MECHANICAL ENGINEERING (ME)

The Mechanical Engineering Program at UNH is accredited by the:

Engineering Accreditation Commission of ABET, http://www.abet.org

Mission

In support of the University and college missions, the Department of Mechanical Engineering is dedicated to educating the highest quality engineering professionals and leaders. Graduates will be prepared to creatively solve engineering problems through the use of analysis, computation, and experimentation. Students completing the program should be well-informed citizens who have the ability to grow intellectually and are able to solve new, challenging problems with self-confidence. It is the department's intent to maintain a general and flexible curriculum that prepares students for both industrial practice and graduate education.

Educational Objectives

The objective of the UNH Mechanical Engineering Program is to produce graduates who are ethical professionals and good citizens. As they progress in the first several years following graduation, they are expected to:

1. Use their engineering education and communication skills for success in:
   a. Technical careers in industry, academia, government, or other organizations;
   b. Graduate school in engineering or physical sciences;
   c. Nontechnical careers or education in areas such as law, medicine, business, public policy, secondary education, service industries, etc.;
   d. Careers involving management or entrepreneurship.
2. Exercise lifelong learning to:
   a. Pursue professional development opportunities in their disciplines;
   b. Develop new knowledge and skills;
   c. Pursue new areas of expertise or careers.
3. Use their engineering background to:
   a. Solve technical problems for societal benefit;
   b. Develop new knowledge and products that will promote sustainable economic and environmental developments to improve the quality of life;
   c. Promote the practice of engineering.

Mechanical engineering is a challenging profession and has two major emphases. The first is the general area of mechanical design, which involves all types of mechanical motion and the forces and energy that drive it. The other emphasis deals with energy generation and conversion and is grounded in the principles of the thermal and fluid sciences. Other subject areas, which support both emphases and are frequently part of designs and products, are the materials sciences, manufacturing, and control systems. All of these areas are included in the education and training of mechanical engineers. Ocean engineering is another focus area in our department which emphasizes solving engineering problems associated with the sustainable utilization of ocean resources and the scientific exploration and study of the ocean environment. Mechanical engineering requires significant study in mathematics, engineering computing, and basic sciences such as chemistry and physics, as well as basic engineering courses, before reaching the more specialized courses. Additional information can be found at the mechanical engineering website.

https://ceps.unh.edu/mechanical-engineering

Programs

- Mechanical Engineering Major (B.S.)
- Mechanical Engineering Minor

Courses

Mechanical Engineering (ME)

ME 441 - Introduction to Engineering Design and Solid Modeling
Credits: 0 or 4
Why are some products better than others? What is the definition of "better"? This course uses an inquiry-guided approach to explore the product design process via team design projects and laboratory exercises. Everyday products are examined from historical, societal, design, safety and manufacturing perspectives. Topics include ideation, sketching, design constraints, solid modeling, decision making, statistical quality control, manufacturing methods and engineering analysis. Students develop an appreciation for good design and the ability to communicate design ideas via 3-D solid models, written and oral reports. Prereq: MATH 418 or equivalent.
Attributes: Inquiry (Discovery); Writing Intensive Course

ME 477 - Introduction to Solid Modeling
Credits: 1
Introduction to solid modeling and engineering drawings using computer-aided design software. For Mechanical Engineering students, this course can only be taken with permission as an alternative to the required ME 441 Introduction to Engineering Design and Solid Modeling for students with extensive engineering design experience (e.g., high school or another university course), an engineering project based program (e.g., FIRST Robotics or Project Lead the Way), or similar experience (e.g., working in the industry). Students should not take both ME 441 and ME 477. Lecture and Lab.

ME 503 - Thermodynamics
Credits: 3
Properties of a pure substance, work and heat, laws of thermodynamics, entropy, thermodynamic relations, cycles. Prereq: PHYS 407. Pre- or Coreq: CHEM 405; MATH 528.

ME #523 - Introduction to Statics and Dynamics
Credits: 3
Overview of statics and dynamics applying concepts to particles then to rigid bodies. Topics include two- and three-dimensional force systems; laws of equilibrium; analyses of trusses and frames; friction; relative motion; impulse-momentum principles; work-energy relationships. Prereq: MATH 426; PHYS 407. Not for ME majors.

