

MECHANICAL ENGINEERING • ME

2212 Introduction to Mechanical Engineering Design (2) Prereq.: ENGL 1001, CM 1020 or 1030, PHYS 2101, ME 2533, or equivalent. 1 hr. lecture; 2 hrs. lab. Art and science of Mechanical Engineering design; reverse engineering; design methodologies; product realization; professional ethics; professional development.

2334 Thermodynamics (4) Prereq.: Grade of "C" or better in CHEM 1202, MATH 1552, PHYS 2101; credit or registration in ME/CSC 2533. Thermodynamic systems and control volumes; thermodynamic properties of simple substances, work and heat; 1st and 2nd law; power and refrigeration cycles; ideal gas mixtures, water-vapor mixtures and psychrometric chart; combustion.

2533 Introduction to Engineering Computation (3) 2 hrs. lecture; 3 hrs. lab. See CSC 2533.

2723 Materials of Engineering for Mechanical Engineers (3) Prereq.: CHEM 1202 and credit or registration in PHYS 2102. Credit will not be given for both this course and ME 2733. Classification and study of engineering materials, their structure, properties, and behavior; typical metals and alloys, plastics and rubber, and ceramic materials; phase equilibria and manipulation of properties and behavior by adjustment of composition and processing variables; responses of engineering materials to stress and environmental variables; emphasis on Mechanical Engineering applications such as fracture and heat treatment processes.

2733 Materials of Engineering (3) Prereq.: CHEM 1201 and credit or registration in PHYS 2102. Not open to Mechanical Engineering majors. Credit will not be given for both ME 2723 and ME 2733. Classification and study of engineering materials, their structure, properties, and behavior; typical metals and alloys, plastics and rubber, and ceramic materials; phase equilibria and manipulation of properties and behavior by adjustment of composition and processing variables; responses of engineering materials to stress and environmental variables.

3133 Dynamics (3) S,Su Prereq.: Grade of "C" or better in CE 2450 and MATH 1552, credit or registration in CHEM 1212 or PHYS 2108. 2 hrs. lecture; 2 hrs. recitation. Vectorial treatment of kinematics and kinetics of particles and rigid bodies; force, mass, acceleration; impulse and momentum; work and energy.

3143 System Dynamics and Modeling (3) F Prereq.: CSC/ME 2533, ME 3133, grade of "C" or better in MATH 2090, and credit or registration in ME 3834. Bond graph and lumped-parameter techniques for deriving dynamic equations of physical systems; time and frequency domain analyses, numerical simulation of mechanical systems.

3249, 3250 Engineering Practice (1-3,1-3) Su Prereq.: ME 2334 and consent of instructor. Pass-fail grading. A minimum of 6 weeks of full-time employment by an industry participating in the summer program. Selected engineering problems in an industrial environment.

3333 Thermodynamics (3) Prereq.: PHYS 2101 and MATH 1552; or equivalent. Not open to mechanical engineering majors. Basic laws of thermodynamics, availability, perfect gases and pure substances, fluid flow, and basic heat transfer.

3603 Instrumentation and Measurement (3) Prereq.: EE 3950, ME 3143; and proficiency in English as required by the College of Engineering. 2 hrs. lecture; 3 hrs. lab. Basic science and technology of instrumentation and measurement systems; fundamental measurement theory; statistical error estimation; error propagation; instrumentation specifications; analog and digital instrumentation fundamentals; data acquisition and analysis; extensive technical report writing.

3633 Manufacturing Processes & Methods (3) Prereq.: CM 1020 or 1030, and ME 2723 or 2733. 2 hrs. lecture; 3 hrs. lab. Modern manufacturing processes integrated into total manufacturing systems; CAD/CAM flexible manufacturing operations; metal casting, forming, removal; welding processes and machinery; fine measurement, inspection, and quality assurance.

3701 Materials of Engineering Laboratory (1) Prereq.: proficiency in English as required by the College of Engineering; ME 2723 or 2733; and credit or registration in CE 3400. Demonstrative and participative experiments to develop better understanding of characteristics of metals, ceramics, and plastics.

