

MECHANICAL ENGINEERING (MCEN)

Courses

MCEN 1024 (4) Chemistry for Energy and Materials Science

Covers the basic physical and chemical fundamentals underlying the disciplines of energy and materials, with a focus on topics relevant to your mechanical engineering education. These fundamentals include atomic structure, stoichiometry, the periodic table, chemical bonding, states of matter, thermochemistry and chemical reactions. Department enforced prerequisite: one year of high school chemistry.

Equivalent - Duplicate Degree Credit Not Granted: CHEN 1211

Requisites: Restricted to Mechanical Engineering or students with a plan of Mechanical Engineering Concurrent Degree or General Engineering Plus students with a MCEN subplan.

Grading Basis: Letter Grade

Additional Information: Departmental Category: Materials

MCEN 1025 (4) Computer-Aided Design and Fabrication

Introduces CAD software and relevant concepts, including orthographic projection, sections, engineering drawing, geometric dimensioning and tolerancing, and an introduction to manufacturing methods. Final design project involves rapid prototyping.

Requisites: Restricted to Mechanical Engineering (MCEN) or Engineering Physics (EPEN) majors only.

Additional Information: Departmental Category: Design

MCEN 1208 (1-4) Special Topics in Mechanical Engineering

Subject matter to be selected from topics of current interest. Credit to be arranged.

Requisites: Restricted to students with 0-26 units (Freshmen) Mechanical Engineering (MCEN) majors only.

Additional Information: Departmental Category: Special Topics

MCEN 2000 (1) Mechanical Engineering as a Profession

Provides an introduction to the profession of mechanical engineering. Specific topics addressed include career opportunities in mechanical engineering, internship search skills, expectations for professional behavior in the classroom and in industry, and current events/ethics topics relevant to the field. Course format may include additional evening/weekend activities.

Requisites: Restricted to students with 27-180 credits (Sophomores, Juniors or Seniors) Mechanical Engineering (MCEN) majors only.

Grading Basis: Letter Grade

Additional Information: Departmental Category: Miscellaneous

MCEN 2023 (3) Statics and Structures

Covers statics of particles, equivalent force systems, rigid bodies, equilibrium of rigid bodies in two and three dimensions, analysis of truss and frame structures, uniaxially-loaded members, distributed force systems and friction.

Equivalent - Duplicate Degree Credit Not Granted: CVEN 2121 or GEEN 2851

Requisites: Requires prereqs of (APPM 1360 or MATH 2300) PHYS 1110 (all min grade C). Restricted to students w/ 27-180 credits (So/Jr/Sr) Mechanical (MCEN) or Environmental (EVEN) or General Engineering Plus (GEEN-BS) students with a sub-plan of Mechanical (MEC).

Additional Information: Departmental Category: Solids

MCEN 2024 (3) Materials Science

Provides an overview of the structure, properties and processing of metallic, polymeric and ceramic materials. Specific topics include perfect and imperfect solids, phase equilibria, transformation kinetics, mechanical behavior and material degradation. Approach incorporates both materials science and materials engineering components.

Requisites: Requires prereq course of MCEN 1024 or CHEN 1211 and CHEM 1221 or CHEM 1113 and 1114, and PHYS 1110 (min grade C). Restricted to students with 27-180 credits (Soph/Jrs/Srs) MECH or EVEN or GEEN-BS students, with a sub-plan of MEC.

Additional Information: Departmental Category: Materials

MCEN 2043 (3) Dynamics

Covers dynamic behavior of particle systems and rigid bodies; 2-D and 3-D kinematics and kinetics; impulse, momentum, potential, and kinetic energy; and work, collision, and vibration.

Requisites: Requires prerequisite courses of MCEN 2023 or CVEN 2121 or GEEN 2851 and APPM 1360 or MATH 2300 (all require minimum grade C). Restricted to students with 27-180 credits (Soph/Jrs/Srs) MECH or EVEN or GEEN-BS students, with a sub-plan of MEC.

Additional Information: Departmental Category: Solids

MCEN 2063 (3) Mechanics of Solids

Covers shear force and bending moment, torsion, stresses in beams, deflection of beams, matrix analysis of frame structures, analysis of stress and strain in 2-D and 3-D (field equations, transformations), energy methods, stress concentrations and columns.

Equivalent - Duplicate Degree Credit Not Granted: CVEN 3161

Requisites: Requires prereq courses of MCEN 2023 or CVEN 2121 or GEEN 2851 and APPM 1360 or MATH 2300 (all require min grade C). Restricted to students with 27-180 credits (Soph/Jrs/Srs) MECH or EVEN or GEEN-BS students, with a sub-plan of MEC.

Additional Information: Departmental Category: Solids

MCEN 3012 (3) Thermodynamics

Explores fundamental concepts and basic theory, including first and second laws of thermodynamics, properties, states, thermodynamic functions and cycles.

Equivalent - Duplicate Degree Credit Not Granted: GEEN 3852

Requisites: Requires prereq course of APPM 2350 or MATH 2400 (minimum grade C). Restricted to students with 27-180 credits (Soph, Jrs or Srs) Mechanical (MCEN) or Environmental (EVEN) or General Engr Plus (GEEN-BS) students, with a sub-plan of Mechanical (MEC).

Additional Information: Departmental Category: Thermal

MCEN 3017 (3) Circuits and Electronics

Introductory course covers analysis of electric circuits by use of Ohm's law, network reduction, node and loop analysis, Thevenin's and Norton's theorems, DC and AC signals, transient response of simple circuits, transfer functions, basic diode and transistor circuits and operational amplifiers.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 3010

Requisites: Requires prerequisite courses of APPM 2360 and PHYS 1140 (all minimum grade C). Restricted to students in the MSC/CU-Boulder Mechanical Engineering Partnership Program only.

Additional Information: Departmental Category: Miscellaneous

MCEN 3021 (3) Fluid Mechanics

Examines fundamentals of fluid flow with application to engineering problems. Topics covered include fluid statics and kinematics, Bernoulli equations, laminar and turbulent viscous boundary layers, laminar and turbulent pipe flow, and conservation equations for mass, momentum and energy.

