MECHANICAL ENGINEERING (ME)

Course numbers with the # symbol included (e.g. #400) have not been taught in the last 3 years.

ME 806 - 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 begins by giving an overview of U.S. energy usage and sources, as well as history and trends. Various renewable energy topics are then introduced and discussed. Where applicable, topics are discussed in detail from a fluid and thermal sciences point of view. Guest lectures and a field trip may be included. This course is open to all engineering graduate students. Prereq: Thermodynamics, Fluid Dynamics, or equivalent, or instructor permission.

ME 807 - Analytical Fluid Dynamics
Credits: 4
Kinematics of flow; constitutive relationships; development of the Navier-Stokes equations; vorticity theorems; potential flow. Prereq: fluid dynamics.

ME 809 - Computational Fluid Dynamics
Credits: 3
Conservation of mass, momentum, and energy, discretization and 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 812 - 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: fluid dynamics; or permission.

ME 824 - Vibrations Theory and Applications
Credits: 4
Discrete vibrating systems. Linear system concepts; single-degree-of-freedom systems 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: statics; dynamics or permission.

ME 827 - 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: strength of materials or permission.

ME 835 - 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: strength of materials or permission.

ME 843 - Satellite Systems, Dynamics, and Control
Credits: 3
General satellite systems with emphasis on spacecraft dynamics and control. Course 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 will include attitude and orbit estimation, and automatic attitude control. Prereq: systems modeling or permission.

ME #860 - Physical Metallurgy I
Credits: 0 or 4
Introduction to physical metallurgy: dislocations, thermodynamics of materials, diffusion, phase transformations, and strengthening mechanisms in solids. Prereq: introduction to materials science or permission. Lab.

ME 870 - Design with Microprocessors
Credits: 4
Basic operation of microprocessors and microcontrollers explained, and interfacing these devices to sensors, displays and mechanical systems explored. Topics include: number systems, architecture, registers, memory mapping, interrupts and interfacing for system design. Methods of programming and interfacing with mechanical/electrical systems are covered and then implemented in lab. Prereq: introduction to electrical engineering. Lab.

ME 872 - Control Systems
Credits: 4
Development of advanced control systems design concepts such as Nyquist analysis; lead-lag compensation; state feedback; parameter sensitivity; controllability; observability; introduction to nonlinear and modern control. Includes interactive computer-aided design and real-time digital control. Prereq: permission. (Also offered as ECE 872.) Lab.
Equivalent(s): ECE 872, EE 872

ME 873 - 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 discussed and used to derive magnetic and electric lumped model elements. A brushless dc motor analyzed using lumped models and FEA. Various drive types discussed and the motor system analyzed to obtain torque-speed curves. Design principles given and utilized in a design project. Prereq: systems modeling, simulation, and control or permission.

ME 877 - 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: Strength of Materials; Mechanics III; Heat Transfer; and Fluid Dynamics (or equivalent); or permission.
Equivalent(s): EE 877

ME 882 - 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 885 - Solid Mechanics in Manufacturing
Credits: 4
Characterization of material properties will be studied with emphasis on plastic deformation. Also, numerical approaches to solve for the forces, stresses, and strains in manufacturing processes will be covered. In particular, two prominent mass production manufacturing areas, metal forming and cutting, will be examined. Prereq: introduction to materials science, dynamics.

ME 886 - 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: Mechanics of Materials, Heat Transfer or permission. Special fee. Lab.

ME 895 - Special Topics
Credits: 1-4
New or specialized courses and/or independent study. May be repeated for credit.

ME 899 - Master's Thesis
Credits: 1-8
May be repeated up to a maximum of 8 credits. Cr/F.
Repeat Rule: May be repeated for a maximum of 8 credits.

ME 906 - Convection Heat Transfer
Credits: 4
An analytical study of heat transfer to laminar and turbulent boundary layers of compressible and incompressible fluids. Basic differential equations governing the heat transfer are derived and analytical solutions are obtained where possible and checked with experimental results.

