MEEN - MECHANICAL ENGINEERING (MEEN)

MEEN 210 Geometric Modeling for Mechanical Design
Credits 2. 1 Lecture Hour. 2 Lab Hours.
Foundations of geometric modeling as applied to mechanical design through use of modern computer-aided design (CAD) and physical prototyping tools; basics of systematic design methodology; geometric visualization concepts: multiview orthographic, isometric, oblique, perspective; three-dimensional representations, surface and solid modeling; dimensioning and tolerancing; rapid prototyping using 3D printing.
Prerequisites: Mechanical engineering major; ENGR 111.

MEEN 221 Statics and Particle Dynamics
Credits 3. 3 Lecture Hours.
Application of the fundamental principles of Newtonian mechanics to the statics and dynamics of particles; equilibrium of trusses, frames, beams and other rigid bodies.
Prerequisites: For non-mechanical engineering majors; admission to an engineering major; MATH 251 or MATH 253 or registration therein; PHYS 218.

MEEN 222/MSEN 222 Materials Science
Credits 3. 3 Lecture Hours.
Mechanical, optical, thermal, magnetic and electrical properties of solids; differences in properties of metals, polymers, ceramics and composite materials in terms of bonding and crystal structure.
Prerequisites: CHEM 102, or CHEM 104 and CHEM 114, or CHEM 107 and CHEM 117; PHYS 218.
Cross Listing: MSEN 222/MEEN 222.

MEEN 225 Engineering Mechanics
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Application of the laws of classical mechanics to simplified, plausibly real world problems or interest to mechanical engineering, including the analysis of cables, frames, trusses, beams, machines and mechanisms.
Prerequisites: Mechanical engineering major; MATH 251 or MATH 253 or registration therein; PHYS 218.

MEEN 260 Mechanical Measurements
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Introduction to the basic principles of engineering experimentation including: instrumentation and measurement techniques, signal processing and data acquisition, statistical data analysis, and interpretation and reporting of results.
Prerequisites: MEEN 225, ECEN 215, MATH 308 and MEEN 315 or registration therein.

MEEN 285 Directed Studies
Credits 1 to 4. 1 to 4 Other Hours.
Directed studies in specific problem areas of mechanical engineering.
Prerequisites: MEEN classification; approval by instructor and department head or delegate.

MEEN 289 Special Topics in...
Credits 0 to 4. 0 to 4 Other Hours.
Selected topics in an identified area of mechanical engineering. May be repeated for credit.
Prerequisite: Approval of instructor.

MEEN 291 Research
Credits 1 to 4. 1 to 4 Other Hours.
Research conducted under the direction of faculty member in mechanical engineering. May be repeated 2 times for credit.
Prerequisites: Freshman or sophomore classification and approval of instructor.

MEEN 315 Principles of Thermodynamics
Credits 3. 3 Lecture Hours.
Theory and application of energy methods in engineering; conservation of mass and energy; energy transfer by heat, work and mass; thermodynamic properties; analysis of open and closed systems; the second law of thermodynamics and entropy; gas, vapor and refrigeration cycles.
Prerequisites: MEEN 225; MATH 251 or MATH 253; junior or senior classification.

MEEN 344 Fluid Mechanics
Credits 3. 3 Lecture Hours.
Application of laws of statics, buoyancy, stability, energy and momentum to behavior of ideal and real fluids; dimensional analysis and similitude and their application to flow through ducts and piping; lift and drag and related problems.
Prerequisites: MEEN 225 and MEEN 315.

MEEN 345 Fluid Mechanics Laboratory
Credit 1. 3 Lab Hours.
Introduction to basic fluid mechanics instrumentation; experimental verification and reinforcement of the analytical concepts introduced in MEEN 344.
Prerequisites: MEEN 260; MEEN 344 or registration therein.

MEEN 357 Engineering Analysis for Mechanical Engineers
Credits 3. 3 Lecture Hours.
Practical foundation for the use of numerical methods to solve engineering problems: Introduction to Matlab, error estimation, Taylor series, solution of non-linear algebraic equations and linear simultaneous equations; numerical integration and differentiation; initial value and boundary value problems; finite difference methods for parabolic and elliptic partial differential equations.
Prerequisites: ENGR 112 and MATH 308; MEEN 210 or concurrent enrollment.

MEEN 360 Materials and Manufacturing Selection in Design
Credits 3. 3 Lecture Hours.
Selecting materials and manufacturing processes in design; emphasis on material mechanical properties; microstructure production and control; manufacturing processes for producing various shapes for components and structures; use of design methodology.
Prerequisites: MEEN 210, MEEN 222/MSEN 222, MEEN 260; CVEN 305; junior or senior classification.