3752 Material Selection for Mechanical Engineers (2) S Prereq.: ME 3701 or equivalent; credit or registration in CE 3400. Analysis of mechanical and other properties of engineering materials required for material selection; advanced engineering materials in mechanical engineering; applications and problems in processing and shaping; materials in selected mechanical systems.

3834 Fluid Mechanics (4) F Prereq.: ME 2334, 3133; and a grade of "C" or better in MATH 2090. Statics, kinematics, and dynamics of continuum liquids and gases; conservation laws (mass, momentum, energy); integral analysis; differential analysis; dimensional analysis and similarity; internal and external viscous flows; compressible flows.

3903 Special Projects for Undergraduates (3) Prereq.: 2.50 cumulative gpa with consent of department. May be taken for a max. of 9 hrs. of credit. Library research, comprehensive design problems, and laboratory investigations.

4133 Machine Design I: Kinematics of Machinery (3) F Prereq.: ME 2533 and 3133; or equivalent. Kinematic and dynamic analysis and synthesis of mechanisms.

4143 Mechanical Vibrations (3) Prereq.: CE 3400, ME 3143, 4133; and a grade of "C" or better in MATH 2090; or equivalent. Basic principles of oscillating mechanical systems; single and multiple degrees of freedom; dynamic balancing; applications to mechanical systems; continuous systems vibrations.

4153 Kinematic Synthesis of Mechanisms (3) S Prereq.: ME 4133 or equivalent. Three-dimensional mechanisms; emphasis on computer solution methods.

4163 Intermediate Dynamics (3) F Prereq.: ME 3133 and a grade of "C" or better in MATH 2090. Rotating reference frames, rigid body kinetics in three dimensions, central force motion, variable mass problems, and Lagrange's equations.

4183 Theory and Design of Mechanical Control Systems (3) F Prereq.: grade of "C" or better in MATH 2090; ME 3143, and credit or registration in ME 3603. Basic principles, concepts, characteristics, and performance of linear feedback control systems; stability of linear systems; frequency response methods; compensator design in the frequency domain.

4201 Mechanical Engineering Design Laboratory (1) Prereq.: credit or registration in ME 4183 or equivalent. 3 hrs. lab. Experiments involving basic concepts in machine design.

4202 Mechanical Engineering Capstone Design II (2) Prereq.: ME 3633, 3752, 4243, 4433, 4183. 6 hrs. lab. Principles from heat transfer, thermodynamics, design, fluids, and materials courses utilized to complete the project set forth in the preliminary design outline submitted in ME 4243.

4243 Mechanical Engineering Capstone Design I (3) Prereq.: ECON 2030, ME 2212, 4244, senior standing in the College of Engineering, and credit or registration in ME 3633, 3752, 4183, and 4433, or equivalent. 2 hrs. lecture; 2 hrs. lab. Design project will be selected and approved (to be completed in ME 4202); project feasibility study and outline of the design project will be completed; design methodology, optimization, product reliability and liability, economics, use of ASME codes, and professional ethics.

4244 Machine Design II: Strength Considerations and Component Design (4) S Prereq.: CE 3400 and credit or registration in ME 4133. Design, three-dimensional stress analysis; deflection and stiffness; static and dynamic loading; failure theories and fatigue; fasteners; welded joints; mechanical springs; bearing; gears; shafts; clutches; breaks and couplings; belts and pulleys.

4253 Introduction to Bearing Design and Lubrication (3) Prereq.: ME 4433 or equivalent. Analysis and design of tribological components particularly hydrodynamic bearings; computational modeling and other modern developments in the field.

4353 Advanced Engineering Thermodynamics (3) S Prereq.: ME 2334 or equivalent. Postulational treatment of laws of thermodynamics; equilibrium and maximum entropy postulates; development of formal relationships; principles and application to general systems.

4383 Thermal System Design (3) Prereq.: ECON 2030, ME 2334, and ME 4433. Principles and practices concerning the design and optimization of thermal systems.

4433 Heat Transfer (3) Prereq.: ME 2334 or 3333, ME 3834; a grade of "C" or better in MATH 2090; or equivalent. Principles of heat transfer by conduction, radiation, and convection.

