

Mechanical Engineering (MEEN)

MEEN 5301 Advanced Probs in Mech Eng **1-4 SCH (1-4)**

Individual or group research on advanced problems conducted under the supervision of a faculty member. Maximum credit 8 semester hours.

MEEN 5303 Advanced Topics in Mech Eng **1-3 SCH (1-3)**

One or more advanced topics. May be repeated when topic changes.

MEEN 5305 Graduate Research Project **1-3 SCH (1-3)**

Designed for project option students and requires completion of research project. Prerequisite: departmental approval. May be repeated for a maximum of 7 semester hours.

MEEN 5306 Thesis **1-3 SCH (1-3)**

Designed for thesis option students. The course requires completion of thesis research. Prerequisite: departmental approval. May be repeated for maximum of 10 semester hours.

MEEN 5313 Numerical Methods in Mech Engi **3 SCH (3-0)**

Numerical methods for advanced analysis and design applications in Mechanical Engineering. Prerequisite: MATH 5372. (Credit may not be obtained in both MEEN 5313 and CEEN 5313.)

MEEN 5314 Finite Element Methods in Engi **3 SCH (3-0)**

Principles and applications of the Finite Element Method: energy based variational principle methods, the principles of virtual work, weighted residual methods. Emphasis on structural and nonstructural elements and applications. Prerequisite: CSEN 2304 or equivalent.

MEEN 5315 Advanced Mechanism Design **3 SCH (3-0)**

Mobility analysis and rotatability criteria. Vector and matrix based mechanism analysis and synthesis. Motion analysis and simulation of mechanisms. Planar, spherical and spatial mechanisms. Mechanisms for path, function and motion generations. Cam and gear mechanisms. Prerequisite: engineering graduate standing.

MEEN 5316 Mechanics Composite Materials **3 SCH (3-0)**

Constituent and application of composite materials, mechanical properties of composite materials using micro-and macro-mechanics perspectives, classical theory, failure theories, manufacturing techniques and experimental testing procedures. Prerequisites: MEEN 3344 and CEEN 3311 or equivalent.

MEEN 5318 Advanced Dynamics **3 SCH (3-0)**

Equations of motion in three dimensions. Derivation and application of Lagrange's equations. Vibrations of mechanical systems. Orbital mechanics. Prerequisite: MEEN 3355.

MEEN 5320 Theory of Elasticity **3 SCH (3-0)**

Discussion of the concept of stress, strain, deformations, strain compatibility and constitutive relations; formulation and solution of extension, bending, torsion and two-dimensional elasticity problems. (Credit may not be obtained in both MEEN 5320 and CEEN 5310.)

MEEN 5321 Advanced Fluid Mechanics **3 SCH (3-0)**

Equations of fluid mechanics: equations of continuity, motion, Navier-Stokes, energy and Bernoulli. Incompressible, laminar, turbulent and compressible flows.

MEEN 5322 Turbulent Flow **3 SCH (3-0)**

Stationary random functions. Correlation tensors. Wave number Space. Mechanics of turbulence. Energy spectrum. Dissipation and energy cascade. Turbulence measurements. Isotropic turbulence. Turbulent transport processes. Mixing and free turbulence. Wall-constrained turbulence.

MEEN 5325 Compu Integrated Manuf Syst **3 SCH (3-0)**

Advanced systems concept of Computer Integrated Manufacturing System, definition of manufacturing and its various levels, planning and control of product movement through the production system, successful use of Automation, Robotics, Just-In-Time Manufacturing and Knowledge Based Systems. Prerequisite: MEEN 5303.

MEEN 5326 Control Systems Engineering **3 SCH (3-0)**

Analysis and design of controlled, dynamic, linear mechanical, electric, fluid and/or thermal systems; introduction to concepts of stability, controllability, observability and to discrete time, sampled data control systems, optimal control systems and nonlinear control theory. Prerequisite: MEEN 5328.

MEEN 5328 Dynamic Systems Engineering **3 SCH (3-0)**

Analysis of dynamic-mechanical, electric, fluid and thermal system elements; modeling, analysis and design of physical, dynamic systems composed of these elements.

MEEN 5330 Continuum Mechanics **3 SCH (3-0)**

Presentation of the fundamental laws of physics as applicable to a continuous medium in a unified viewpoint. Material is discussed in terms of Cartesian tensors. Topics covered include: vectors and indicial notation of tensors, tensor operations, stress, strain and deformation of continuous media in Eulerian and Lagrangian descriptions. Applications to solid mechanics, fluid mechanics and thermodynamics are explored.

MEEN 5331 Advance Materials Science 3 SCH (3-0)

Formation of metallic materials, polymers and composite materials, both applications and properties including chemical resistance and mechanical properties such as elasticity, creep and fracture. Prerequisite: MEEN 3344.

MEEN 5333 Polymer Science 3 SCH (3-0)

Structure properties of polymeric materials, polymer-solvent thermodynamics, physical and mechanical properties such as viscosity, glass transition, viscoelasticity, fatigue, creep, toughening principles. Prerequisite: graduate standing in science or engineering with materials science (MEEN 3344) or equivalent taken in undergraduate study.

MEEN 5335 Advnd Robotics and Automation 3 SCH (3-0)

Analysis of methods of design and operation of robots and robotic systems. Kinematics and dynamics of manipulators, trajectory planning and motion control, sensing and vision, discussion of command languages and planning of job assignments.

MEEN 5337 Engin Analysis in Applied Mech 3 SCH (3-0)

Simultaneous Equations - Equilibrium, Eigenvalues and Eigenvectors; Extreme Values of Functions; Calculus of Variations; Extremum Principles of Thermodynamics; Stationarity and Extremum Principles of Solid Mechanics; Equations of Motion and the Stationarity Principles of Lagrange and Hamilton. Prerequisites: graduate standing and approval of instructor.

