

MECHANICAL ENGINEERING (ME)

ME 5105. Basic Concepts of Continuum Mechanics. (3 Credits)

An introductory course in the theory of continuum mechanics. Development of physical principles using Cartesian tensors. Concepts of stress, strain and motion. Basic field equation for the Newtonian fluid and the elastic solid.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205105>)

ME 5110. Advanced Thermodynamics. (3 Credits)

Microscopic view of thermodynamics: probability and statistics of independent events, thermodynamic probabilities and most probable thermodynamic distributions, molecular structure and partition function, Ensemble of microstates describing macroscopic behavior, with ideal gas as an example, Macroscopic descriptions of thermodynamic equilibrium and equilibrium states, Reversible processes, Heat and Work interactions, Mixtures of pure substances and chemical equilibrium, Stability and phase transitions, Irreversible thermodynamics, Onsager reciprocity relations and thermo-electric effects, Kinetic theory of gases.

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ME 5120. Advanced Thermo-Fluids I. (3 Credits)

Fluid as a continuum, Kinematics and decomposition of fluid motion, Conservation of mass and momentum, Navier-Stokes equations, Conservation of energy, Exact solutions to governing equations, Potential flows, Vorticity dynamics and low Reynolds number flows, Laminar boundary layers including heat transfer, Laminar free shear flows including heat transfer, Flow instabilities and transition.

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ME 5130. Advanced Heat and Mass Transfer. (3 Credits)

Review of thermophysical properties of matter including nanoscale effects. Exact and computational solutions of heat conduction equation. Dimensionless conduction rate approach for steady-state and transient conduction. Species diffusion equations with emphasis on stationary media and partitioning effects. Navier-Stokes equations and exact solutions for special cases. Correlation approach for treatment of single phase laminar, turbulent and two-phase flow. Radiative properties and treatment of surface radiation with spectral and directional effects. Emphasis on multimode heat transfer with applications in manufacturing, nanotechnology, information technology and biotechnology.

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ME 5140. Heat and Mass Transfer in Multiphase Systems. (3 Credits)

Presentation of basic principles for analysis of transport phenomena in multi-phase systems and how they can be applied to a wide variety of applications. The scope is limited to thermodynamics and heat and mass transfer fundamentals in solid <-> liquid, liquid <-> vapor and solid <-> vapor with emphasis in condensation, evaporation, sublimation, vapor deposition, boiling, two phase flow, melting and solidification.

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ME 5150. Analytical and Applied Kinematics. (3 Credits)

Analytical methods of coordinate transformation and two and three dimensional motion, analysis of relative motion and relative freedom through kinematics connections, study of finite and instantaneous properties of motion, study of the geometry of single and multi-parameter engineering curves, surfaces and motions. Application in the analysis and design of linkages and mechanisms.

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ME 5160. Theory and Design of Automatic Control Systems. (3 Credits)

Design features of a closed loop control system. Laplace domain analysis of electromechanical, pneumatic, hydraulic, thermal, and mechanical systems. Computer simulation of dynamic responses using software tools. Stability issues, Routh analysis, root locus, Bode and Nyquist analyses are addressed. An open-ended, hands-on design project from a current research topic is assigned.

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ME 5180. Dynamics. (3 Credits)

Three-dimensional particle and rigid-body mechanics. Particle kinematics. Newton's laws, energy and momentum principles. Systems of particles. Rigid body kinematics, coordinate transformations. Rigid body dynamics, Euler's equations. Gyroscopic motion. Lagrange's equations.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205180>)

ME 5190. Advanced Solid Mechanics. (3 Credits)

Fundamental idealizations used in linear solid mechanics and the fundamental principles of the subject. Idealizations covered include beams, circular torsion, struts and thick cylinders. Basic principles include principle of minimum potential energy, principle of minimum complementary energy, virtual work, equations of static equilibrium and direct and potential methods of solving equilibrium equations. Example applications vary but may include, bounding of elastic properties of composites, derivation of finite elements, solution of plate problems by Green's functions and others.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205190>)

ME 5210. Intelligent Material Systems and Structures. (3 Credits)

Overview of piezoelectric materials and electrostrictive materials, shape memory alloys, magnetostrictive materials, and ER/MR fluids. Development of adaptive structure integrated with piezoelectric material, actuation and sensing, simultaneous optimal design/control of electromechanical integrated system, nonlinear and robust control. Design of shape memory alloy system for position control. Development of semi-active control using ER/MR fluids. Structural health monitoring and system identification research.

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ME 5215. Underwater Sensor Systems Analysis and Design. (3 Credits)

The Underwater Sensor Systems Analysis and Design course explores the analysis and synthesis of underwater sensing and communication systems. The intended applications of these systems and the factors that affects their performances in various environmental conditions. Size, weight, and cost provide the constraints to achieve the optimized (or compromised) design.