4443 Introduction to Combustion (3) S Prereq.: ME 4433. Basic principles of combustion and their application in solving engineering problems.

4453 Laser Methods in Engineering (3) *Prereq.: senior standing in the College of Engineering.* Basic principles of lasers and their application to engineering problems.

4533 Engineering Use of Electronic Computers (3) *Prereq.: ME 2533 or equivalent; or graduate standing.* General rules of programming; construction of programs to solve mathematical problems common to all engineers; numerical methods including solutions to linear and nonlinear differential equations, least-squares approximation, interpolations, and integration.

4563 Mathematical Methods in Engineering (3) *See MATH 4038.*

4573 Interactive Computer Graphics (3) *Prereq.: experience in mathematics and computer programming. Also offered as CSC 4356.* Analytical treatment of graphics using the digital computer; graphical display and input devices; computer graphics systems and standards; two- and three-dimensional transformations; geometric modeling; interactive techniques; basic data structures; realism in 3-D graphics; future trends.

4583 Applied Interactive Graphics and Computer-Aided Design (3) F *Prereq.: ME 4573 or equivalent. Also offered as CSC 4357.* Application of interactive graphics techniques to solve specific problems in engineering design and data retrieval.

4611 Thermal System Laboratory (1) *Prereq.: ME 2334 or equivalent and credit or registration in ME 4433 and 3603. 3 hrs. lab. Oral presentations required.* Thermal system analysis and independent experimentation.

4621 Thermal Science Laboratory (1) *Prereq.: ME 3603, 3834, 4433, or equivalent.* Laboratory demonstrations and experimentation in fluid mechanics, thermodynamics, and heat transfer concepts.

4633 Internal Combustion Engines (3) *Prereq.: ME 2334 or 3333 or equivalent.* Classification of internal combustion engines, gas turbines, cycles with different components, spark-ignition gasoline engines, detonation, carburetion, compression-ignition engines, combustion and diesel knock, fuel atomization and atomizers, combustion chambers, two- and four-stroke cycle engines, and supercharging.

4643 Thermal Environmental Engineering (3) *Prereq.: ME 2334 and credit or registration in ME 4433; or equivalent.* Design of thermal environment for humans, animals, processes, and inanimate objects; the means of control.

4663 Power Plant Engineering (3) *Prereq.: ME 2334 and 4433; or equivalent.* Power plants for industrial and central-station use; emphasis on cycles, design, capabilities, and economics of the plant as a whole; components used in various types of plants.

4673 Introduction to Modern Control Theory (3) *Prereq.: ME 4183 or equivalent.* State space modeling, controllability, observability and stability, pole placement, optimal control laws via minimum principle and dynamic programming.

4683 Sensors and Actuators (3) V *Prereq.: EE 3950, ME 3143.* Basic knowledge and operational principles of various transduction (sensing and actuating) methods, especially electro mechanical sensors and actuators; actual designing, building, and testing transducers.

4723 Advanced Materials Analysis (3) F *Prereq.: ME 2733, 3701 or equivalent. 1 hr. lecture; 6 hrs. lab.* Concepts and operation of modern analytical instruments using photon or electron beams and X-rays; macroscopic and microscopic examination of materials coupled with separate and combined testing of mechanical, tribological, and corrosion properties.

4733 Deformation and Fracture of Engineering Materials (3) F *Prereq.: CE 3400 and either ME 2733 or equivalent.* Effect of temperature, strain rate, corrosion, and microstructure on stress-strain behavior and fracture of engineering materials, including metals, ceramics, and plastics.

4743 Kinetics in Materials Processes (3) *Prereq.: ME 2334, ME 2733 or equivalent.* Applications of the principles of diffusion, phase transformation, and thermodynamics to describe the kinetics of micro structural evolution in engineering materials.

4763 Fundamentals of Corrosion Science and Engineering (3) F *Prereq.: ME 2733 or equivalent, and any first course in thermodynamics.* Corrosion principles; polarization, passivation, inhibition, and other phenomena; principal methods used in corrosion prevention.

