

Course Descriptions

Required Courses

MECH 200 Engineering Graphics

2(1, 0, 2)¹

An introductory course on 2-D drawing, orthogonal projection, auxiliary views, sectioning and sectional views, dimensioning and tolerance schemes, and standard drawing layouts and an introduction to the use of AutoCAD. Prerequisite: Discretion of advisor.

MECH 210 Thermodynamics I

3(3, 0, 0)

A course on the thermodynamic state and properties of a pure substance, system and control volume concepts, work and heat, the first law of thermodynamics, energy and mass conservation, entropy, the second law of thermodynamics; applications to closed setups and flow devices; simple vapor and gas cycles applications. Prerequisite: Discretion of advisor.

MECH 211 Thermodynamics For Civil Engineering

2(2, 0, 0)

Introduction to the thermodynamics: which include thermodynamics state and properties of a pure substance, system and control volume concepts, work and heat, the first law of thermodynamics, energy and mass conservation, entropy, the second law of thermodynamics; applications to closed setups and flow devices; simple vapor and gas cycles applications.

MECH 220 Dynamics

3(3, 1, 0)

A course on kinematics and kinetics of particles, systems of particles, and rigid bodies in 2-D and 3-D motion, Newton's laws, work and energy, impulse and momentum, impact, and mass moments of inertia. Prerequisites: MATH 201 and CIVE 210.

MECH 230 Engineering Materials

3(3, 0, 0)

The course introduces fundamental concepts in materials science as applied to engineering materials: crystalline structures; imperfections, dislocations, and strengthening mechanisms; diffusion; phase diagrams and transformations. Ferrous and non-ferrous metal alloys, ceramics, and polymers. Structure-property relationships. Material selection case studies.

MECH 231 Strength of Materials

3(3, 0, 0)

A course on stresses, strains, and stress-strain relationship; stress and deformation of axially loaded members; thermal stresses; torsion of circular bars; bending and shear in beams; combined stresses; stress transformation and Mohr's circle. Stress concentration; stresses in pressurized cylinders. Deflection and stiffness; deflection due to bending; beams deflection by superposition; beam deflection by singularity functions; Castigliano's theorem; deflection in columns. Prerequisite: CIVE 210.

MECH 320 Kinematics of Mechanical Systems

3(3, 0, 0)

A course that deals with the mechanization of motion, kinematics analysis of linkage mechanisms, synthesis of cam-follower mechanisms, gear terminology and types of gears, analysis and synthesis of gear trains, force analysis, and introduction to linkage synthesis; computer aided project. Prerequisite: MECH 220.

MECH 330 Mechanical Design

3(3, 0, 0)

A course covering the analytical tools needed for the mechanical design of various machine components for rigidity and strength. The course covers the design of machine elements such as screws and joints, bearings, gears, shafts, and mechanisms. The course offers practice in skills needed for machine design such as estimation, drawing, and experimentation. The course deals with failures theories that result from static and variable loading. Applications are covered through case studies and a team project. Prerequisites: MECH 200, MECH 230 and MECH 231.

MECH 331 Materials Lab

1(0, 0, 2)

A laboratory course consisting of standard metallurgical and mechanical characterization tests on metals. Stress-strain plots, derived properties, fracture toughness, crystallography, hardness, and other properties. Ceramic flexure testing: Weibull plots. Polymers: stress-strain plots and derived properties, impact properties, creep, and relaxation. Prerequisite: MECH 230.

MECH 341 Fluid Mechanics

3(3, 0, 0)

An introductory course on fluid behavior emphasizing conservation of mass, momentum, and energy and dimensional analysis; study of fluid motion in terms of the velocity field, fluid acceleration, the pressure field, and the viscous effects; applications of Bernoulli's equation, Navier-Stokes, and modeling; flow in ducts, potential flows, and boundary layer flows. Prerequisite: MECH 220.

MECH 342 Heat Transfer

1(1, 0, 0)

A course investigating steady and transient heat conduction; extended surfaces; numerical simulations of conduction in one and two-dimensional problems; external and internal forced convection of laminar and turbulent flows; natural convection; heat

¹ Credits (Lecture, Tutorial, Lab)

exchanger principles; thermal radiation, view factors and radiation exchange between diffuse and gray surfaces as well as the use of computer packages in problem solving. Prerequisite: MECH 341.

MECH 350 Instrumentation and Measurements 3(2, 0, 2)

This course introduces general concepts of measurement systems; classification of sensors and sensor types; interfacing concepts; data acquisition, manipulation, transmission, and recording; introduction to LabVIEW; applications; team project on design, and implementation of a measuring device. Pre- or co-requisite: MECH 341.

MECH 360 Manufacturing Processes I 3(3, 0, 0)

A course on material removal processes, processes both traditional and non-traditional. Assembly processes such as welding, brazing, soldering, and fastening are also covered with an emphasis on process capabilities and limitations, relative cost, and guidelines for process selection. This course examines the behavior of materials under processing conditions and design for manufacturing guidelines, and involves hands-on exercises in a machine shop environment. Prerequisite: MECH 230.