Equivalent - Duplicate Degree Credit Not Granted: CHEN 3200 and CVEN 3313

Requisites: Requires prereq of MCEN2023 or CVEN2121 or GEEN2851 and APPM2350 or MATH2400. All require C or higher. Restricted to students with 27-180 credits (Soph/Jrs/Srs) MECH or EVEN or GEEN-BS students, with a sub-plan of MEC.

Additional Information: Departmental Category: Fluids

MCEN 3022 (3) Heat Transfer

Studies fundamentals of heat transfer by conduction, convection, and radiation. Emphasizes problem formulation and selection of appropriate solution techniques. Provides applications to modern engineering systems, which may include energy, biological, environmental, and materials engineering problems.

Requisites: Requires prereq courses of MCEN 3021 or CVEN 3313, and MCEN 3012 or AREN 2110 or GEEN 3852, and APPM 2360 or MATH 2130 and 3430 (all min grade C). Restricted to students with 57-180 credits (Jrs/Srs) MECH or EVEN or GEEN-BS students with sub-plan of MEC

Additional Information: Departmental Category: Thermal

MCEN 3025 (3) Component Design

Application of mechanics and materials science to the detailed design of various machine elements including shafts, bearings, gears, brakes, springs, and fasteners. Emphasizes application and open-ended design problems.

Requisites: Requires prereqs of MCEN 1025 and MCEN 2024 and MCEN 2063 (all minimum grade C). Restricted to students with 57-180 credits (Jrs/Srs) Mechanical (MCEN) or Environmental (EVEN) or General Engr Plus (GEEN-BS) students, with a sub-plan of Mechanical (MEC).

Additional Information: Departmental Category: Design

MCEN 3030 (3) Computational Methods

Studies fundamental numerical techniques for the solution of commonly encountered engineering problems. Includes methods for linear and nonlinear algebraic equations, data analysis, numerical differentiation and integration, ordinary and partial differential equations.

Requisites: Requires prerequisite courses of APPM 2360 and CHEN 1310 or CSCI 1300 or CSCI 1310 or CSCI 1320 (all minimum grade C). Restricted to students with 57-180 credits (Jrs/Srs) Mechanical or Environmental Engineering majors only.

Additional Information: Departmental Category: Math

MCEN 3032 (3) Thermodynamics 2

Offers advanced topics and applications for thermal system design and analysis. Topics include thermodynamics of state, entropy, thermodynamic cycles and reacting and nonreacting mixtures. Provides application to power generation, refrigeration and HVAC with conventional and advanced technologies. Most assignments are design oriented.

Requisites: Requires prerequisite courses of MCEN 3021 and MCEN 3012 or GEEN 3852 and APPM 2360 (all minimum grade C). Restricted to students with 57-180 credits (Junior/Senior) Mechanical or Environmental Engineering majors only.

Additional Information: Departmental Category: Thermal

MCEN 3047 (4) Data Analysis and Experimental Methods

Learn to plan and carry out experiments and analyze the results. Topics covered include measurement fundamentals, design of experiments, elementary statistics and uncertainty analysis. Topics in statistics include probability, error propagation, confidence intervals, hypothesis testing, linear regression, one- and two-factor ANOVA and time series analysis. Formerly MCEN 3037.

Equivalent - Duplicate Degree Credit Not Granted: GEEN 3853

Requisites: Prereq APPM2360 PHYS1140 MCEN2063. Prereq or Coreq (ECEN3010 or MCEN3017) (MCEN3030 APPM4650) and (WRTG3030 or WRTG3055 or HUEN1010 or HUEN3100) (min grade C). Restricted to 57-180 credits MCEN or EVEN or GEEN-BS students, with a sub-plan of MEC

Additional Information: Departmental Category: Miscellaneous

MCEN 3208 (1-4) Special Topics in Mechanical Engineering

Subject matter to be selected from topics of current interest.

Repeatable: Repeatable for up to 15.00 total credit hours.

Requisites: Requires prereq courses of APPM 2360 PHYS 1140 and prereq or coreq courses of ECEN 3010 and WRTG 3030 or WRTG 3035 or HUEN 1010 or 3100 (all min grade C). Restricted to students with 57-180 credits (Jrs/Srs) Mechanical Engineering (MCEN) majors only.

Additional Information: Departmental Category: Special Topics

MCEN 3930 (6) Mechanical Engineering Cooperative Education

Students enrolled in this course participate in a previously arranged, department-sponsored education program with a university, government agency, or industry. This course is offered only through Continuing Education.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: At least a 2.75 cumulative GPA is required. Restricted to Mechanical Engineering or students with a plan of Mechanical Engineering Concurrent Degree or General Engineering Plus students with a MCEN subplan.

Recommended: Prerequisite 3.00 GPA or higher.

Grading Basis: Pass/Fail

Additional Information: Departmental Category: Math

MCEN 4010 (3) Microsystems Integration

A microsystem consists of microelectronic, optoelectronic, microwave, microelectromechanical and energy components interconnected. Thermal, electrical, fabrication and assembly issues for microsystems represented by iPhone series will be studied. The packaging and interconnection technologies used to establish the design and manufacturing infrastructure of microsystems will be reviewed. Other optoelectronic, MEMS and batter components for microsystems will also be studied.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5010

Requisites: Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering (MCEN) majors only.

Grading Basis: Letter Grade

MCEN 4026 (3) Manufacturing Processes and Systems

Examines manufacturing processes for metals, polymers, and composites as well as manufacturing systems that integrate these processes. Lecture topics include forming, machining, joining, assembling, process integration, computer-aided manufacturing, and manufacturing system engineering.

Requisites: Requires prerequisite course of MCEN 2024 or GEEN 3024 (minimum grade C). Restricted to students with 57-180 credits (Jrs/Srs) Mechanical Engineering majors only.