4783 Composite Materials: Manufacturing, Properties, and Design (3) *Prereq.: ME 2733 and CE 3400 or equivalent.* Constituent materials, micro- and macromechanics, mechanical behavior, fracture, manufacturing and design of components made of composite materials, including polymer, ceramic, and metal matrix materials.

4813 Interdisciplinary Fluid Dynamics: Physical Concepts (3) *Prereq.: Diff. Equations and Introductory Physics. Also offered as HNRS 4813.* An introduction to fluid dynamics from a multi-disciplinary perspective, emphasizing theoretical, mathematical and physical concepts of fluid flows, and their application to a range of physical scales and disciplines.

4823 Interdisciplinary Fluid Dynamics: Computational Methods (3) *Prereq.: Diff. Equations, Linear Algebra, and Computer Programming. Also offered as HNRS 4823.* Numerical solution strategies for differential equations relevant to fluid flow and transport processes. Finite-difference, finite-volume, and finite-element methods. Parallel computations.

4843 Gas Dynamics (3) *Prereq.: ME 2334; a grade of "C" or better in MATH 2090; or equivalent.* Derivation and review of basic equations of compressible fluid flow; reduction of the general problem to 1-D flow; 1-D flow in nozzles with and without friction; 1-D flow with heat addition; normal shock wave, Prandtl-Myer turn, and oblique shock waves.

4853 Turbomachinery (3) *Prereq.: ME 2334, 3834, and 4433.* Preliminary design of axial- and radial-flow pumps, compressors, and turbines; determination of optimum flow angles and dimensions, blade design, blade selection, and performance prediction.

4933 Advanced Topics in Mechanical Engineering (3) *May be taken for a max. of 6 hrs. of credit when topics vary. Two sections may be taken concurrently.*

4943 Special Problems in Aerospace Engineering (3) *Prereq.: senior standing in mechanical engineering or related discipline. May be taken for a max. of 12 sem. hrs. of credit when topics vary.* Aerodynamic problems of special interest in the analysis and design of water, land, air, and space transportation systems.

7153 Advanced Vibrations (3) *Prereq.: ME 4143 or equivalent.* Modeling and response of continuous vibratory systems; inverse problems in vibration; active vibration control; dynamic absorption; wave propagation and reflection; numerical methods for continuous systems.

7233 Advanced Machine Design (3) S *Prereq.: ME 4244 or equivalent.*

7243 Bearing Design and Lubrication (3) *Prereq.: consent of instructor.* Derivation of fluid flow in bearings; principles of hydrodynamics lubrication and application to journal and thrust bearings; effect of environment on type of lubrication systems and lubricants; heat generation in bearing and heat transfer; compressible fluid and solid lubricants.

7263 Computer-Aided Geometric Modeling (3) S *Prereq.: ME 4573 or equivalent.* Mathematical elements of modeling complex free-form geometry in two and three dimensions for design, analysis, and display; wireframe, surface, and solid geometric modeling; computer graphics and algebraic, computational, and projective geometry.

7433 Advanced Heat Transfer I (3) F *Prereq.: MATH 4038 or equivalent.* Steady and transient heat conduction.

7443 Advanced Heat Transfer II (3) F *Prereq.: ME 7843 or equivalent.* Convection heat transfer.

7453 Advanced Heat Transfer III (3) S *Prereq.: consent of instructor.* Radiation heat transfer and advanced topics.

7533 Numerical Methods in Applied Mechanics (3) Computer methods used to solve engineering problems; advanced numerical methods.

7603 Advanced Experimental Methods (3) S *Prereq.: consent of instructor. 2 hrs. lecture; 3 hrs. lab.* Applied course in contemporary analog and digital laboratory tools and techniques.

7633 Advanced Engineering System Dynamics (3) *Prereq.: ME 4183 or equivalent.* Dynamic system modeling; bond graphs; state-determined systems; simulation;

controllability/observability.

7643 Advanced System Modeling (3) *Prereq.: ME 7633 or equivalent.* Mathematical models and dynamic behaviors of engineering systems in multi-energy domains; bond-graph modeling methods, simulations using contemporary software.

