

MECHANICAL ENGINEERING (MEEN)

MEEN 210 Computer Aided Design 2 Credits

Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): ENGR 110, Grade C or better in ENGR 110

Introduction to geometric modeling for mechanical design using modern computer-aided design (CAD) and prototyping tools; covers systematic design methodology, geometric visualization (orthographic, isometric, oblique, and perspective), and three-dimensional modeling (surface and solid representations); includes dimensioning, tolerancing, and rapid prototyping with 3D printing. Prerequisite: Grade C or better in ENGR 110.

MEEN 223 Principles of Engineering Materials 3 Credits

Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): CHEM 127 and PHYS 216 and CHEM 128, CHEM 127, CHEM 128, and PHYS 216

Structures of metals, polymers, ceramics, and composites; structure-property relationships and their impact on material performance; defects and diffusion in materials; mechanical, thermal, electrical, magnetic, and optical properties of materials; fundamental structure-property-processing relationships; emphasis on phase diagrams, deformation mechanisms, and performance in engineering applications. Prerequisites: CHEM 127, CHEM 128, and PHYS 216.

MEEN 225 Statics 3 Credits

Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): PHYS 216, PHYS 216; MATH 261 or concurrent enrollment

Application of the laws of classical mechanics to simplified, plausibly real-world problems or interest to mechanical engineering, including the equilibrium analysis of frames, trusses, beams, machines and mechanisms, internal forces; basics of stress analysis in axially loaded members and beams. Prerequisites: PHYS 216; MATH 261 or concurrent enrollment.

MEEN 260 Measurement and Instrumentation 3 Credits

Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): STAT 211, STAT 211; ELEN 215 or concurrent enrollment

Introduction to the basic instrumentation and experimental methodology in mechanical engineering data acquisition and signal processing; introduction to various types of sensors, principles of operation, use, calibration, precision, and accuracy; statistical data analysis, and interpretation and reporting of results. Prerequisites: STAT 211; ELEN 215 or concurrent enrollment.

MEEN 263 Dynamics 3 Credits

Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 225 and MATH 261, MEEN 225, MATH 261

Dynamics of particles, system of particles and rigid bodies, rectilinear and curvilinear kinematics, Newtonian mechanics, principles of work and energy, and impulse-momentum relationships, kinematic analyses and equations of motion for diverse mechanical systems, analytical and numerical solution of equations of motion using modern software, In-lecture demonstration simulation, and experimental studios to strengthen the understanding concept of mechanical dynamic systems. Prerequisites: MEEN 225, MATH 261.

MEEN 305 Mechanics of Materials 3 Credits

Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 225 and MEEN 223, MEEN 223, MEEN 225

Applications of stress and deformation relationships for deformable bodies and mechanical elements relevant to mechanical engineers; to include axially loaded members, stability of columns, torsional members and beams, combined loadings, and introduction to structural design. Prerequisites: MEEN 223, MEEN 225.

MEEN 315 Engineering Thermodynamics 3 Credits

Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): CHEM 127 and MATH 162 and PHYS 216

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; phase behavior and equations of state, the second law of thermodynamics and entropy; gas, vapor and refrigeration cycles. Pre/Co-requisite(s): CHEM 127, PHYS 216, and MATH 162

MEEN 344 Fluid Mechanics 3 Credits

Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 315 and MATH 318

Application and the laws of statics, buoyancy, mass, momentum, and energy to the behavior of ideal and real fluids; conservation laws, laminar and turbulent flow in compressible and incompressible flows, Reynolds number, Moody diagram, dimensional analysis and similitude and their application to flow through ducts, pipe, and pumps; lift and drag, fundamental principles of boundary layers. Pre/Co-requisite(s): MEEN 315, MATH 318

MEEN 345 Fluid Mechanics Laboratory 1 Credit

Grade Mode: Standard Letter
Prerequisite(s): MEEN 260

Introduction to basic fluid mechanics instrumentation; experimental verification and reinforcement of the analytical concepts introduced in MEEN 344 . Pre/Co-requisite(s): MEEN 260; MEEN 344 or concurrent enrollment