Additional Information: Departmental Category: Manufacturing and Systems

MCEN 4032 (3) Sustainable Energy

Examines sustainability of our current energy systems, including transportation, using environmental and economic indicators. Uses systems analysis that addresses energy supply and demand. Explores the science and technology as well as environmental and economic feasibility of efficiency measures and renewable energy technologies. Additional emphasis is given to the global nature of the challenges and the potential for locally optimal solutions.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5032

Requisites: Requires prerequisite course of MCEN 3012 and MCEN 3022 (minimum grade C).

Grading Basis: Letter Grade

Additional Information: Departmental Category: Thermal

MCEN 4037 (2) Measurements Lab

Conduct experiments designed to introduce methods of experimentation and data analysis. Experiments taken from solid mechanics, fluid mechanics, thermal science and materials science. Emphasizes planning an experiment, applying sound scientific procedures, keeping proper records and communicating results orally and in written reports. Projects extend over two or more weeks.

Requisites: Requires prereq of MCEN 2063 3047 WRTG 3030 or 3035 or HUEN 1010 or 3100 (all min. grade C). Restricted to students with 57-180 credits (Jrs/Srs) MECH or EVEN or GEEN-BS students, with a sub-plan of MEC.

Additional Information: Departmental Category: Miscellaneous

MCEN 4043 (3) System Dynamics

Covers linear dynamic systems and mathematical tools for understanding them, input-output relationships, modeling templates, complex variables, Laplace transform, time-harmonic forcing and response, Fourier series and discrete Fourier transform, and coupled systems.

Requisites: Requires prereq courses of MCEN 2043 ECEN 3010 or MCEN 3017 APPM 2360 (min grade C) a prereq or coreq course of MCEN 3030. Restricted to students with 57-180 credits (Jrs or Srs) MCEN or GEEN-BS students, with a sub-plan of Mechanical (MEC).

Additional Information: Departmental Category: Solids

MCEN 4045 (3) Mechanical Engineering Design Project 1

First part of a two-course capstone design experience in mechanical engineering. Covers problem definition, determining design requirements, alternative design concepts, engineering analysis, proof-of-concept prototype and CAD drawings. Students make several oral design reviews, a final design presentation, and prepare a written report. GEEN-BS and GEEN-BSGE students are not required to complete MCEN 2000, MCEN 3022, MCEN 3030 or MCEN 4026 but have additional prerequisites of GEEN 1400, 2400 and 3400.

Requisites: Prereqs ECEN3010/CSCI1320/GEEN1400, APPM1350-2360, PHYS1110/1120/1140 MCEN2000/2024/2043/2063/3012/3021/3025 3030, min grd C. Pre or coreqs MCEN3022/3047/4026/4043, WRTG3030. Restricted to stdnts w 87-180 units, MCEN or GEEN stdnts w/ sub-plan ME

Additional Information: Departmental Category: Design

MCEN 4047 (2) Measurements 2

Emphasizes experiment planning, applying sound experimental procedures, using statistics, keeping proper records, and communicating results orally, visually, and through written reports. Projects extend over several weeks and relate to solid mechanics, acoustics, electronics, and/or other ME-related disciplines.

Requisites: Requires prerequisite courses of MCEN 2024 and MCEN 4037 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Miscellaneous

MCEN 4057 (3) Environmental Modeling

Enables students to develop and evaluate pollutant transport, fate, exposure, and risk models for air, water, and multi-media systems, with a special emphasis on air. Emphasizes the fundamental physics and chemistry that govern contaminant fate and transport and the basic mathematical equations and numerical approaches for describing these processes.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5057

Requisites: Requires prerequisite courses of CHEN 1211 or CHEM 1113 or MCEN 1024 and CSCI 1300 or CSCI 1320 (all minimum grade C).

Grading Basis: Letter Grade

Additional Information: Departmental Category: Miscellaneous

MCEN 4064 (3) Soft Machines

Introduces soft machines as a new paradigm of engineering that starts to impact healthcare, consumer electronics, renewable energy and collaborative robotics. Prepares students to participate in research on soft machines by starting with fundamentals of soft materials and by covering soft robotics, stretchable electronics, energy harvesting and functional polymers. Includes guest lectures, a literature review and a hands-on lab project.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5046 and MSEN 5046

Requisites: Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering (MCEN) majors only.

Grading Basis: Letter Grade

MCEN 4085 (3-4) Mechanical Engineering Design Project 2

Second part of a two-course capstone design experience in mechanical engineering. Includes refinement of prototype, design optimization, fabrication, testing, and evaluation. Students orally present the final design and prepare a written report and operation manual for the product. GEEN-BS and GEEN-BSEPL students are not required to complete MCEN 4026.

Requisites: Requires prereq of MCEN 4026, MCEN 4045 and WRTG 3030 or WRTG 3035 or HUEN 1010 or HUEN 3100 and prereq or coreq of MCEN 3022, 3047 and 4043 (all min grade C). Restricted to students with 87-180 units, MCEN or GEEN-BS students, with a sub-plan of MEC.

Additional Information: Departmental Category: Design

MCEN 4086 (1) Writing for Design Projects

Communicate professionally in writing to the technical and nontechnical audience. Develop skills to analyze rhetorical situations and compose documents, such as reports, technical manuals and user guides, that achieve a specific purpose and meet the needs of a particular audience. Writing with clarity, conciseness and correctness will be emphasized.

Requisites: Requires enrollment in corequisite course of MCEN 4085.

Grading Basis: Letter Grade

Additional Information: Departmental Category: Manufacturing and Systems

MCEN 4115 (3-4) Mechatronics and Robotics I

Focuses on design and construction of microprocessor-controlled electro-mechanical systems. Lectures review critical circuit topics, introduce microprocessor architecture and programming, discuss sensor and actuator component selection, robotic systems and design strategies for complex, multi-system devices. Lab work reinforces lectures and allows hands-on experience with robotic design. Students must design and build an autonomous robotic device. Project expenses may be incurred (\$50 maximum).