ME 909 - Viscous Flow
Credits: 3
Exact solutions of the Navier-Stokes equations; laminar boundary layers; wakes and jets; Stoke's flow; stability of parallel flows and boundary layers; transition to turbulence. Prereq: analytical fluid dynamics or permission.

ME 910 - Turbulence
Credits: 3
Modern analysis of turbulent flow: the governing equations; stationary random functions and the various averaging techniques; empirical results on turbulence; homogenous turbulence; the Kolmogorov theory for isotropic turbulence; upper bound theory; turbulence in the atmosphere and oceans; applications to problems in science and engineering. Prereq: ME 807 or permission.

ME 922 - Continuum Mechanics
Credits: 4
Cartesian tensors. Lagrangian and Eulerian description of a continuum. The material time derivative. Deformation gradient. Displacement and rotation. Strain tensors. Rates of deformation. Conservation of mass. Momentum balance equations. Cauchy and Piola-Kirchhoff stress tensors. Balance of energy: stress power, rate of work, and internal energy. Entropy and the second law of thermodynamics. Constitutive equations for elasticity and plasticity. Newtonian and non-Newtonian fluids. Inviscid and viscous flow. Naiver-Stokes equations. Ideal and rotational flows.

ME 927 - Theory of Plasticity
Credits: 4
Analysis of stress and deformation in inelastic solids; general development of stress invariants, variational principles, constitutive relations, and yield and loading functions. Special emphasis on ideal plasticity, strain-hardening, creep, limit analysis, and limit design.

ME 935 - Micromechanics of Composite and Porous Materials
Credits: 4
Classification of composites, periodic and random microstructures. Mechanics of materials approach to micro-mechanical modeling. Representative volume element, analytical and numerical modeling of the effective properties. Micromechanics of failure of composite and porous materials. Prereq: mechanics of composites or permission.

ME 944 - Nonlinear Control Systems
Credits: 4
Analysis and design of nonlinear control systems from the classical and modern viewpoints are discussed. Liapunov's stability theory; phase space methods; linearization techniques; simulation; frequency response methods; generalized describing functions; transient analysis utilizing functional analysis; and decoupling of multivariable systems. Prereq: advanced control systems I. (Also offered as ECE 944.)
Equivalent(s): ECE 944, EE 944

ME 951 - Advanced Control Systems I
Credits: 3
State-space representation of multivariable systems; analysis using state transition matrix. Controllability and observability; pole placement using state and output feedback; Luenberger observers. Introduction to computer-controlled systems (sampling, discrete state representation, hybrid systems): nonlinear analysis (Liapunov, Popov, describing function). Prereq: control systems. (Also offered as ECE 951.)
Equivalent(s): ECE 951, EE 951

ME 952 - Advanced Control Systems II
Credits: 3
Special topics in control theory: continuous and discrete systems: optimal control systems, including calculus of variations, maximum principle, dynamic programming, Weiner and Kalman filtering techniques, stochastic systems, adaptive control systems. Prereq: advanced control systems I. (Also offered as ECE 952.)
Equivalent(s): ECE 952, EE 952

ME 986 - Advanced Finite Element Analysis
Credits: 4
Topics include introduction to dynamics, treatment of nonlinear material behavior, and plate and shell element technology. Emphasis given to problems in solid mechanics and heat transfer. Prereq: finite element analysis or equivalent.

ME 992 - Master's Project
Credits: 4
The student works with a faculty member during one or two semesters on a well-defined research and/or original design problem. A written report and seminar are presented. IA (continuous grading). Cr/F.
Repeat Rule: May be repeated up to 1 time.

ME 995 - Graduate Special Topics
Credits: 1-4
Investigations of graduate-level problems or topics in mechanical engineering.

ME 999 - Doctoral Research
Credits: 0
Cr/F.