ME 525 - Statics
Credits: 4
Introduces statics. Two- and three-dimensional force systems, the concept of equilibrium, analysis of trusses and frames, centroids, bending moment and shear force diagrams, and friction. Prereq: PHYS 407 and MATH 426.
Equivalent(s): CEE 500, CIE 525, CIE 528

ME 526 - Mechanics of Materials
Credits: 3
Introduces strength of materials. Analysis of members under torsion, axial, shear and bending stresses, superposition of stresses, stability of columns. Prereq: ME 525. Writing intensive.
Attributes: Writing Intensive Course
Equivalent(s): CEE 501, CIE 526, CIE 529

ME 561 - Introduction to Materials Science
Credits: 4
The concepts of materials science and the relation of structure of material properties. Atomic structure, bonding material transport, mechanical properties of materials, solidification, phase diagrams, solid state transformations, and corrosion and oxidation. Laboratory exercises are carried out to demonstrate the basic concepts of the course. Prereq: one semester of introductory chemistry with a lab or equivalent; MATH 425. Writing intensive.
Attributes: Writing Intensive Course
Equivalent(s): ME 661

ME 603 - Heat Transfer
Credits: 3
Analysis of phenomena; steady-state and transient conduction, radiation, and convection; engineering applications. Prereq: MATH 527, ME 608.

ME 608 - Fluid Dynamics
Credits: 0 or 3
Dynamics and thermodynamics of compressible and incompressible fluid flow; behavior of fluids as expressed by hydrostatic, continuity, momentum, and energy equations. Prereq: ME 503. Pre- or Coreq: MATH 527, IAM 550.
Co-requisite: ME 627
Equivalent(s): ME 508

ME 627 - Dynamics
Credits: 3
Introduction to particle and rigid body dynamics. Rectilinear and curvilinear motion, translation and rotation, momentum and impulse principles, and work-energy relationships. Prereq: ME 525 or permission. Writing intensive.
Attributes: Writing Intensive Course
Equivalent(s): CIE 527, ME 527

ME 643 - Machine Design
Credits: 3
Analysis, synthesis, and design of machine elements and systems. Development of engineering judgment; selection of materials stress and failure analysis; kinematic arrangement design for finite and infinite life. Open-ended design problems unify course topics. Prereq: ME 526, ME 561, ME 627. Writing intensive.
Attributes: Writing Intensive Course

ME 646 - Experimental Measurement and Data Analysis
Credits: 0 or 4
Basic and advanced techniques of engineering and scientific parameter measurement including statistical data and error analysis, curve fitting, calibration and application of transducers, and technical writing. Laboratory experiments draw on concepts from mechanics, thermodynamics, and fluid mechanics. Prereq: ME 526. Pre - or Co-req: ME 608. Writing intensive.
Attributes: Writing Intensive Course

ME 670 - Systems Modeling, Simulation, and Control
Credits: 0 or 4
Lumped parameter models for mechanical, electrical, thermal, fluid, and mixed systems. Matrix representation, eigenvalues, eigenvectors, time domain solutions, frequency response plots, and computer simulations are used to explore system response. Design of system for desired responses. Introduces feedback control, stability, and performance criteria. Prereq: ECE 537, ME 627, MATH 527. Writing intensive.
Attributes: Writing Intensive Course

ME 695 - Special Topics
Credits: 2-4
Course topics not offered in other courses. May be repeated for credit. Lab. Prereq: permission.

ME 696 - Projects
Credits: 1-4
Analytical, experimental, or design projects undertaken individually or in teams under faculty guidance. May be repeated for credit.

ME 699 - Engineering Internship
Credits: 1
Internship experience provides on-the-job reinforcement of academic programs in mechanical engineering. Contact the Mechanical Engineering department office for guidelines. Prereq: appropriate class standing in major, 2.5 grade point average, and permission. Cr/F.
Repeat Rule: May be repeated for a maximum of 3 credits.

ME 705 - Thermal System Analysis and Design
Credits: 4
Engineering design of thermal systems that involve real problems and analysis of performance of the design. Design criteria include function, performance, optimization, economy, safety, and others as appropriate for the system. Required for ME seniors. Prereq: ME 503. Writing intensive.
Co-requisite: ME 608
Attributes: Writing Intensive Course
Equivalent(s): ME 605

ME 706 - Renewable Energy: Physical and Engineering Principles
Credits: 3
The goal of this course is to become "Fluent in energy" and to learn about the engineering fundamentals of renewable energy technologies. The course will begin by giving an overview of U.S. energy usage and sources, as well as history and trends. Various renewable energy topics will then be discussed. Where applicable, topics will be discussed in detail from a fluid and thermal sciences point of view. Guest lecturers and a field trip may be included. This course is open to all engineering seniors. Prereq: ME 503 - Thermodynamics, ME 608 - Fluid Dynamics, or equivalent, or instructor permission.

ME 707 - Analytical Fluid Dynamics
Credits: 4
Kinematics of flow; constitutive relationships; development of the Navier-Stokes equations; vorticity theorems; potential flow. Prereq: ME 608.

ME 709 - Computational Fluid Dynamics
Credits: 3
Conservation of mass, momentum, and energy, discretization schemes, boundary and initial conditions, turbulence and turbulence models, two-equation models, CFD software such as OpenFOAM, best practice guidelines for CFD. The class incorporates the use and creation of Open Educational Resources (OER).