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5115

Requisites: Requires prerequisite courses of ECEN 3010 or 2250 and ECEN 1310 (formerly GEEN 1300/COEN 1300) or CSCI 1300 or 1310 or 1320 (all min grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Design

MCEN 4117 (3) Anatomy and Physiology for Engineers

Explores human physiological function from an engineering, specifically mechanical engineering, viewpoint. Provides an introduction to human anatomy and physiology with a focus on learning fundamental concepts and applying engineering (mass transfer, fluid dynamics, mechanics, modeling) analysis.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5117

Requisites: Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Miscellaneous

MCEN 4123 (3) Vibration Analysis

Highlights free and forced vibration of discrete and continuous systems. Examines Lagrange's equation, Fourier series, Laplace transforms, and matrix and computational methods. Applies knowledge to practical engineering problems.

Equivalent - Duplicate Degree Credit Not Granted: ASEN 4123

Requisites: Requires prerequisite course of MCEN 3030 or ASEN 3112 (minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Solids

MCEN 4124 (3) Mechanical Behavior of Materials

Addresses the relationship between material structure and the fundamental processes of deformation, yield, and fracture. Examines elements of elasticity theory, introduction to plasticity, and formulation of failure criteria. Studies basic deformation processes in terms of dislocation mechanics and macroscopic mechanical behavior. Takes into consideration the influence of compositional and processing strengthening mechanisms on mechanical properties.

Requisites: Requires prerequisite courses of MCEN 2024 and MCEN 2063 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Materials

MCEN 4125 (3) Optimal Design

Focuses on linear optimization and will introduce non-linear optimization. Formulating Engineering applications as optimization problems that can be solved using industry known solvers will be learned. Some of these applications will include minimum cost mechanical design, wind farm power maximization, minimum energy control, production control, and more. Previous programming experience required.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5125

Requisites: Requires prerequisite courses of MCEN 3030 (all minimum grade C). Restricted to students with 57-180 credits (Junior, Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Design

MCEN 4127 (3) Biomedical Ultrasound

Covers the design of ultrasound systems for medical imaging and therapy, including the physics of wave propagation, transducers, acoustic lenses, pulse-echo imaging and cavitation dynamics, with an emphasis on current topics in biomedical ultrasound. Includes lectures on theory, practice and special topics; a laboratory on wave propagation; oral presentations on current literature; and a design project.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5127

Requisites: Requires prerequisite course of MCEN 3021 (minimum grade C). Restricted to students with 57-180 credits (juniors/seniors).

Grading Basis: Letter Grade

Additional Information: Departmental Category: Miscellaneous

MCEN 4131 (3) Air Pollution Control Engineering

Introduces air quality regulations, meteorology and modeling. Examines methods for controlling major classes of air pollutants, including particulate matter and oxides of sulfur and nitrogen, as well as control technology for industrial sources and motor vehicles. Requires interdisciplinary design projects.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5131

Requisites: Requires prerequisite courses of MCEN 3012 and MCEN 3021 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical or Environmental Engineering majors only.

Additional Information: Departmental Category: Fluids

MCEN 4133 (3) Biomechanics

Focuses on developing an understanding of the fundamental mechanical principles that govern the response of hard and soft biological tissue to mechanical loading. Specifically, covers mechanical behavior of biological materials/tissues, classical biomechanics problems in various tissues, the relationship between molecular, cellular and physiological processes and tissue biomechanics and critical analysis of related journal articles.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5133

Requisites: Requires prerequisite courses of MCEN 2024, MCEN 2063 and MCEN 3021 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Materials

MCEN 4135 (3) Wind Energy and Wind Turbine Design

Focuses on understanding and applying principles related to current wind energy technology. Students will apply technical coursework from throughout the ME curriculum (fluids, dynamics, circuits, economics) to the process of designing a wind turning and determining whether their proposal is feasible from an economic standpoint.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5135

Requisites: Requires prerequisite courses of MCEN 3021 and ECEN 3010 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical or Environmental Engineering majors only.

Additional Information: Departmental Category: Design

MCEN 4137 (3) Anatomy and Physiology 2

Provides in-depth understandings of anatomy and physiology as well as introductions to transport phenomena, flow mechanics and solid mechanics in several organ systems: the cardiovascular, pulmonary, kidney, endocrine and digestive systems. Introduces artificial physiological systems to replace or assist physiological functions and introduce the concepts of physiological barriers that prevent diagnosis or effective therapeutics.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5137

Requisites: Requires prerequisite course of MCEN 4117 (minimum grade C). Restricted to students with 57-180 credits (juniors/seniors).

Grading Basis: Letter Grade

Additional Information: Departmental Category: Miscellaneous

MCEN 4141 (3) Indoor Air Pollution

Describes the impact of indoor air pollutants on human health, including an introduction to key pollutants and their sources. Students will estimate emission factors, calculate generation/ventilation rates, quantify the impact of deposition and chemical reactions and explore relevant control technology. Current issues will also be addressed, including climate change, green building design, economic concerns and relevance to the developing world.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5141

Requisites: Requires prerequisite courses of MCEN 3021 and MCEN 3022 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Fluids

MCEN 4151 (3) Flow Visualization

Explores techniques for the visualization of the physics of fluid flows including seeding with dyes, particles and bubbles, and shadowgraphy and schlieren. Reviews optics and fluid physics, especially atmospheric clouds. Assignments are student-driven, to individuals and mixed teams of graduates, undergraduates, engineering majors and photography/video majors.

Equivalent - Duplicate Degree Credit Not Granted: ARTF 5200, CINE 4200, MCEN 5151, ATLS 4151 and ATLS 5151

Requisites: Requires prerequisite course of MCEN 3021 (minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Arts Sci Gen Ed: Distribution-Arts Humanities
Departmental Category: Fluids

MCEN 4152 (3) Introduction to Combustion

Focuses on the mechanisms by which fuel and oxidizers are converted into combustion products. Application to practical combustion devices such as Otto, Diesel, gas turbine and power plant combustion systems. Consideration of combustion-generated air pollution, fire safety and combustion efficiency.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5152

Requisites: Requires prerequisite course of MCEN 3012 (minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Recommended: Prerequisites MCEN 3021 and MCEN 3022.

