Hours.**

Introduction to a wide range of probabilistic risk analysis and probabilistic design methods for mechanical systems. Topics covered are probabilistic description, sampling methods, risk assessment, and reliability-based design.

**ME 4730. Emerging Technologies for Forest Bioproducts. 3 Credit Hours.**

The course provides comprehensive knowledge of the manufacture of nontraditional products from forest biomaterials. It analyzes and assesses emerging manufacturing technologies, materials and products. Cross-listed with ChBE 4730.

**ME 4740. Biologically Inspired Design. 3 Credit Hours.**

We examine evolutionary adaptation as a source for engineering design inspiration, utilizing principles of scaling, adaptability, and robust multifunctionality that characterize biological systems. Credit not allowed for both ME 4740 and (BIOL 4740, or ISYE 4740 or PTFE 4740 or MSE 4740).

**ME 4741. Integrative Management Development - Project Preparation. 3 Credit Hours.**

Individual and group-based experiential learning activities to develop integrated human system management skills that prepare students for more successful capstone collaboration and learning. Credit not allowed for both ME 4741 and CS 4741 or MGT 4741.

**ME 4742. Integrated Technology and Management Capstone Project. 4 Credit Hours.**

Project-based course where students in the Technology and Management Program will work in inter-disciplinary teams on projects provided by corporate affiliates. Credit not allowed for both ME 4742 and CS 4742 or MGT 4742.

**ME 4744. Global Development Capstone. 3 Credit Hours.**

Teams develop solutions to multidisciplinary problems selected from globalization, food security, infrastructure, health, water, sanitation, hygiene, ecosystem resilience, services, capacity building, and urbanization.

**ME 4753. Topics in Engineering Practice. 3 Credit Hours.**

Topics of current importance offered in collaboration with an approved partner of Georgia Tech's Distance Learning Program.

**ME 4754. Electronics Packaging Assembly, Reliability, Thermal Management, and Test. 3 Credit Hours.**

The course provides hands-on instruction in electronics packaging, including assembly, reliability, thermal management, and test of next-generation microsystems. Crosslisted with ECE and MSE 4754.

**ME 4757. Biofluid Mechanics. 3 Credit Hours.**

Introduction to the study of blood flow in the cardiovascular system. Emphasis on modeling and the potential of flow studies for clinical research application. Crosslisted with AE and CHE 4757.

**ME 4758. Biosolid Mechanics. 3 Credit Hours.**

The mechanics of living tissue, e.g., arteries, skin, heart muscle, ligament, tendon, cartilage, and bone. Constitutive equations and some simple mechanical models. Mechanics of cells. Applications. Crosslisted with AE and CHE 4758.

**ME 4759. Electrochemical Energy Storage and Conversion. 3 Credit Hours.**

An elective class for senior-level students interested in electrochemical storage and conversion, including the fundamentals of electrochemistry and practical battery and fuel cells. Cross-listed with ChBE and MSE 4759.

**ME 4760. Engineering Acoustics and Noise Control. 3 Credit Hours.**

Study of acoustics related to noise and its control; acoustic terminology, wave propagation, wave equation solutions, instrumentation, data processing, room acoustics, noise control, hearing, noise legislation. Crosslisted with AE 4760.

**ME 4766. Fabrication and Properties of Nanoscale Devices. 3 Credit Hours.**

Fundamental properties at the nanoscale for photonics and sensors. Nanoscale fabrication methods including thin films, ion beam, lithography, electroplating, and example case studies in NEMS/MEMS and photonics. Credit not allowed for both ME 4766 and MSE 4766.

**ME 4767. Pulp and Paper Lab. 3 Credit Hours.**

The course offers the fundamentals of pulp and paper testing procedures. Cross-listed with ChBE 4767.

**ME 4775. Polymer Science and Engineering I: Formation and Properties. 3 Credit Hours.**

An introduction to the chemistry, structure and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHEM, CHE, MSE, and PTFE 4775.

**ME 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory. 3 Credit Hours.**

Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, CHEM, MSE, and TFE 4776.

**ME 4777. Introduction to Polymer Science and Engineering. 3 Credit Hours.**

An introduction to the structure and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids, and processing of polymers. Crosslisted with MSE and PTFE 4777.