ME 710 - Experimental Fluid Dynamics
Credits: 4
This course will introduce students to a variety of experimental methods and techniques for the measurement of fluid flow. Topics include signal processing and analysis, pressure measurement, thermal anemometry, imaging, and advanced laser based optical diagnostics. The knowledge gained in this course is intended to help students carry out advanced research in fluid mechanics at the graduate level or in an industrial research lab setting. Prereq: ME 503, ME 603, ME 608, ME 646.

ME 712 - Waves in Fluids
Credits: 3
Linear and nonlinear dynamics of hyperbolic and dispersive wave systems with application to acoustic waves, surface and internal gravity waves, Rossby waves, and capillary waves. Key physical concepts include wave-generation mechanisms, wavelength and amplitude dispersion, group velocity and energy propagation, steady streaming, and mode interactions. Prereq: ME 608 or equivalent.

ME 717 - Marine Robotics and Applications
Credits: 3
The purpose of this course is to cover (in lecture and lab format) the broad spectrum of marine vehicles and applications, as well as what is involved in designing and building robotic vehicles for specific missions. Course topics include: marine applications, sensors for marine environments, vehicle subsystems, ocean and open water environment, dynamic modeling and control, and design/fabrication.testing. Various invited speakers (both scientists and engineers) provide learning modules on various marine robotic related topics.
Co-requisite: ME 670
Equivalent(s): OE 717

ME #724 - Vibration Theory and Applications
Credits: 4
Discrete vibrating systems. Linear system concepts; single-degree-of-freedom system with general excitation. Matrix theory and eigenvalue problems. Many degrees of freedom, normal mode theory for free and forced vibration. Numerical methods; introduction to continuous systems; applications to structural and mechanical systems. Prereq: ME 526; ME 627 or permission.

ME 726 - Fracture Mechanics
Credits: 4
The goal is to acquaint the student with understanding of the basic principles behind the derivation of the most common linear and non-linear fracture mechanical equations. The aim is also to gain knowledge in analytical predictions of the failure of materials and become familiar with the ongoing fracture mechanical research. The motivation for this course is that many practical problems in mechanical engineering, manufacturing and materials science have to do with material deformation and failure. Prereq: Mechanics of Materials; Introduction to Materials Science.

ME 727 - Advanced Mechanics of Solids
Credits: 4
Stress, strain, stress-strain relations, anisotropic behavior, introduction to elasticity, plane stress/strain, bending and torsion of members with general cross-sections introduction to thin plates and shells, energy methods. Prereq: ME 526 or permission.

ME 730 - Mechanical Behavior of Materials
Credits: 4
Elastic and inelastic behavior of materials in terms of micro- and macro-mechanics. Stress, strain, and constitutive relations related to recent developments in dislocation theory and other phenomena on the atomic scale and to the continuum mechanics on the macroscopic scale. Elasticity, plasticity, visoelasticity, creep, fracture, and damping. Anisotropic and heterogeneous materials. Prereq: ME 526; 561 or permission.

ME 735 - Mechanics of Composite Materials
Credits: 4
Classification of composites. Anisotropy of composite materials. Micromechanical predictions of elastic and hygrothermal properties. Strength and failure of composite materials. Analysis of laminates. Experimental methods for characterization of composites. Prereq: ME 526 or permission.

ME 742 - Materials Processing in Manufacturing
Credits: 4
Description and analysis of major material shaping processes in modern manufacturing. Casting: fluid flow and heat transfer, solidification, casting processes, properties of cast components and geometric capabilities. Forming: plasticity and formability, bulk and sheet metal forming processes, properties of formed components and geometric capabilities. Machining: cutting forces and tool wear, machining processes, properties of machined components and geometric capabilities. Overview of some non-conventional processes. Lab demonstrations. Prereq: ME 526 and ME 561.

ME 743 - Satellite Systems, Dynamics, and Control
Credits: 3
General satellite systems with emphasis on spacecraft dynamics and control. Topics include general satellite information such as types of satellites, missions, and orbits, as well as satellite subsystems. Basic spacecraft dynamics and orbital mechanics topics are covered. Advanced topics include attitude and orbit estimation, and automatic attitude control. Prereq: ME 670 or permission.