Enrollment Requirements: Undergraduate courses in Calculus Based Physics; MATLAB or equivalent for computer simulations; or Underwater Acoustics and Sensing Systems.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205215>)

ME 5311. Computational Fluid Dynamics. (3 Credits)

An introduction to the fundamentals of computational fluid dynamics (CFD) including thermal transport. Introduces the main computational techniques and methods and analyze their properties. Strong emphasis will be given to the implementation and application of computational techniques and methods. The course is not training on how to use commercial CFD software, and we do not use or discuss such software in the class. The course serves the needs of students that conduct CFD-related research or students who want to develop an in-depth understanding of the subject to critically assess the results CFD software.

Enrollment Requirements: Instructor consent.

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ME 5320. Flow of Compressible Fluids I. (3 Credits)

Equations of motion of a compressible fluid. Quasi-one-dimensional flow including effects of friction, heat addition, and normal shocks. Two and three dimensional flows. Velocity potential and stream function. Small perturbation theory. Subsonic pressure correction formulas. Kelvin and Crocco Theorems. Method of characteristics for steady and unsteady, rotational and irrotational flows. Curved and oblique shock waves. Shock tube theory.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205320>)

ME 5341. Radiation Heat Transfer. (3 Credits)

Fundamentals of radiative emission (black body behavior and Planck's law), surface properties (emissivity, absorptivity, reflectivity, and transmissivity), electromagnetic theory for prediction of radiative properties, development of the methods of solution for radiant energy interchange between surfaces and in enclosures with and without absorbing, emitting, and scattering media present.

Enrollment Requirements: ME 5507.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205341>)

ME 5420. Mechanical Vibrations I. (3 Credits)

Variational principles, Lagrange's equation. Equations of motion for multi-degree of freedom systems. Free vibration eigenvalue problem: modal analysis. Forced solutions: general solutions, resonance, effect of damping, and superposition. Vibrations of continuous systems: vibration frequencies and mode shapes for strings, bars, membranes, beams, and plates. Experimental methods and techniques.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205420>)

ME 5430. Mechanics of Composite Materials. (3 Credits)

Provides students with the fundamental knowledge to perform stress analysis of fiber-reinforced composite materials. The focus is on the use of mechanics to study the stresses due to applied deformations, loads, and temperature changes. This course begins with an introduction to composite materials including their constituent properties, applications, advantages and limitations, and manufacturing techniques. The generalized Hooke's Law for anisotropic solids is along with the Classical Lamination Plate Theory (CLPT) is introduced for composite laminates. Students will learn how to apply CLPT to the failure analysis of composite laminates under combined mechanical and thermal loads. The course concludes with the study of interlaminar stresses and the analysis of composite laminated beams.

Enrollment Requirements: Instructor consent.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205430>)

ME 5442. Composites Design. (3 Credits)

Fundamental principles and best practices for designing structural parts made from composite materials. Students will apply the knowledge and skills obtained throughout the course towards solving a practical design problem. Students will learn and use engineering software for predicting laminated composite properties, designing composite parts, and predicting the part performance under specified loads. At the end of the course, students will have created a complete definition of their design that may be manufactured and tested in subsequent courses.

Enrollment Requirements: ME 5430 or MSE 5364.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205442>)

ME 5443. Composites Manufacturing. (3 Credits)

(Also offered as MFGE 5220.) This course will provide an overview of multiple manufacturing methods for a select group of material types. Manufacturing methods will focus on production and process qualification for Aerospace Components. Students will have the opportunity to survey multiple materials, methods, and processes for part fabrication. Part evaluation methods will also be covered (destructive and non-destructive). There will be entry level exposure to manufacturing risk analysis through the use of industry standard tools (Manufacturing Flow, PFMEA, Control Plan, and PPAP).

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205443>)

ME 5507. Engineering Analysis I. (3 Credits)

Matrix algebra, indicial notation and coordinate transformations. Cartesian and general vectors and tensors, vector and tensor calculus. Partial differential equations: Fourier series, solution procedures to boundary value problems in various domains. Application to the mechanics of continuous media.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205507>)

ME 5511. Principles of Optimum Design. (3 Credits)

Engineering modeling and optimization for graduate students in all areas of engineering. Problem formulation, mathematical modeling, constrained and unconstrained optimization, interior and boundary optima constraint interaction, feasibility and boundedness, model reduction, sensitivity analysis, linear programming, geometric programming, nonlinear programming, and numerical methods in optimization.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205511>)

ME 5512. Introduction to Structural Optimization. (3 Credits)

Application of mathematical optimization techniques to the design of structures modeled via the finite element method, including size, shape and topology optimization. Mathematical derivation and computational implementation aspects of material and shape sensitivities used for shape and topology optimization, including direct and adjoint sensitivity analysis, and finite difference sensitivities. Size optimization of discrete systems and of distributed parameter systems. Optimization techniques for structural optimization, including fully-stressed design, optimality criterion methods and gradient-based nonlinear programming methods. Topology optimization of discrete systems and of continua, including density-based and level-set-based methods. Shape optimization techniques.