MEEN 361 Materials and Manufacturing in Design Laboratory
Credit 1. 3 Lab Hours.
Experiments in materials characterization and manufacturing processes; emphasis on material mechanical properties; microstructure production and control; manufacturing processes for producing various shapes for components and structures.
Prerequisites: MEEN 222/MSEN 222, MEEN 260; CVEN 305; MEEN 360 or registration therein; junior or senior classification or approval of instructor.
MEEN 363 Dynamics and Vibrations
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Dynamics and Vibration. Application of Newtonian and energy methods to model dynamic systems (particles and rigid bodies) with ordinary differential equations; solution of models using analytical and numerical approaches; interpreting solutions; linear vibrations.
Prerequisites: MEEN 225; MATH 308; MEEN 357 or concurrent enrollment; CVEN 305 or concurrent enrollment.

MEEN 364 Dynamic Systems and Controls
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Mathematical modeling, analysis, measurement and control of dynamic systems; extensions of modeling techniques of MEEN 363 to other types of dynamic systems; introduction to feedback control, time and frequency domain analysis of control systems, stability, PID control, root locus; design and implementation of computer-based controllers in the lab.
Prerequisites: MEEN 260 and MEEN 363; ECEN 215.

MEEN 368 Solid Mechanics in Mechanical Design
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Stress analysis of deformable bodies and mechanical elements; stress transformation; combined loading; failure modes; material failure theories; fracture and fatigue; deflections and instabilities; thick cylinders; curved beams; design of structural/mechanical members; design processes.
Prerequisites: CVEN 305; MEEN 357 and MEEN 360 or registration therein; junior or senior classification.

MEEN 381 Seminar
Credit 1. 2 Other Hours.
Presentations by practicing engineers and faculty addressing: effective communications, engineering practices, professional registration, ethics, career-long competence, contemporary issues, impact of technology on society and being informed; preparation of a resume, a lifelong learning plan, two papers, two oral presentations and complete an online assessment of the mechanical engineering program.
Prerequisite: Upper-level classification in mechanical engineering.

MEEN 399 High Impact Experience for Mechanical Engineers
Credits 0. 0 Other Hours.
Participation in an approved high-impact learning practice; reflection on professional outcomes from engineering body of knowledge; documentation and self-assessment of learning experience at mid-curriculum point.
Prerequisite: Junior or senior classification.

MEEN 401 Introduction to Mechanical Engineering Design
Credits 3. 2 Lecture Hours. 3 Lab Hours.
The design innovation process; need definition, functional analysis, performance requirements and evaluation criteria, conceptual design evaluation, down-selected to an embodiment; introduction to systems and concurrent engineering; parametric and risk analysis, failure mode analysis, material selection, and manufacturability; cost and life cycle issues, project management.
Prerequisites: MEEN 360, MEEN 361, MEEN 364, MEEN 368, MEEN 461.

MEEN 402 Intermediate Design
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Product detail design and development process including case studies; project management, marketing considerations, manufacturing, detailed design specifications; failure modes, application of codes and standards, selection of design margins; product (component) development guidelines; intellectual property, product liability and ethical responsibility.
Prerequisites: MEEN 401; junior or senior classification.

MEEN 404 Engineering Laboratory
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Systematic design of experimental investigations; student teams identify topics and develop experiment designs including: establishing the need; functional decomposition; requirements; conducting the experiment; analyzing and interpreting the results and written and oral reports documenting the objectives, procedure, analysis, and results and conclusion of two or three experiments.
Prerequisites: MEEN 260, MEEN 360, MEEN 361, MEEN 364 and MEEN 461; MEEN 401 or registration therein; junior or senior classification.

MEEN 408 Introduction to Robotics
Credits 3. 3 Lecture Hours.
Forward and inverse kinematics of robot manipulators, path planning, motion planning for mobile robots, dynamics of robot manipulators, control algorithms; computed torque algorithm, adaptive control algorithms and current topics in mobile robots; cooperative motion planning of mobile robots and formation control.
Prerequisites: MEEN 364 or equivalent; junior or senior classification.

MEEN 410 Internal Combustion Engines
Credits 3. 3 Lecture Hours.
Thermodynamics of cycles for internal combustion engines and gas turbines, including fuels and combustion; performance characteristics of various types of engines.
Prerequisite: MEEN 344 or equivalent or approval of instructor.