MECH 361 Manufacturing Processes Laboratory 1(0, 0, 2)

An introduction to the use and operation of selected industrial machinery, various machining operations, selected welding processes and precision measuring instruments. Laboratory projects will emphasize safety and apply selected manufacturing processes, various inspection processes, fixturing and engineering materials. Pre- or co-requisite: MECH 360.

MECH 400 Summer Internship (1 Cr.)

This is an eight to twelve-week professional training course in mechanical engineering. Prerequisite: Senior standing.

MECH 401 Final Year Project I (1 Cr.)

A supervised project in groups of normally three students aimed at providing practical experience in some design aspects of mechanical engineering. Students are expected to complete a literature survey, to critically analyze, and to acquire the necessary material needed for their intended end product. Prerequisite: Senior Standing.

MECH 402 Final Year Project II (3 Crs.)

A course in which the student integrates his/her acquired knowledge to deliver the product researched and planned in MECH 401. Prerequisite: MECH 401.

MECH 441 Thermal-Fluid Systems Laboratory 1(0, 0, 2)

This lab includes a series of experiments on basic thermodynamic cycles, psychrometry, combustion, and elementary fluid mechanics, with special emphasis on the use of the computer as a laboratory tool for data acquisition, reduction, analysis, and report preparation. Prerequisite: MECH 342.

MECH 490 Control Systems 3(3, 0, 0)

This course is intended to provide students with the tools that enable them to model and control physical systems. It includes the following: modeling of mechanical, fluid, electrical, and thermal systems; transfer function and block diagrams; time-domain analyses; root-locus; frequency-domain methods; stability analysis; design of PID controllers and dynamic compensators via the root locus and frequency methods. Prerequisites: MECH 220 and ELEE 210.

MECH 491 Control Systems Laboratory 1(0, 0, 2)

This course involves a series of hands-on experiments on modeling and design of control systems using Matlab, Simulink, and LabVIEW. The course also includes a team project. Pre- or co-requisites: MECH 350 and MECH 490.

Elective Courses

MECH 430 Product Design and Development 3(3, 1, 0)

This course covers modern tools and methods for product design and development. Teams of students conceive, design, and prototype a new physical product. Topics include identifying customer needs, product planning, product specifications, concept generation, industrial design, product architecture, product development economics, and design-for-manufacturing. Prerequisites: MECH 320 and MECH 330.

MECH 431 Manufacturing Processes II 3(2, 0, 2)

A course on heat treatments, deformation, phase-change, and particulate consolidation processing of metals; fabrication processing of non-metallic engineering materials such as ceramics, polymers, and composites; emphasis on process capabilities and limitations, relative cost, and guidelines for process selection; the behavior of materials under processing conditions; design for manufacturing guidelines. This course emphasizes hands-on training exercises. Prerequisite: MECH 230.

MECH 432 Mechanical CAD/CAE/CAM 3(2, 0, 2)

This course seeks to expose the senior ME students to the realm of computer-aided design (CAD), computer-aided engineering (CAE), and computer-aided manufacturing (CAM); geometric modeling; numerical control; dimensioning and tolerancing; statistical tolerancing; process selection; metrology. Prerequisites: MECH 200, MECH 330, and MECH 360.

MECH 433 Mechatronics System Design 3(2, 0, 2)

A course that discusses mechatronics; data; numbering systems, architecture of microcontrollers, assembly language programming, A/D and D/A conversion; parallel I/O, programmable timer operation, interfacing sensors and actuators, applications; a team project on design and implementation of a mechatronic system. Prerequisites: MECH 350.

MECH 434 Mechanical Vibrations 3(3, 0, 0)

A course on free and forced response of non-damped and damped system; damping vibration absorption; response of discrete multi-degree of freedom systems; modal analysis; vibration measurement, case studies, vibration analysis with Matlab and Simulink. Prerequisite: MECH 220.

MECH 435 Dynamics and Applications 3(3, 0, 0)

This course examines the dynamics of particles and rigid bodies moving in three dimensions. Topics include Lagrange's equations of motion for particles, rotations of rigid bodies, Euler angles and parameters, kinematics of rigid bodies, and the Newton-Euler equations of motion for rigid bodies. The course material will be illustrated with real-world examples such as gyroscopes, spinning tops, vehicles, and satellites. Applications of the material range from vehicle navigation to celestial mechanics, numerical simulations, and animations. Prerequisites: MECH 220.

MECH 436 Intermediate Mechanics of Materials 3(3, 0, 0)

Review of energy methods, Betti's reciprocal theorem; bending of beams of asymmetrical cross-section; shear center and torsion of thin-walled sections; membrane stresses in axisymmetric shells; axisymmetric bending of circular plates; elastic, thermoelastic analysis of axisymmetric thick cylinders and rotating discs; bending of rectangular and circular plates, including asymmetric problems; beams on elastic foundations; axisymmetric bending of cylindrical shells; Analysis of torsion: non-circulation sections. Prerequisites: MECH 231.