Additional Information: Departmental Category: Thermal

MCEN 4154 (3) Biocolloids and Biomembranes

Covers the thermodynamics and mechanics of biological membranes and biomedical colloids. Considers intermolecular and surface forces, self-assembly and colloidal stability. Addresses structure-property relationships and design principles for biomedical applications. Focuses on monolayers, bilayers, micelles, filomicelles, liposomes, polymersomes, emulsions, microbubbles, polyplexes and polyelectrolyte multilayer capsules.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5154

Requisites: Requires prerequisite courses of APPM 2360 and PHYS 1120 (all minimum grade C). Restricted to students with 57-180 credits (juniors/seniors).

Grading Basis: Letter Grade

Additional Information: Departmental Category: Materials

MCEN 4162 (3) Energy Conversion

Examines common energy-conversion methods and devices. Topics include power-cycle thermodynamics, turbocompressor and expander processes, combustion systems, and applications and limitations of direct energy-conversion systems.

Requisites: Requires prerequisite course of MCEN 3012 (minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Thermal

MCEN 4173 (3) Finite Element Analysis

Introduces the theory behind and applications of the finite element method as a general and powerful tool to model a variety of phenomena in mechanical engineering. Applications include structural mechanics, mechanics of elastic continua and heat conduction.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5173

Requisites: Requires prerequisite courses of MCEN 2023 and MCEN 2063 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Solids

MCEN 4174 (3) Failure of Engineering Materials

Examines the fundamental concepts regarding the failure of engineering materials. Case studies are used to integrate a basic understanding of material failure mechanisms with analysis techniques and tools. Topics include the elastic properties (isotropic and anisotropic materials) and the origin of elastic behavior, viscoelasticity, plasticity (dislocation mechanisms, yielding criteria, strengthening mechanisms), creep, fracture and fatigue.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5174

Requisites: Requires prerequisite courses of MCEN 2024 and MCEN 2063 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Materials

MCEN 4183 (3) Mechanics of Composite Materials

Introduces various kinds of composite materials, composite fabrication techniques, the physical and mechanical behavior of composites, and analytical and experimental methodologies.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5183

Requisites: Requires prerequisite courses of MCEN 2024 and MCEN 2063 (all minimum grade C). Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Solids

MCEN 4194 (3) Electrochemical Energy Conversion and Storage

Presents the fundamentals, principles and experimental techniques of electrochemistry, the background of ionic or electronic conduction of metal, semiconductor, inorganic and polymer materials and applications in the areas of batteries, fuel cells, electrochemical double layer capacitors, electrochemical photonics, sensors and semiconductor electrochemistry.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5194

Requisites: Requires prereq courses of MCEN 2024 and 3032 (all min grade C). Restricted to graduate students or to students with 87-180 credits (Seniors) in the College of Engineering and Applied Science or to Mech Engr Concurrent Degree students only.

Grading Basis: Letter Grade

Additional Information: Departmental Category: Materials

MCEN 4228 (1-4) Special Topics in Mechanical Engineering

Subject matter to be selected from topics of current interest.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 5228

Repeatable: Repeatable for up to 15.00 total credit hours. Allows multiple enrollment in term.

Requisites: Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Miscellaneous

MCEN 4848 (1-6) Independent Study

Subjects arranged in consultation with instructor and undergraduate advisor. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Requisites: Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical Engineering majors only.

Additional Information: Departmental Category: Miscellaneous

MCEN 5010 (3) Microsystems Integration

A microsystem consists of microelectronic, optoelectronic, microwave, microelectromechanical and energy components interconnected.

Thermal, electrical, fabrication and assembly issues for microsystems represented by iPhone series will be studied. The packaging and interconnection technologies used to establish the design and manufacturing infrastructure of microsystems will be reviewed. Other optoelectronic, MEMS and batter components for microsystems will also be studied.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4010

Requisites: Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical (MCEN) majors or College of Engineering graduate students only.

Grading Basis: Letter Grade

MCEN 5020 (3) Methods of Engineering Analysis 1

Studies selected topics from linear algebra, ordinary differential equations, and Fourier series. Assigns computer exercises. Correlates with analysis topics in other mechanical engineering graduate courses, and emphasizes applications.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Math

MCEN 5021 (3) Introduction to Fluid Dynamics

Focuses on physical properties of gases and liquids, and kinematics of flow fields. Analyzes stress; viscous, heat-conducting Newtonian fluids; and capillary effects and surface-tension-driven flow. Other topics include vorticity and circulation, ideal fluid flow theory in two and three dimensions, Schwartz-Christoffel transformations, free streamline theory, and internal and free-surface waves.

Requisites: Requires corequisite course of MCEN 5020. Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Fluids

MCEN 5022 (3) Classical Thermodynamics

First and second laws of thermodynamics. Entropy and availability. Cycle analysis. Thermodynamic properties of pure substances and mixtures. Property relations. Chemical reactions and chemical availability. Energy systems analysis.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Thermal

MCEN 5023 (3) Solid Mechanics 1

Introduces stress, strain and motion of a continuous system. Discusses material derivative; fundamental laws of mass, momentum, energy and entropy; constitutive equations and applications to elastic and plastic materials.

Equivalent - Duplicate Degree Credit Not Granted: ASEN 5012

Requisites: Requires coreq course of MCEN 5020. Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering (MCEN) majors only.

Additional Information: Departmental Category: Solids

MCEN 5024 (3) Materials Chemistry and Structures

Provides graduate level students with a comprehensive overview of the chemistry and structure of material systems, with a focus on chemical bonding., the resulting material structures and their properties. This course is intended to become one of the four core courses offered in the new Materials Science curriculum. Course topics include: bonding in solids, crystalline and amorphous states, basic group theory, diffraction, metals and alloys, ceramics, and an intro to mat. characterization.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Materials

MCEN 5027 (1) Graduate Seminar

Offers weekly presentations by visiting speakers, faculty, and students.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Grading Basis: Pass/Fail

Additional Information: Departmental Category: Miscellaneous

MCEN 5032 (3) Sustainable Energy

Examines sustainability of our current energy systems, including transportation, using environmental and economic indicators. Uses systems analysis that addresses energy supply and demand. Explores the science and technology as well as environmental and economic feasibility of efficiency measures and renewable energy technologies. Additional emphasis is given to the global nature of the challenges and the potential for locally optimal solutions.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4032

Grading Basis: Letter Grade

Additional Information: Departmental Category: Thermal

MCEN 5034 (3) Thermodynamics of Materials

Provides a unified presentation of fundamental concepts applicable to the thermodynamics of engineering materials. Develops quantitative tools for understanding the physical principles that govern phase equilibrium and transformation. Generates binary and ternary phase diagrams and determine the resulting materials structures and corresponding physical and mechanical properties.