MEEN 411 Mechanical Controls
Credits 3. 3 Lecture Hours.
Application of classical and modern control theory techniques to modeling, analysis and synthesis of linear, mechanical control systems.
Prerequisite: MEEN 364.

MEEN 414 Principles of Turbomachinery
Credits 3. 3 Lecture Hours.
Aero-thermodynamic and mechanical design of turbomachinery components including steam and gas turbine stages, compressor stages, and inlet and exhaust systems, and their integration into power and thrust generation units; design and off-design behaviors of turbine and compressor stages and units; design with SolidWorks.
Prerequisites: MEEN 421 or approval of instructor; junior or senior classification.

MEEN 417/NUEN 417 Basics of Plasma Engineering and Applications
Credits 3. 3 Lecture Hours.
Basic plasma properties and confinement techniques; single particle orbits in electric and magnetic fields, moments of Boltzmann equation and introduction to fluid theory; wave phenomena in plasmas and introduction to plasma kinetic theory; analysis of laboratory plasmas and plasma applications including fusion, electric propulsion, materials processing and plasmas enhanced chemistry.
Prerequisites: PHYS 208 or equivalent; senior classification in nuclear, mechanical or aerospace engineering, physics, or approval of instructor.
Cross Listing: NUEN 417/MEEN 417.
MEEN 421 Thermal-Fluids Analysis and Design  
Credits 3. 3 Lecture Hours.  
Integration of thermodynamics, fluid mechanics and heat transfer through application to the design of various thermal systems comprised of several components requiring individual analyses; analysis of the entire system; representative applications of thermal-fluids analysis with a design approach.  
Prerequisites: MEEN 461; MEEN 315; junior or senior classification.

MEEN 430 Nanomaterials  
Credits 3. 3 Lecture Hours.  
Fundamentals of nanotechnology, including nanomaterials, types of nanomaterials, fabrication, characterization methods, and applications; explore current roles in technology and future impact on such systems on industry.  
Prerequisites: Junior or senior classification and approval of instructor.

MEEN 431 Advanced System Dynamics and Controls  
Credits 3. 3 Lecture Hours.  
Unified framework for modeling, analysis, synthesis, design and simulation of mechanical systems with energy exchange across multiple domains; study of mechanical, electrical, hydraulic and thermal subsystems; Newtonian mechanics, rigid body dynamics, multiple degrees of freedom vibrations and control system design.  
Prerequisites: MEEN 364; junior or senior classification.

MEEN 432 Automotive Engineering  
Credits 3. 3 Lecture Hours.  
Introduction to vehicle dynamics; application of engineering mechanics principles to analysis of acceleration and braking, cornering and handling; analysis and design of drive train, suspension, brakes, and tires to achieve desired performance.  
Prerequisite: MEEN 363.

MEEN 433 Mechatronics  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Basic principles of digital logic and analog circuits in mechanical systems; electrical-mechanical interfacing; sensors and actuators; digital control implementation; precision design and system integration.  
Prerequisite: MEEN 364 or equivalent.

MEEN 434 Dynamics and Modeling of Mechatronic System  
Credits 3. 3 Lecture Hours.  
Mechatronic interactions in lumped parameter and continuum systems; review of integral and differential electromagnetic laws, including motions; lumped elements and dynamic equations of motion; linear and nonlinear actuators and transducers; field transformation and moving media; electromagnetic force densities and stress tensors.  
Prerequisite: MEEN 364.

MEEN 436 Principles of Heating, Ventilating and Air Conditioning  
Credits 3. 3 Lecture Hours.  
Application of thermodynamics fluid mechanics, and heat transfer to the design of HVAC equipment; selection of equipment, piping and duct layouts.  
Prerequisite: MEEN 461 or equivalent.

MEEN 437 Principles of Building Energy Analysis  
Credits 3. 3 Lecture Hours.  
Analysis of building energy use by applying thermodynamics and heat transfer to building heating and cooling load calculations; heat balance and radiant time series calculation methods; psychrometric analysis, indoor air quality, effect of solar radiation on heating and cooling of buildings. Required design project.  
Prerequisites: MEEN 315 or equivalent; junior or senior classification.

MEEN 439 Solar Energy Engineering  
Credits 3. 3 Lecture Hours.  
Solar energy; solar angles and radiation; solar thermal systems; solar water heating and space heating; concentrated solar power; energy storage; solar photovoltaics; solar cell manufacturing; other solar energy technologies.  
Prerequisite: MEEN 315.