MECH 440 Thermodynamics II 3(3, 0, 0)

A course investigating the availability and work potential of systems; irreversibility; second law efficiency; availability; gas mixtures, air-conditioning; chemical reactions; high speed flow, nozzles and diffusers, environmental, economic, and social implications. Prerequisite: MECH 210.

MECH 442 Modeling and Design of Thermal Systems 3(3, 0, 0)

This course covers analysis, modeling, and design of engineered systems involving applications of thermodynamics, economics, heat transfer, and fluid flow; selection of components in fluid- and energy-processing systems to meet system performance requirements; system simulation and optimization techniques; use of modern computational tools to model thermal performance characteristics of components and systems. Prerequisite: MECH 342.

MECH 443 Intermediate Fluid Mechanics 3(3, 0, 0)

A course that deals with potential flow and boundary layer analysis; lift and drag; flow separation; the use of computational techniques to solve boundary layer problems; viscous internal channel flow and lubrication theory; one-dimensional compressible flow in nozzles and ducts; normal shock waves and channel flow with friction or heat transfer; fluid machinery including pumps and hydraulic turbines. Prerequisites: MECH 342.

MECH 444 Internal Combustion Engines 3(3,0, 0)

This course examines the fundamentals of internal combustion engine design and operation, with emphasis on fluid/thermal processes. Topics include analysis of the respiration, combustion, and pollutant formation processes; heat transfer and friction

phenomena; engine types and performance parameters; thermo-chemistry of fuel-air mixtures; the use of engine cycle models for performance predictions; and social implications of motorization. Prerequisites: MECH 210 and MECH 350.

MECH 445 Air Conditioning 3(3, 0, 0)

A course on human thermal comfort and indoor air quality; solar radiation; heating and cooling load calculations in buildings; air conditioning systems; air and water distribution systems; computer-based calculations. Prerequisite: MECH 342.

MECH 446 Gas Turbines 3(3, 0, 0)

A course that introduces the thermodynamic and aerodynamic theory forming the basis of gas turbine design: shaft power cycles; gas turbine cycles for aircraft propulsion; turbofan and turbojet engines; design and analysis of centrifugal and axial flow compressors and turbines. Prerequisite: MECH 341.

MECH 447 Steam Turbines 3(3, 0, 0)

A course that deals with impulse and reaction steam turbines, steam turbine cycles, flow of steam in nozzles, design aspects of turbines stage losses and efficiency, velocity diagrams; and impulse and reaction blading velocities; nucleation, condensation, and two-phase phenomena in flowing steam; boiler room and its various equipment; the complete steam power plants; governors, electric generator, and power transmission lines. Prerequisite: MECH 341.

MECH 448 Aerodynamics 3(3, 0, 0)

A course on theoretical and empirical methods for calculating the loads on airfoils and finite wings by application of classical potential theory, thin airfoil approximations, lifting line theory, and panel methods; wings and airplanes; application of linearized supersonic flow to supersonic airfoils; performance and constraint analysis; longitudinal stability and control. Prerequisite: MECH 341.

MECH 449 Compressible Flow 3(3, 0, 0)

This course covers general one-dimensional flow of a perfect gas homenergetic and homentropic flow in nozzles and constant area ducts, normal shock waves, and one-dimensional unsteady gas flow. Prerequisite: MECH 341 and MATH 202.

MECH 450 Refrigeration 3(3, 0, 0)

This course covers fundamental concepts and principles of mechanical vapor compression refrigeration cycles; gas cycle refrigeration; ultra-low- temperature refrigeration, cold storage refrigeration; functions and specifications of refrigeration equipment, applications. Prerequisite: MECH 210 and MECH 342.

MECH 451 Solar Energy 3(3, 0, 0)

This course discusses the fundamentals of solar radiation, collectors and concentrators, energy storage, estimation and conversion formulas for solar radiation. Prerequisite: MECH 342.

MECH 460 Finite Element Methods in Mechanical Engineering 3(3, 0, 0)

A course on the classification of machine components; displacement-based formulation; line elements and their applications in design of mechanical systems; isoparametric formulation; plane stress, plane strain, axi-symmetric, and solid elements and their applications; modeling considerations and error analysis; introduction to ALGOR general formulation and Galerkin approach; and analysis of field problems. Prerequisites: MATH 215, MECH 330, and MECH 342.

MECH 461 Mechanical Engineering Analysis 3(3, 0, 0)

A course dealing with the application of numerical techniques to the solution of a variety of mechanical engineering problems involving systems of linear or non-linear algebraic equations, systems of ordinary differential equations of the initial and boundary value types, systems of ordinary differential equations, and partial differential equations of the parabolic, elliptic, and hyperbolic types. Engineering applications are introduced through a number of case study problems. Prerequisite: MATH 202, MECH 220, and MECH 231.

MECH 470 Mechanics of Composite Materials 3(3, 0, 0)

This course covers anisotropic elasticity and laminate theory, analysis of various members of composite materials, energy methods, failure theories, and micromechanics. Materials and fabrication processes are introduced. Prerequisites: MECH 230 and MECH 231.