Recommended: Prerequisites MCEN 2024 and MCEN 3012.

Additional Information: Departmental Category: Materials

MCEN 5040 (3) Methods of Engineering Analysis 2

Studies selected topics from the theory of complex variables, integral transform methods, partial differential equations, and variational methods. Assigns computer exercises. Correlates with analysis topics in other mechanical engineering graduate courses, and emphasizes applications.

Requisites: Requires prerequisite course of MCEN 5020 (minimum grade D-). Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Math

MCEN 5041 (3) Advanced Fluid Mechanics 1

Highlights exact solution of Navier-Stokes equations and fundamentals of rotating fluids. Considers Low Reynolds number flow; similarity solutions; viscous boundary layers, jets, and wakes; and unsteady viscous flow.

Requisites: Requires corequisite course of MCEN 5020. Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Fluids

MCEN 5042 (3) Heat Transfer

Studies development of equations governing transport of heat by conduction, convection, and radiation, and their solution. Includes analytical and numerical solution of initial and boundary value problems representative of heat conduction in solids. Describes heat transfer in free and forced convection, including laminar and turbulent flow. Also involves radiation properties of solids, liquids, and gases and transport of heat by radiation.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Thermal

MCEN 5044 (3) Mechanical Behavior of Materials

This introductory-level graduate course incorporates relevant aspects of materials science, solid mechanics, thermodynamics and mathematics, and applies them to achieve a fundamental understanding of the mechanical behavior of crystalline and non-crystalline engineering materials.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering (MCEN) majors only.

Additional Information: Departmental Category: Materials

MCEN 5045 (3) Design for Manufacturability

Topics include general design guidelines for manufacturability; aspects of manufacturing processes that affect design decisions; design rules to maximize manufacturability; economic considerations; value engineering and design for assembly. Presents case studies of successful products exhibiting DFMA principles. Priority enrollment for students admitted to the MS or BS/MS design track. Prerequisite of MCEN 4026 required for undergraduate students.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering (MCEN) majors only.

Additional Information: Departmental Category: Materials

MCEN 5055 (3) Advanced Product Design

Introduces engineering design and development of consumer products. Includes learning sketching, brainstorming, idea generation, design thinking, user-centered design, product requirements and specifications, product constraints, human factors, aesthetics, industrial design, intellectual property, concept prototyping, idea selection, tolerancing, cost estimating, design for assembly, and materials selection. Entails a semester-long team re-design of a consumer product.

Additional Information: Departmental Category: Design

MCEN 5057 (3) Environmental Modeling

Enables students to develop and evaluate pollutant transport, fate, exposure, and risk models for air, water, and multi-media systems, with a special emphasis on air. Emphasizes the fundamental physics and chemistry that govern contaminant fate and transport and the basic mathematical equations and numerical approaches for describing these processes.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4057

Grading Basis: Letter Grade

Additional Information: Departmental Category: Miscellaneous

MCEN 5064 (3) Soft Machines

Introduces soft machines as a new paradigm of engineering that starts to impact healthcare, consumer electronics, renewable energy and collaborative robotics. Prepares students to participate in research on soft machines by starting with fundamentals of soft materials and by covering soft robotics, stretchable electronics, energy harvesting and functional polymers. Includes guest lectures, a literature review and a hands-on lab project.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4046 and MSEN 5046

Requisites: Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical (MCEN) majors or College of Engineering graduate students only.

Grading Basis: Letter Grade

MCEN 5065 (3) Graduate Design I

First part of a two-course graduate product design experience in mechanical engineering. Covers problem definition and specifications, determining design requirements, user feedback, alternative design concepts, engineering analysis, concept prototypes and CAD drawings. Students make several oral design reviews, a final design presentation and prepare a written report. Entails a team product design, fabrication and testing cycle of sponsored project.

Requisites: Requires prerequisite course of MCEN 5055 (minimum grade C).

Grading Basis: Letter Grade

Additional Information: Departmental Category: Design

MCEN 5075 (3) Graduate Design II

Second part of two-course graduate product design experience in mechanical engineering. Includes refinement of prototype, design optimization, fabrication, testing, and evaluation. Students orally present the final design and prepare a written report and operation manual for the product. Entails a team product design, fabrication, and testing cycle of a sponsored project, leading to a fully-functional product.

Requisites: Requires prerequisite course of MCEN 5065 (minimum grade C-).

Grading Basis: Letter Grade

Additional Information: Departmental Category: Design

MCEN 5115 (3) Mechatronics and Robotics I

Focuses on design and construction of microprocessor-controlled electro-mechanical systems. Lectures review critical circuit topics, introduce microprocessor architecture and programming, discuss sensor and actuator component selection, robotic systems and design strategies for complex, multi-system devices. Lab work reinforces lectures and allows hands-on experience with robotic design. Students must design and build an autonomous robotic device. Project expenses may be incurred (\$50 maximum).

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4115

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Design

MCEN 5117 (3) Anatomy and Physiology for Engineers

Explores human physiological function from an engineering, specifically mechanical engineering, viewpoint. Provides an introduction to human anatomy and physiology with a focus on learning fundamental concepts and applying engineering (mass transfer, fluid dynamics, mechanics, modeling) analysis.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4117

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Miscellaneous

MCEN 5121 (3) Compressible Flow

Applies energy, continuity, and momentum principles to compressible flow. Topics include normal and oblique shocks; Prandtl-Meyer expansion; methods of characteristics; and one-, two-, and three-dimensional subsonic, supersonic, and hypersonic flows.