MEEN 440 Bio-inspired Engineering Design  
Credits 3. 3 Lecture Hours.  
Expand design space available to engineering by developing and understanding of how nature solves problems; study of effective bio-inspired design and biomimetic applications to draw solutions from nature; enhance concept generation through the use of bio-inspired design; use current state of the art methods in bioinspired design; view nature's solutions to different problems form an engineering perspective.  
Prerequisite: MEEN 368, BMEN 361, or BAEN 375.

MEEN 441 Design of Mechanical Components and Systems  
Credits 3. 3 Lecture Hours.  
Design of machine elements, characteristics of prime movers, loads and power transmission elements as related to mechanical engineering design.  
Prerequisite: MEEN 368 or approval of instructor.

MEEN 442 Computer Aided Engineering  
Credits 3. 3 Lecture Hours.  
Effective and efficient use of modern computer hardware and software in modeling, design, and manufacturing; simulation of a broad spectrum of mechanical engineering problems.  
Prerequisites: MEEN 363 and MEEN 368.

MEEN 444 Finite Element Analysis in Mechanical Engineering  
Credits 3. 3 Lecture Hours.  
Introduction to basic theory and techniques; one- and two-dimensional formulations for solid mechanics applications; direct and general approaches; broader aspects for field problems; element equations, assembly and solution schemes; computer implementation, programming and projects; error sources and application consideration.  
Prerequisites: MEEN 357 and 368 or equivalents.

MEEN 445 Engineering Applications of Solid Mechanics  
Credits 3. 3 Lecture Hours.  
Mechanical and mathematical basis for modeling response of solid bodies undergoing coupled mechanical and non-mechanical effects, analysis of stress and deformation for structural members subjected to axial, torsional and bending loads, design of multifunctional systems.  
Prerequisites: CVEN 305, MEEN 368.

MEEN 451 Viscoelastic Materials  
Credits 3. 3 Lecture Hours.  
Mechanical and mathematical bases for modeling linear viscoelastic materials which focus on polymeric solid materials; characterization of viscoelastic material properties from experimental tests; applications of stress and deformation relationships for viscoelastic structural members subjected to axial, torsional, and bending loads.  
Prerequisites: CVEN 305; junior or senior classification.

MEEN 454 Tribology  
Credits 3. 3 Lecture Hours.  
History and significance of tribology, rough surfaces, hertzian contact, rough surfaces in contact, friction of surfaces in contact, surface failures/wear, boundary lubrication, fluid properties, thick film lubrication, thin film lubrication, micro- and nano-tribology.  
Prerequisites: Grade of C or better in MEEN 344 and MEEN 368.
MEEN 455 Engineering with Plastics
Credits 3.3 Lecture Hours.
Polymer structure, processing, property characterization at the molecular, microscopic and macroscopic dimensional levels for thermosets, thermoplastics, elastomers, fibers and advanced fibrous nonparticle filled composites and smart multi-performance structures.
Prerequisite: MEEN 222/MSEN 222 or approval of instructor.

MEEN 458 Processing and Characterization of Polymers
Credits 3.3 Lecture Hours.
Introduction of flow behavior in polymers; structure-property-process relationship; mixing rules for polymer blends; mechanical properties; laboratory demonstrations: injection molding, extrusion, melt mixing, and study of morphology using OM, SEM, and TEM.
Prerequisite: MEEN 222/MSEN 222.

MEEN 459 Sound and Vibration Measurements
Credits 3.3 Lecture Hours.
Basic acoustics, review of vibration theory, wave propagation in vibrating systems, sound radiation from vibrating systems, sound and vibration sensors and instrumentation, data acquisition systems, measurement techniques, spectral analysis, spatial FFT analysis, design of experiments with vibro-acoustic systems, applications.
Prerequisites: MEEN 363; MATH 308.

MEEN 460 Corrosion Engineering
Credits 3.3 Lecture Hours.
Basic corrosion phenomena are described, including mixed potential theory, types of corrosion, experimental methods, and prevention techniques.
Prerequisite: MEEN 360 and MEEN 361, or equivalent.

MEEN 461 Heat Transfer
Credits 3.3 Lecture Hours.
Heat transfer by conduction, convection and radiation: steady and transient conduction, forced and natural convection, and blackbody and gray body radiation; multi-mode heat transfer; boiling and condensation; heat exchangers.
Prerequisites: MEEN 344; MATH 308.

MEEN 463 Cogeneration Systems
Credits 3.3 Lecture Hours.
Design and analysis of cogeneration system; selection of the prime mover, matching power and thermal needs, institutional factors, economic evaluations, financial options and the study of actual and hypothetical systems.
Prerequisite: MEEN 421 or equivalent.