ME 747 - Experimental Measurement and Modeling of Complex Systems
Credits: 0 or 4
Experimental measurements for evaluation, design, and control of mechanical, electrical, and thermal/fluid phenomena. Emphasizes the dynamic response of both sensors and systems and the interactions between physical processes. Experimental examples are drawn from mechanics, material science, thermal-fluid science and controls. Prereq: ME 646; ME 670. Writing intensive.
Attributes: Writing Intensive Course

ME 755 - Senior Design Project I
Credits: 2
Part I of this two-part sequence emphasizes problem definition, analysis, development of alternative concepts, decision-making processes, synthesis of an optimum solution and the development of a conceptual design. Lectures on these and other topics are combined with seminars given by professionals from industry, government, and academia. Related topics include ISO9000 quality systems, engineering management, design review process, engineering economics, team building and communications. Students are organized into project teams to develop a conceptual design. Formal design reviews are conducted. A formal proposal documents the semester's work. Prereq: Senior standing in ME. Lab. Writing intensive.
Attributes: Writing Intensive Course
Equivalent(s): ME 656

ME 756 - Senior Design Project II
Credits: 2
Continuation of Senior Design Project I, in which the proposal submitted in the previous course is developed into a prototype system. Part II emphasizes the development, assembly, testing and evaluation of the system designed in Part I. Lectures and seminars focus on the prototype development process, design verification and industry practices. A formal report documents the semester's work. Prereq: ME 755. Writing intensive.
Attributes: Writing Intensive Course
Equivalent(s): ME 656

ME #757 - Coastal Engineering and Processes
Credits: 3
Introduces small amplitude and finite amplitude wave theories. Wave forecasting by significant wave method and wave spectrum method. Coastal processes and shoreline protection. Wave forces and wave structure interaction. Introduces mathematical and physical modeling. Prereq: ME 608 or permission. (Also offered as CIE 757 and OE 757.)
Equivalent(s): CIE 757, OE 757

ME 761 - Diffraction and Imaging Methods in Materials Science
Credits: 4
Introduces x-ray diffraction and electron microscopy. Basic crystallography, reciprocal lattice, x-ray and electron diffraction, x-ray methods, transmission and scanning electron microscopy. Prereq: CHEM 403; PHYS 408 or permission. Lab.

ME 772 - Control Systems
Credits: 0 or 4
Development of advanced control system design concepts such as Nyquist analysis, lead-lag compensation, state feedback, parameter sensitivity, controllability, observability, introduction to non-linear and modern control. Includes interactive computer-aided design and real-time digital control. Prereq: ME 747 or permission. (Also offered as ECE 772.) Lab.
Equivalent(s): ECE 772, EE 772

ME #773 - Electromechanical Analysis and Design
Credits: 4
Analysis and design of electromechanical systems using lumped parameter models and magnetic finite element analysis (FEA). Electrostatic and magnetic field equations are discussed and used to derive magnetic and electric lumped model elements. Brushless dc motor is analyzed using lumped models and FEA. Various drive types are discussed and the motor system analyzed to obtain torque-speed curves. Design principles are given and utilized in a design project. Prereq: ME 670 or permission.

ME 777 - Computer Aided Engineering
Credits: 4
In this course, modules of Solid Works (beyond its basic solid modeling capabilities) and other software is used to demonstrate how computer based tools can be used in engineering practice, in particular design analysis and optimization. Emphasis placed on using knowledge from past engineering courses to obtain theoretical calculations to compare with the results from the computer software package. Prereq: ME 526 Strength of Materials; ME 627 Mechanics III; ME 603 Heat Transfer; and ME 608 Fluid Dynamics (or equivalent).
Attributes: Writing Intensive Course

ME 782 - Industrial Skills and Engineering
Credits: 3
In this course, the principles of Lean Manufacturing and Value Stream Mapping (VSM) as pioneered by Toyota and now utilized by most leading manufacturers will be studied and applied. Lean Manufacturing principles will be taught with classroom instruction and a structured model factory exercise. Instruction on the theory of Value Stream Mapping (VSM) will be followed with an actual industrial VSM activity where a process will be studied and a Desired Future State defined with VSM methods. This factory floor activity will be done collaboratively with employees from a manufacturing company.

ME 785 - Solid Mechanics in Manufacturing
Credits: 4
Characterization of material properties are studied with emphasis on plastic deformation. Also, numerical approaches to solve for the forces, stresses, and strains in manufacturing processes are covered. In particular, two prominent mass production manufacturing areas, metal forming and cutting, are examined. Prereq: ME 561; ME 627.

ME 786 - Introduction to Finite Element Analysis
Credits: 4
Topics include basic matrix theory, potential energy approach, direct stiffness method, calculus of variations, development of finite element theory, and modeling techniques. Applications in solid mechanics, heat transfer, fluids, and electromagnetic devices, via both commercially available codes and student-written codes. Prereq: ME 526 or permission. Lab.
Equivalent(s): CIE 786

ME 795 - Special Topics
Credits: 1-4
New or specialized courses and/or independent study.
Repeat Rule: May be repeated for a maximum of 20 credits.

ME 797 - Honors Seminar
Credits: 1
Course enrichment and/or additional independent study in subject matter pertaining to a 600- or 700-level ME course other than ME 695, ME 696, ME 697, or ME 795.
Attributes: Honors course

Faculty

https://ceps.unh.edu/directory/all