Requisites: Requires prerequisite course of MCEN 5021 (minimum grade D-). Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Fluids

MCEN 5122 (3) Statistical Thermodynamics

Axiomatic formulation of macroscopic thermodynamics. Quantum mechanical description of atomic and molecular structure. Statistical mechanics description of thermodynamic properties of gases, liquids and solids. Elementary kinetic theory of gases and evaluation of transport properties. Department enforced requisite: undergraduate thermodynamics.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Thermal

MCEN 5125 (3) Optimal Design

This course focuses on linear optimization and will introduce non-linear optimization. Formulating engineering applications as optimization problems that can be solved using industry known solvers will be learned. Some of these applications will include minimum cost mechanical design, wind farm power maximization, minimum energy control, production control, and more. Previous programming experience required.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Design

MCEN 5127 (3) Biomedical Ultrasound

Covers the design of ultrasound systems for medical imaging and therapy, including the physics of wave propagation, transducers, acoustic lenses, pulse-echo imaging and cavitation dynamics, with an emphasis on current topics in biomedical ultrasound. Includes lectures on theory, practice and special topics; a laboratory on wave propagation; oral presentations on current literature; and a design project.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4127

Requisites: Restricted to graduate students only.

Grading Basis: Letter Grade

Additional Information: Departmental Category: Miscellaneous

MCEN 5131 (3) Air Pollution Control Engineering

Introduces air quality regulations, meteorology and modeling. Examines methods for controlling major classes of air pollutants, including particulate matter and oxides of sulfur and nitrogen, as well as control technology for industrial sources and motor vehicles. Requires interdisciplinary design projects.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4131

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Fluids

MCEN 5133 (3) Biomechanics

Focuses on developing an understanding of the fundamental mechanical principles that govern the response of hard and soft biological tissue to mechanical loading. Specifically, covers mechanical behavior of biological materials/tissues, classical biomechanics problems in various tissues, the relationship between molecular, cellular and physiological processes and tissue biomechanics and critical analysis of related journal articles.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4133

Additional Information: Departmental Category: Materials

MCEN 5135 (3) Wind Energy and Wind Turbine Design

Focuses on understanding and applying principles related to current wind energy technology. Students will apply technical coursework from throughout the ME curriculum (fluids, dynamics, circuits, economics) to the process of designing a wind turning and determining whether their proposal is feasible from an economic standpoint.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4135

Requisites: Restricted to Mechanical (MCEN), Civil (CVEN) or Aerospace (ASEN) Engineering graduate students only.

Additional Information: Departmental Category: Design

MCEN 5137 (3) Anatomy and Physiology 2

Provides in-depth understandings of anatomy and physiology as well as introductions to transport phenomena, flow mechanics and solid mechanics in several organ systems: the cardiovascular, pulmonary, kidney, endocrine and digestive systems. Introduces artificial physiological systems to replace or assist physiological functions and introduce the concepts of physiological barriers that prevent diagnosis or effective therapeutics.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4137

Grading Basis: Letter Grade

Additional Information: Departmental Category: Miscellaneous

MCEN 5141 (3) Indoor Air Pollution

Describes the impact of indoor air pollutants on human health, including an introduction to key pollutants and their sources. Students will estimate emission factors, calculate generation/ventilation rates, quantify the impact of deposition and chemical reactions and explore relevant control technology. Current issues will also be addressed, including climate change, green building design, economic concerns and relevance to the developing world.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4141

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Fluids

MCEN 5147 (3) Mechanobiology

Studies how mechanical forces modulate the morphological and structural fitness of biological tissues. Current molecular mechanisms by which cells convert mechanical stimulus into chemical activity and the literature supporting them will be discussed. Students will acquire an understanding and expertise from the analysis of primary literature and completion of a synthesis project.

Requisites: Restricted to students with 87-180 credits (Senior, Fifth Year Senior) Mechanical (MCEN) majors or College of Engineering graduate students only.

Grading Basis: Letter Grade

MCEN 5151 (3) Flow Visualization

Explores techniques for the visualization of the physics of fluid flows including seeding with dyes, particles and bubbles, and shadowgraphy and schlieren. Reviews optics and fluid physics, especially atmospheric clouds. Assignments are student-driven, to individuals and mixed teams of graduates, undergraduates, engineering majors and photography/video majors.

Equivalent - Duplicate Degree Credit Not Granted: CINE 4200, MCEN 4151, ARTF 5200, ATLS 4151 and ATLS 5151

Additional Information: Departmental Category: Fluids

MCEN 5152 (3) Introduction to Combustion

Focuses on the mechanisms by which fuel and oxidizers are converted into combustion products. Application to practical combustion devices such as Otto, Diesel, gas turbine and power plant combustion systems. Consideration of combustion-generated air pollution, fire safety and combustion efficiency.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4152

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Thermal

MCEN 5154 (3) Biocolloids and Biomembranes

Covers the thermodynamics and mechanics of biological membranes and biomedical colloids. Considers intermolecular and surface forces, self-assembly and colloidal stability. Addresses structure-property relationships and design principles for biomedical applications. Focuses on monolayers, bilayers, micelles, filomicelles, liposomes, polymersomes, emulsions, microbubbles, polyplexes and polyelectrolyte multilayer capsules.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4154

Recommended: Prerequisites APPM 2360 and PHYS 1120.

Grading Basis: Letter Grade

Additional Information: Departmental Category: Materials

MCEN 5161 (3) Aerosols

Introduces atmospheric aerosols and properties of their distributions, followed by fundamental descriptions of single particle dynamics, thermodynamics, nucleation, coagulation, mass transfer and populations dynamics. During the second half of the course, the focus will shift to sources and sinks of atmospheric aerosols, their impacts on atmospheric chemistry and radiation, and the impacts of these processes on air quality and climate.

Requisites: Restricted to graduate students only.