Enrollment Requirements: Recommended preparation: Previous knowledge in principles of optimum design and in finite element analysis.

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ME 5513. Modern Computational Mechanics. (3 Credits)

An advanced course in Computational Mechanics with emphasis on modeling problems using Finite Differences and Finite Element techniques. Projects include initial value problems, ordinary differential equations and partial differential equations. Course evaluation is made by the successful completion of several assigned projects.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205513>)

ME 5515. Introduction to Hands-On Finite Element Analysis. (3 Credits)

This course introduces the basic theory of finite element analysis (FEA) and the use of ANSYS® Workbench in the modeling and simulation of engineering problems. It uses simple mechanics problems as examples and focuses on the application of one-dimensional bar and beam elements, two-dimensional plane stress and plane strain elements, plate and shell elements, and three-dimensional solid elements in the analysis of engineering structures. It covers the application of FEA to the analysis of mechanical stresses, vibrations, dynamics, thermal effects, and failure. In each of these application areas, ANSYS® Workbench is introduced through hands-on case studies. Clear understanding of the FEA principles, element behaviors, solution procedures, and correct usage of the FEA software is emphasized throughout the course.

Enrollment Requirements: CE 2110 or 3110 or equivalent.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205515>)

ME 5522. Advanced Analysis of Composite Materials and Structures. (3 Credits)

Advanced course in composite materials analysis that focuses on micromechanics analysis, failure prediction and hygrothermal effects. It will provide students with the skills to perform elasticity-based micromechanics analysis of composite thermal and mechanical properties and failure. Students will also learn about the analysis of discontinuous fiber composites. The analysis of the effects of temperature and moisture on multidirectional composite laminate properties and constitutive behavior will be covered along with the analysis of processing-induced residual stresses and laminate deformation. Students will work on a project that applies the skills learnt in the course to a practical composite application.

Enrollment Requirements: Instructor consent. Recommended preparation: undergraduate degree in mechanical engineering or similar discipline.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205522>)

ME 5702. Data Science for Materials and Manufacturing. (3 Credits)

(Also offered as SE 5702.) This course will provide students with data analytics skills for knowledge discovery and design optimization. The students will also learn how to apply data mining and machine learning techniques to tackle the challenges in manufacturing and computational materials engineering. Topics include basic concepts of supervised/unsupervised learning, design of experiments and data collection, material image processing, surrogate modeling, optimization and model calibration, multi-fidelity modeling, and applications of data analytics in manufacturing and computational materials engineering problems.

Enrollment Requirements: Undergraduate degree in engineering or computer science, departmental or unit consent required. Recommended preparation: Knowledge or coursework in probability and statistics. Ability to read, interpret and modify Python and MATLAB code. Ability to use Python and MATLAB for analyzing data for the course project.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205702>)

ME 5895. Special Topics in Mechanical Engineering. (1-3 Credits)

Classroom and/or laboratory courses in special topics as announced in advance for each semester. The field of study or investigation is to be approved by the Head of the Department before announcement of the course.

May be repeated for a total of 12 credits

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%205895>)

ME 6130. Advanced Thermo-Fluids II. (3 Credits)

Review of governing flow equations, instability and transition, Reynolds averaging and closure approximations, Algebraic turbulence models, Two-equation turbulence models, Large eddy simulations, Turbulence statistics: probability density function and power spectral densities, Energy cascade and intermittency, Turbulent boundary layers including heat transfer, Turbulent free shear flows, Turbulent internal flows (pipes and channels) including heat transfer, Natural convection.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%206130>)

ME 6160. Turbines and Centrifugal Machinery. (3 Credits)

Theory, design and performance of centrifugal and axial flow machinery including turbines, blowers, fans, compressors, superchargers, pumps, fluid couplings and torque converters. A detailed study of the mechanics of the transfer of energy between a fluid and a rotor.

Enrollment Requirements: ME 5320.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%206160>)

ME 6170. Combustion and Air Pollution Engineering. (3 Credits)

Review of thermodynamics and chemical equilibrium. Introduction to chemical kinetics. Studies of combustion processes, including diffusion and premixed flames. Combustion of gases, liquid, and solid phases, with emphasis on pollution minimization from stationary and mobile systems. Air pollution measurement and instrumentation.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%206170>)

ME 6300. Independent Study in Mechanical Engineering. (3 Credits)

Individual exploration of special topics as arranged by student and instructor.

May be repeated for a total of 12 credits

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%206300>)

ME 6330. Advanced Measurement Techniques. (1-3 Credits)

A critical examination of measurement techniques. Principles of operation of various instruments. Estimates of accuracy, precision, and resolution of measurements. Intended primarily for students contemplating experimental theses. When possible, specific topics covered will be structured to the needs of the class.

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%206330>)

ME 6340. Graduate Seminar. (0 Credits)

Presentations by invited guest speakers on topics of current interest in various Mechanical Engineering and allied fields.

May be repeated for a total of 0 credits

View Classes (<https://catalog.uconn.edu/course-search/?details&code=ME%206340>)