MEEN 464 Heat Transfer Laboratory
Credit 1.3 Lab Hours.
Basic measurement techniques in conduction, convection, and radiation heat transfer; experimental verification of theoretical and semi-empirical results; uncertainty analysis.
Prerequisite: MEEN 345, MEEN 461 or registration therein.

MEEN 467 Mechanical Behavior of Materials
Credits 3.3 Lecture Hours.
Fundamentals of flow and fracture in metals, emphasizing safe design by anticipating response of materials to complex stress and environmental service conditions; micromechanisms of flow, fatigue, creep and fracture; fracture mechanics approach to design. Special emphasis given to microstructure-mechanical property relationship and damage tolerant design.
Prerequisite: MEEN 360 and MEEN 361.

MEEN 469 Alternative Energy Conversion
Credits 3.3 Lecture Hours.
Design and analysis of alternative energy conversion processes and systems that are based on converting energy directly (e.g., fuel cells, photovoltaics), utilizing non-combustible heat sources (e.g., geothermal, ocean gradients, solar and nuclear fission and fusion) and obtaining energy from the environment (e.g., wind, hydroelectric, ocean tides and waves).
Prerequisite: MEEN 315.

MEEN 471 Elements of Composite Materials
Credits 3.3 Lecture Hours.
Fundamentals concerned with relating structure of multiphase materials to physical properties; plastic, metallic and ceramic matrices reinforced with continuous and discontinuous fibers, whiskers and particulates.
Prerequisites: MEEN 360, MEEN 361, and MEEN 368 or approval of instructor.

MEEN 472 Gas Dynamics
Credits 3.3 Lecture Hours.
Fundamental analysis of compressible flows and its application to supersonic airfoils/projectiles, jet and rocket nozzles, normal and oblique shock waves, explosion waves, shock tubes, supersonic wind tunnels, and compressible pipe flows.
Prerequisite: MEEN 344.

MEEN 473 Elements of Energy Conversion
Credits 3.3 Lecture Hours.
The heuristics of synthesis of material properties, configuration and processing in the optimization of material selection in the design process; product design and development overview, failure mode effects analysis, design margin establishment; role of the generic failure modes and codes and standards; fundamental characteristics of process methods.
Prerequisites: MEEN 360 and MEEN 361; CVEN 305.

MEEN 474 Nanoscale Issues in Manufacturing
Credits 3.3 Lecture Hours.
Fundamentals concerned with relating structure of multiphase materials to physical properties; plastic, metallic and ceramic matrices reinforced with continuous and discontinuous fibers, whiskers and particulates.
Prerequisite: MEEN 360, MEEN 361, and MEEN 368 or approval of instructor.

MEEN 475 Materials in Design
Credits 3.3 Lecture Hours.
The heuristics of synthesis of material properties, configuration and processing in the optimization of material selection in the design process; product design and development overview, failure mode effects analysis, design margin establishment; role of the generic failure modes and codes and standards; fundamental characteristics of process methods.
Prerequisites: MEEN 360 and MEEN 361; CVEN 305.

MEEN 476 Nanoscale Issues in Manufacturing
Credits 3.3 Lecture Hours.
The heuristics of synthesis of material properties, configuration and processing in the optimization of material selection in the design process; product design and development overview, failure mode effects analysis, design margin establishment; role of the generic failure modes and codes and standards; fundamental characteristics of process methods.
Prerequisites: MEEN 222/MSEN 222 or approval of instructor; junior or senior classification.

MEEN 477 Air Pollution Engineering
Credits 3.3 Lecture Hours.
Design of air pollution abatement equipment and systems to include cyclones, bag filters, and scrubbers; air pollution regulations; permitting; dispersion modeling; National Ambient Air Quality Standards.
Prerequisite: ENGR 214 or equivalent.
Cross Listing: BAEN 477 and SENG 477.

MEEN 485 Directed Studies
Credits 1 to 6.1 to 6 Other Hours.
Special problems relating to a specific project in some phase of mechanical engineering. A commitment of two semesters with 6 hours 485 credit is required.
Prerequisites: Approval of department head and senior classification.

MEEN 489 Special Topics in...
Credits 1 to 4.1 to 4 Other Hours.
Selected topics in an identified area of mechanical engineering.
Prerequisite: Approval of instructor.
MEEN 491 Research
Credits 1 to 4. 1 to 4 Other Hours.
Research conducted under the direction of faculty member in mechanical engineering. May be repeated 2 times for credit. Registration in multiple sections of this course is possible within a given semester provided that the per semester credit hour limit is not exceeded.
Prerequisites: Junior or senior classification and approval of instructor.