MEEN 357 Computational Methods in Mechanical Engineering 3 Credits

Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MATH 318, MATH 318

Practical foundations for the use of numerical methods to solve engineering problems: Review of Python programming; Taylor series, error estimation, numerical solution of non-linear algebraic equations, numerical solution of linear systems of equations and linear eigenvalue problems; numerical integration and differentiation; least-squares curve fitting and interpolation, numerical solution of ordinary differential equations (initial value and boundary value problems); finite difference methods for parabolic and elliptic partial differential equations; Introduction to the finite element method; Implementation and debugging of various numerical methods in Python codes. Prerequisite: MATH 318.

MEEN 360 Manufacturing of Engineering Materials 3 Credits

Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 223, MEEN 223

An extension of the fundamental understanding of the structure-property relationship of materials; microstructure production and control; manufacturing processes for producing various classes of engineering materials including machining and additive technologies, design considerations for materials and manufacturing processes selection. Prerequisite: MEEN 223.

MEEN 361 Manufacturing of Engineering Materials**Laboratory****1 Credit**

Grade Mode: Standard Letter

Prerequisite(s): MEEN 210 and MEEN 260, MEEN 210, MEEN 260; MEEN 360 or concurrent enrollment

Experiments in materials characterization and manufacturing processes; emphasis on mechanical properties of materials; microstructure production and control; manufacturing processes for producing various shapes for components and structures for different classes of engineering materials. Prerequisites: MEEN 210, MEEN 260; MEEN 360 or concurrent enrollment.

MEEN 363 Mechanical Vibrations**3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

Prerequisite(s): MEEN 263 and MATH 318, MEEN 263, MEEN 318; MEEN 260 or concurrent enrollment

Free and forced vibration of single and multiple degree-of-freedom systems; distributed parameter systems; development and application of mathematical methods and computational tools for modeling, analysis, and design of vibrating systems; introduction to vibration testing experimental modal analysis; practical engineering applications. Prerequisites: MEEN 263, MEEN 318; MEEN 260 or concurrent enrollment.

MEEN 364 Dynamic Systems and Controls**3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

Prerequisite(s): MEEN 363 and ELEN 215, MEEN 363, ELEN 215

Mathematical modeling and analysis of different types of dynamic systems; introduction to feedback control, time and frequency domain analysis of control systems, stability, PID control, root locus; design of computer-based controllers. Prerequisites: MEEN 363, ELEN 215.

MEEN 365 Dynamic Systems and Controls Laboratory**1 Credit**

Grade Mode: Standard Letter

Prerequisite(s): MEEN 260, MEEN 260; MEEN 364 or concurrent enrollment

Introduction to basic control systems instrumentation; experimental verification of control system concepts; implementation of computer-based controllers; data acquisition and analysis. Prerequisites: MEEN 260; MEEN 364 or concurrent enrollment.

MEEN 368 Design of Mechanical Components and System I**3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

Prerequisite(s): MEEN 305, MEEN 305

Design for stiffness and stability (Internal forces and deflections using singularity functions, Deflections of straight and curved members, statically indeterminate beams, buckling design of columns and frames); Design for strength (stress analysis in 3D, Strength design to avoid static failure, Strength design to avoid failure under variable loading); Design of mechanical components and assemblies (design for strength and stiffness concepts to mechanical components and assemblies, Analysis of shafts with gears using singularity functions, Analysis of tension-loaded bolted and welded joints). Prerequisite: MEEN 305.

MEEN 381 Seminar**1 Credit**

Grade Mode: Standard Letter

Presentations by practicing engineers, professionals, and faculty members 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: Major in mechanical engineering.

MEEN 391 Internship**0 Credits**

Grade Mode: Pass/Non Pass

Participation in an approved high-impact learning practice, such as engaging with industry, research entities, or startup companies.