MEEN 5339 Comp Aided Geometric Design 3 SCH (3-0)

Introduction of affine maps, barycentric coordinates, piecewise linear interpolation, tessellation and triangulation. Bezier and B-Spline curves and surfaces. Techniques for constructing curves, surfaces and solids.

MEEN 5341 Tribology: Friction Wear & Lub 3 SCH (3-0)

Surface properties and surface topography, contact mechanics, friction of surfaces in contact, heat dissipation, lubrication, wear and surface damages, surface engineering. Prerequisite: graduate standing in engineering with machine design (MEEN 4351) or equivalent course taken in undergraduate study.

MEEN 5345 Cond and Convection Heat Trans 3 SCH (3-0)

Theory of steady-state and transient heat conduction and theory of convective transport combined with boundary layer theory. Prerequisite: MEEN 3348.

MEEN 5347 Advanced Thermodynamics 3 SCH (3-0)

The equations of state for various systems are given extensive treatment. Prerequisite: MEEN 3347.

MEEN 5348 Auto. Sys. and Ind. Controls 3 SCH (3-0)

Industrial Control Systems, Hardware Components of Automation and Process Controls, Instrument Calibration, Programmable Logic Controllers, PLC interfacing, Computer Numerical Control, Automated Machine Systems, Industrial Networking.

MEEN 5349 Mechanical Vibrations 3 SCH (3-0)

Free and Forced Vibration of Single/Multi Degree of Freedom Systems, Harmonic Excitation, Vibration of Continuous Systems, Vibration Control, Nonlinear and Random Vibrations.

MEEN 5359 Advanced Manufacturing Processes 3 SCH (2-3)

Development of advanced processes and detailed selection criteria for manufacturing processes, processing of castings, additive manufacturing, sheet metal working, polymer and polymer-matrix composites production, machining and laser cutting processes. Prerequisites: MEEN 1310 or equivalent, MEEN 3344 or equivalent.

MEEN 5385 Advanced Manufacturing of Composites 3 SCH (2-3)

Advanced development of composites manufacturing processes; hand lay-up, air and oven curing, 3D printing/ additive manufacturing of composites, filament winding and compression molding. In-depth materials selection and fabrication of marine, aerospace, chemical and civil structures. Practical case studies and individual projects. Prerequisites: MEEN 3344 or equivalent and CEEN 3311 or equivalent.

MEEN 6303 Special Topics Mechanical Eng 3 SCH (3-0)

One or more advanced topics to strengthen and provide further depth of study in important areas of Mechanical Engineering. May be repeated when topic changes.

MEEN 6306 Proposal/Dissertation Research 1-9 SCH (0-0-1-9)

This course is for doctoral students undertaking dissertation research to take towards fulfilling doctoral dissertation proposal and dissertation requirements.

MEEN 6321 Adv Eng Data Analysis & Opt 3 SCH (3-0)

Data collection and random sampling methods for engineering applications, advanced probability and data analysis for engineering problems, linear and non-linear regressions including multi-variable regression, and heuristic optimization algorithms.

MEEN 6325 Analytical Dynamics 3 SCH (3-0)

Generalized coordinates and forces. Hamilton's principle and equations. Quasi-coordinates and quasi-velocities. Gibbs-Appell equations. Kane's equations. Stability of nonlinear dynamic systems. Analyses of nonlinear dynamic systems. Prerequisite: engineering graduate student.

MEEN 6326 Advanced Control Systems 3 SCH (3-0)

Input-output and state space representation of linear continuous and discrete time dynamic systems. Controllability, observability, and Lyapunov stability. Design and analysis of single and multi-variable feedback control systems. State observer, linear quadratic optimum control, linear robust control. Application to engineering system.

MEEN 6327 Nonlinear Solid Mechanics 3 SCH (3-0)

Constitutive equations for nonlinear behaviors of solids. Nonlinear strains and stresses of solids. Material and geometric nonlinearities of solids. Nonlinear deformation, buckling and stability analyses of bars, frames, plates and shells. Prerequisite: engineering graduate student.

MEEN 6330 Advanced Composite Materials 3 SCH (3-0)

General characteristics of composite Materials, Polymer-, Metal, Ceramic-Matric Composites; glass, carbon, Kevlar, and natural fibers; thermoset and thermoplastic polymers, fabrication methods, experimental characterization - morphological, static and dynamic, nanocomposites. Prerequisites: graduate standing in science or engineering with materials science (MEEN 3344) or equivalent course taken in undergraduate study.

MEEN 6331 Advanced Polymer Science 3 SCH (3-0)

Structure and properties of polymeric materials, polymer-solvent thermodynamics, physical and mechanical properties such as viscosity, glass transition, viscoelasticity, rheology, fatigue, creep, toughening principles. Prerequisite: graduate standing in science or engineering with materials science (MEEN 3344) or equivalent course taken in undergraduate study.

MEEN 6332 Advanced Mechanics of Composites and Design 3 SCH (3-0)

Lamina Stress-Strain Relationships, Effective Moduli and Strength of a Continuous Fiber-Reinforced Lamina, Hygrothermal Behavior, Analysis of Laminates, and Selection of Laminate Designs. Prerequisite: graduate standing in science or engineering with strength of materials (CEEN 3311) or equivalent course taken in undergraduate study.

MEEN 6333 Nondestructive Evaluation Techniques 3 SCH (3-0)

Importance of NDE in engineering design, manufacturing, maintenance and service, principles of NDE techniques such as penetrant, ultrasonics, Acoustic Emission, Magnetic Particle, and eddy current testing, emerging technologies in the field of NDE. Prerequisite: graduate standing in science or engineering.