7673 Advanced Mechanical Systems Control (3) *Prereq.: ME 4183 or equivalent.* Design and analysis of nonlinear control systems; adaptive and robust control techniques; state estimation; stability theory; control and stability of distributed parameter systems.

7723 Materials Characterization Using Electron Beam Methods (3) *Prereq.: ME 2733. 2 hrs. lecture; 3 hrs. lab.* Theory and principles of electron optics, electron microscopy, and spectroscopy; preparation, observation, and characterization of materials by electron beams.

7733 Flow and Fracture in Solids (3) S *Prereq.: CE 4440 or equivalent.* Plastic deformation of single crystals and polycrystalline aggregates; theories of ductile and brittle fracture; internal friction; fatigue, creep and stress rupture; residual stresses; plastic forming of metals.

7743 Defects, Diffusion, and Transformations in Solids (3) S *Prereq.: ME 2733 or equivalent.* Defects and atomistic mechanisms, dislocation theory, quantitative description of diffusion processes and phase transformations in materials.

7753 Thermodynamics of Solid Materials (3) *Prereq.: ME 2733 and any first level course in Thermodynamics.* Review of first and second laws of thermodynamics; material property relationships; chemical equilibrium in reactions; solid solutions and phase diagram enunciations; reaction kinetics and non-equilibrium thermodynamics.

7763 Advanced Corrosion Science and Engineering (3) S *Prereq.: ME 4763 or equivalent.* Advanced topics in corrosion; stress corrosion, high temperature corrosion, hydrogen embrittlement, etc.; thermodynamics of surfaces and corrosion.

7813 Computation of Boundary Layer Flows and Heat Transfer (3) *Prereq.: ME 3834 and 4433 or equivalent, and ME 4533 or equivalent.* Finite-difference methods for the solution of parabolic or boundary layer equations; use of a computer program for two-dimensional boundary layers; wall boundary layers, jets and wakes, flows in pipes, annuli, nozzles, and diffusers.

7823 Computation of Fluid Flow and Heat Transfer (3) *Prereq.: ME 3834, 4433 and ME 4533; or equivalent.* Finite-difference methods for solving equations of fluid motions and energy; computer program used to solve complex problems involving fluid flow, heat transfer, and chemical reaction; mathematical models for turbulence, radiation, and combustion; their computing implications; application of prediction procedures for practical situations.

7833 Inviscid Fluid Flow (3) S *Prereq.: ME 7863 or equivalent.* Potential flow theory and gas dynamics; multidimensional compressible flow; computational gas dynamics.

7843 Viscous Fluid Flow (3) S *Prereq.: ME 7863 or equivalent.* Navier-Stokes equations; Stokes and Oseen approximations for low Reynolds number flows; incompressible laminar boundary layer theory; transition; turbulent boundary layers, compressibility effects, and numerical methods.

7853 Advanced Boundary Layer Theory (3) S *Prereq.: ME 7843 or equivalent.* NonNewtonian and turbulent fluid mechanics.

7863 Fluid Dynamics (3) F *Prereq.: credit or registration in MATH 4038 or equivalent.* Fluid dynamics as continuum mechanics; potential flow using complex variables in two dimensions and superposition in three dimensions; viscous flow and Navier-Stokes equations; compressible flow, including mach waves, shocks, and linearized aerodynamics.

7901 Seminar (1) *All graduate students are expected to attend this course every semester; only 1 sem. hr. of credit in this course allowed toward degree. Pass-fail grading.*

7903 Independent Study in Mechanical Engineering (3) *May be taken for a max. of 6 hrs. of credit.* Directed independent study for graduate students.

7933, 7943 Mechanical Engineering Problems (3,3)

7953 Advanced Topics in Mechanical Engineering (3) *May be taken for a max. of 6 hrs. of credit when topics vary, with consent of department.* Mechanical engineering treatment of various areas of interest.

8000 Thesis Research (1-12 per sem.) "S"/"U" grading.

9000 Dissertation Research (1-12 per sem.) "S"/"U" grading.