MEEN 401 Senior Design Project I**3 Credits**

Grade Mode: Standard Letter

Prerequisite(s): MEEN 360 and MEEN 361, MEEN 360, MEEN 361; MEEN 364, MEEN 365, MEEN 368, MEEN 461, MEEN 464 or concurrent enrollment

The design innovation process; needs 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 365, MEEN 368, MEEN 461, MEEN 464 or concurrent enrollment.

MEEN 402 Senior Design Project II**3 Credits**

Grade Mode: Standard Letter

Prerequisite(s): MEEN 401, MEEN 401

. 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.

MEEN 404 Design of Experiments for Engineering**Applications****3 Credits**

Grade Mode: Standard Letter

Prerequisite(s): MEEN 361, MEEN 360, MEEN 361; MEEN 364, MEEN 365, MEEN 368, MEEN 461, MEEN 464 or concurrent enrollment

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 360, MEEN 361; MEEN 364, MEEN 365, MEEN 368, MEEN 461, MEEN 464 or concurrent enrollment.

MEEN 421 Thermal-Fluids Analysis and Design**3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

Prerequisite(s): MEEN 461

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. Pre/Co-requisite(s): MEEN 461; or approval from the instructor.

MEEN 423 Machine Learning for Mechanical Engineers 3 Credits
Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 357, MEEN 357

Machine learning techniques with applications to the analysis and design of mechanical, fluid, thermal, material and multidisciplinary systems; linear and kernel support vector machines; neural networks; Bayesian techniques; decision trees and random forests; dimension reduction and model selection; data management and learner validation strategies; tools and application studies. Prerequisite: MEEN 357

MEEN 433 Principles of Mechatronics 3 Credits
Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 364, MEEN 364

Introduction to mechatronics; 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.

MEEN 435 Automation and Robotics 3 Credits
Grade Mode: Standard Letter, Audit/Non Audit

Industrial robotics with a focus on applications. This includes kinematics and programming of industrial robots, robotic welding, robotic assembly, and other industrial applications. Computer vision for use in robotic systems is an important area. Industrial computer systems for the implementation of robotic manufacturing systems, and mechatronics. Automation for offshore applications with a focus on top-side automation for drilling platforms and control systems for subsea production systems for oil and gas. Prerequisite: Senior Standing

MEEN 441 Design of Mechanical Components and Systems II 3 Credits
Grade Mode: Standard Letter, Audit/Non Audit

Basics of finite element analysis of trusses and beams under static and dynamic loading; Review of failure theories due to static loading; Review of fatigue failure theories due to variable loading; Shaft design; Design of bolted joints; Design of welded joints; Gear design; Design of springs; Design of flexible mechanical elements (belts); Simulation studios using engineering software such as SAP2000, ANSYS and MSC/ADAMS. Prerequisites: MEEN 368.

MEEN 444 Finite Element Analysis 3 Credits
Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 357 and MEEN 368, MEEN 357; MEEN 368

Physical FEM with applications to bars, trusses and beams; Mathematical FEM: Integral formulations and variational method; Second-order boundary value problems in 1-D: Finite Element Models & Applications; Fourth-order boundary value problems in 1-D: Beams and Frames; Dynamic eigenvalue problems of trusses and beams; Dynamic analysis of rotating rotors; Computer implementation of 1-D problems in Python (bars, trusses and beams); Aspects of finite element modeling of 1-D problems; Single-variable problems in 2-D (temperature distribution in a plate); Size optimization in structures using FEA; Theory and applications of finite element updating; Simulation studios using SAP2000, ANSYS and FEMTOOLS. Prerequisites: MEEN 357; MEEN 368.

MEEN 453 Advanced Manufacturing Processes 3 Credits
Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 360 and MEEN 361, MEEN 360; MEEN 361

Machining theory; traditional and non-traditional machining processes; CNC machines and tools; geometric dimensioning and tolerance (GD&T); additive manufacturing systems and processes; materials in additive manufacturing. Prerequisites: MEEN 360; MEEN 361.

MEEN 460 Corrosion Engineering 3 Credits
Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 360 and MEEN 361, MEEN 360; MEEN 361

Basic corrosion phenomena are described, identification of corrosion types and application of mixed potential theory, kinetics, and thermodynamics; methods for measuring corrosion rates and employing corrosion control strategies through design strategies, inhibitors, coatings and cathodic protection. Prerequisites: MEEN 360; MEEN 361.