Additional Information: Departmental Category: Fluids

MCEN 5173 (3) Finite Element Analysis

Introduces the theory behind and applications of the finite element method as a general and powerful tool to model a variety of phenomena in mechanical engineering. Applications include structural mechanics, mechanics of elastic continua and heat conduction.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4173

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Solids

MCEN 5174 (3) Failure of Engineering Materials

Examines the fundamental concepts regarding the failure of engineering materials. Case studies are used to integrate a basic understanding of material failure mechanisms with analysis techniques and tools. Topics include the elastic properties (isotropic and anisotropic materials) and the origin of elastic behavior, viscoelasticity, plasticity (dislocation mechanisms, yielding criteria, strengthening mechanisms), creep, fracture and fatigue.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4174

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Materials

MCEN 5183 (3) Mechanics of Composite Materials

Introduces various kinds of composite materials, composite fabrication techniques, the physical and mechanical behavior of composites, and analytical and experimental methodologies.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4183

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Solids

MCEN 5194 (3) Electrochemical Energy Conversion and Storage

Presents the fundamentals, principles and experimental techniques of electrochemistry, the background of ionic or electronic conduction of metal, semiconductor, inorganic and polymer materials and applications in the areas of batteries, fuel cells, electrochemical double layer capacitors, electrochemical photonics, sensors and semiconductor electrochemistry.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4194

Recommended: Prerequisites MCEN 2024 and MCEN 3032.

Grading Basis: Letter Grade

Additional Information: Departmental Category: Materials

MCEN 5208 (1-4) Special Topics

Credit hours and subject matter to be arranged.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Grading Basis: Pass/Fail

Additional Information: Departmental Category: Miscellaneous

MCEN 5228 (1-4) Special Topics in Mechanical Engineering

Subject matter to be selected from topics of current interest.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 4228

Repeatable: Repeatable for up to 15.00 total credit hours. Allows multiple enrollment in term.

Requisites: Restricted to graduate students in College of Engineering and Applied Science or to students with 57-180 credits (Junior or Senior) or Mechanical Engineering Concurrent Degree students.

Additional Information: Departmental Category: Miscellaneous

MCEN 5255 (3) Design for Mfg

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Design

MCEN 5258 (1-3) Sp Tpcs-Combustion Seminar

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Special Topics

MCEN 5636 (3) Micro-Electro-Mechanical Systems 1

Addresses issues of micro-electro-mechanical systems (MEMS) modeling, design, and fabrication. Emphasizes the design and fabrication of sensors and actuators due to significance of these devices in optics, medical instruments, navigation components, communications, and robotics. Department consent required.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Manufacturing and Systems

MCEN 5832 (3) Special Topics

Additional Information: Departmental Category: Special Topics

MCEN 5848 (1-6) Independent Study

Available only through approval of graduate advisor. Subjects arranged to fit the needs of the particular student. May be repeated for up to 6 total credits.

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Requisites: Restricted to College of Engineering graduate students only.

Additional Information: Departmental Category: Miscellaneous

MCEN 5858 (1-6) Independent Study

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: Miscellaneous

MCEN 5868 (1-3) Independent Study

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: Miscellaneous

MCEN 5878 (1-3) Independent Study

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: Miscellaneous

MCEN 5888 (1-3) Independent Study

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: Miscellaneous

MCEN 6001 (3) Reacting Flows

Provides an introduction to reacting flows and combustion. Covers chemical kinetics, including global and detailed mechanisms and the variable density flow equations are derived. Relevant non-dimensional parameters and limiting behaviors are discussed. The Rankine-Hugoniot relations are presented and various aspects of diffusion, kinetically dominated and balanced combustion are outlined. Flame structures are discussed, including laminar and turbulent flames, and the Burke-Schumann solution is outlined. The turbulent forms of the motion equations are derived, and the reactive scalar transport equation and mixture fraction variable are presented. The flamelet progress variable approach is outlined, including a comparison of steady and unsteady flamelet models. Specific topics in spray combustion, triple flames, solid-gas reactors and detonations are discussed.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 6001

Requisites: Requires prerequisite course of MCEN 5021 (minimum grade C-). Restricted to College of Engineering and Applied Science graduate students or BS/MS Concurrent Degree Students only.

Grading Basis: Letter Grade

Additional Information: Departmental Category: Fluids

MCEN 6184 (3) Structure and Properties of Polymers

Emphasizes the relationship between molecular structure and macroscopic properties. Structural aspects include chain conformation, configuration, and the crystalline and amorphous states. Discusses physical and mechanical properties with a focus on solution and phase behavior, transitions of bulk polymers, and rubber and viscoelastic behavior. Requires background in basic material science and polymer related concepts.

Requisites: Restricted to College of Engineering graduate students only.

Additional Information: Departmental Category: Materials

MCEN 6228 (3) Special Topics

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Special Topics

MCEN 6848 (1-6) Independent Study

Available only through approval of graduate advisor. Subjects arranged to fit the needs of the particular student.

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Requisites: Restricted to graduate students only.

Additional Information: Departmental Category: Miscellaneous

MCEN 6858 (1-6) Independent Study

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: Miscellaneous

MCEN 6868 (1-6) Independent Study

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: Miscellaneous

MCEN 6878 (1-6) Independent Study

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: Miscellaneous

MCEN 6888 (1-6) Independent Study

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: Miscellaneous

MCEN 6949 (1) Master's Candidate for Degree

Grading Basis: Pass/Fail

Additional Information: Departmental Category: Thesis

MCEN 6959 (1-6) Master's Thesis

Additional Information: Departmental Category: Thesis

MCEN 7221 (3) Turbulence

Hydrodynamic stability theory, equations for turbulent flows, free shear flows and boundary layers, homogeneous and isotropic turbulence, overview of turbulent combustion, reaction kinetics, energy equation, Favre averaging, Pdfs, premixed and nonpremixed flame modeling, and recent developments.

Requisites: Restricted to any College of Engineering and Applied Science graduate students or to Mechanical Engineering undergraduate majors only.

Additional Information: Departmental Category: Fluids

MCEN 7228 (3) Special Topics

Additional Information: Departmental Category: Special Topics

MCEN 8999 (1-10) Doctoral Thesis

Additional Information: Departmental Category: Thesis