**ME 4781. Biomedical Instrumentation. 3 Credit Hours.**

A study of medical instrumentation from a systems viewpoint. Pertinent physiological and electro-physiological concepts will be covered. Credit not allowed for both ME 4781 and (CHE 4781 or CHBE 4781 or BMED 4781 or ECE 4781).

**ME 4782. Biosystems Analysis. 3 Credit Hours.**

Analytical methods for modeling biological systems, including white-noise protocols for characterizing nonlinear systems. Crosslisted with BMED, CHE and ECE 4782.

**ME 4790. Materials Selection and Design. 3 Credit Hours.**

Principles of selecting materials and processes for engineering applications. Methodologies for designing new materials and conceiving hybrid solutions. Credit not allowed for both ME 4790 and ME 4213 or ME 4790.

**ME 4791. Mechanical Behavior of Composites. 3 Credit Hours.**

Stress-strain behavior of composites, properties of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CEE, CHE, MSE, and PTFE 4791.

**ME 4793. Composite Materials and Processes. 3 Credit Hours.**

Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, CHE, ME, MSE, and PTFE 4793.

**ME 4795. Fundamental Elements of Nuclear Reactor Materials. 3 Credit Hours.**

Introduction to fundamentals of nuclear reactor materials. Topics covered are basics of radiation damage, defect creation and evolution, microstructure-property correlations in cladding and fuel of nuclear materials.

**ME 4801. Special Topics in Mechanical Engineering. 1 Credit Hour.**

Special topic offerings of current interest not included in regular courses.

**ME 4802. Special Topics in Mechanical Engineering. 2 Credit Hours.**

Special topic offerings of current interest not included in regular courses.

**ME 4803. Special Topics in Mechanical Engineering. 3 Credit Hours.**

Special topic offerings of current interest not included in regular courses.

**ME 4804. Special Topics in Mechanical Engineering. 4 Credit Hours.**

Special topic offerings of current interest not included in regular courses.

**ME 4805. Special Topics in Mechanical Engineering. 5 Credit Hours.**

Special topic offerings of current interest not included in regular courses.

**ME 4811. Special Topics. 1 Credit Hour.**

**ME 4812. Special Topics. 2 Credit Hours.**

**ME 4813. Special Topics. 3 Credit Hours.**

**ME 4814. Special Topics. 4 Credit Hours.**

**ME 4815. Special Topics. 5 Credit Hours.**

**ME 4821. Special Topics. 1 Credit Hour.**

**ME 4822. Special Topics. 2 Credit Hours.**

**ME 4823. Special Topics. 3 Credit Hours.**

**ME 4824. Special Topics. 4 Credit Hours.**

**ME 4825. Special Topics. 5 Credit Hours.**

**ME 4831. Special Topics. 1 Credit Hour.**

**ME 4832. Special Topics. 2 Credit Hours.**

**ME 4833. Special Topics. 3 Credit Hours.**

**ME 4834. Special Topics. 4 Credit Hours.**

**ME 4835. Special Topics. 5 Credit Hours.**

**ME 4843. Special Topics- ME Lab. 3 Credit Hours.**

ME Special Topics with lab component.

**ME 4853. Special Topics. 3 Credit Hours.**

ME Special Topics with lab component.

**ME 4863. Special Topics. 3 Credit Hours.**

Special Topics in Mechanical Engineering.

**ME 4873. Special Topics. 3 Credit Hours.**

**ME 4901. Special Problems in Mechanical Engineering. 1-21 Credit Hours.**

Individual studies in certain specialized areas, and mathematical analyses and/or experimental investigations of problems of current interest in mechanical engineering.

**ME 4902. Special Problems. 1-21 Credit Hours.**

Individual studies in certain specialized areas, and mathematical analyses and/or experimental investigations of problems of current interest in mechanical engineering.

**ME 4903. Special Problems. 1-21 Credit Hours.**

Individual studies in certain specialized areas, and mathematical analyses and/or experimental investigations of problems of current interest in mechanical engineering.

**ME 4XXX. Mechanical Engineering Elective. 1-21 Credit Hours.**