MEEN 461 Heat Transfer 3 Credits
Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 344

Heat transfer by conduction, convection and radiation: steady and transient conduction, forced and natural convection, blackbody and gray body radiation; multi-mode heat transfer; boiling and condensation; heat exchangers. Pre/Co-requisite(s): MEEN 344

MEEN 464 Heat Transfer Laboratory 1 Credit
Grade Mode: Standard Letter
Prerequisite(s): MEEN 345

Basic measurement techniques in conduction, convection, and radiation heat transfer; experimental verification of theoretical and semi-empirical results; uncertainty analysis. Pre/Co-requisite(s): MEEN 345; MEEN 461 or concurrent enrollment.

MEEN 467 Mechanical Behavior of Materials 3 Credits
Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 360 and MEEN 361, MEEN 360; MEEN 361

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. Prerequisites: MEEN 360; MEEN 361.

MEEN 470 Principles of Energy Conversion 3 Credits
Grade Mode: Standard Letter, Audit/Non Audit
Prerequisite(s): MEEN 461

The Principles of Energy Conversion course introduces the fundamentals of thermodynamics, heat transfer, and fluid mechanics as applied to energy systems. It covers analyzing and optimizing conventional systems like fossil fuel engines and power cycles (Rankine, Brayton), renewable technologies (solar, wind, geothermal), and advanced systems such as fuel cells and thermoelectric generators. The course emphasizes computational modeling and the socio-economic impact of energy technologies, equipping students with tools to design and optimize modern energy solutions. Pre/Co-requisite(s): MEEN 461

MEEN 472 Building Science, Technology, and HVAC

Systems

3 Credits

Grade Mode: Standard Letter, Audit/Non Audit

Prerequisite(s): MEEN 461

In this course, students will explore the fundamental principles of building science, including heat transfer, moisture control, and air movement, to design energy-efficient and sustainable buildings. Key topics include the integration of HVAC systems, indoor air quality, thermal insulation, the basic principles of building enclosure design, including the design of walls and roofs, and acoustics are examined. Case studies and hands-on projects will provide practical experience in developing solutions that optimize building performance for sustainability and occupant comfort. Pre/Co-requisite(s): MEEN 461; or approval from the instructor

MEEN 473 Advanced Natural Gas Engineering and Handling

Equipment

3 Credits

Grade Mode: Standard Letter, Audit/Non Audit

Natural gas well production and deliverability fundamentals, process description and design aspects of gas processing facilities including inlet separation operations, flow assurance challenges including multiphase flow, hydrate prevention and control, gas dehydration, gas transmission and transportation systems, natural gas handling equipment with the aid of ANSYS and HYSYS. Pre/Co-requisite(s): MEEN 315, MEEN 344; or approval from the instructor

MEEN 474 Sustainable Energy Technologies and Systems

3 Credits

Grade Mode: Standard Letter, Audit/Non Audit

Prerequisite(s): MEEN 461

This course will introduce students to the fundamentals of sustainable energy technologies, focusing on key renewable energy sources such as solar, wind, hydro, tidal, geothermal, biomass, CCUS, ammonia, and hydrogen. It will explore the principles, applications, and integration of these technologies into modern energy systems. Through lectures, case studies, and hands-on exercises, students will gain insights into the design, operation, and socio-economic implications of renewable energy solutions. Emphasis is placed on practical skills development and real-world applications, equipping students to contribute effectively to the global transition towards a more sustainable and resilient energy future studying the transition to a low-carbon economy. Pre/Co-requisite(s): MEEN 461; or approval from the instructor

MEEN 489 Selected Topics in Mechanical Engineering

1-3 Credits

Grade Mode: Standard Letter, Audit/Non Audit

Advanced or applied topics in mechanical engineering offered according to student's interest and availability of instructors and equipment. Lecture hours, laboratory, and/or computation period to be arranged.