

DEPARTMENT OF MECHANICAL ENGINEERING
Master of Science Degree in Mechanical Engineering (MSME)

COURSE DESCRIPTIONS
MECHANICAL ENGINEERING
(ME)

- 5013 Topics in Mechanical Engineering**
(3-0) 3 hours credit. Prerequisite: Graduate standing in engineering or consent of instructor.
Current topics in mechanical engineering. May be repeated for credit with consent of Graduate Committee as topics vary.
- 5013 Topics in Mechanical Engineering: Advanced Manufacturing Systems Engineering**
(3-0) 3 hours credit. Prerequisite: Graduate standing in engineering or consent of instructor
This course focuses on design, planning, scheduling, and control of manufacturing systems with emphasis on information flow and decision-making. After introducing students to system simulation, simulation models of manufacturing systems are developed and evaluated in terms of system performance under different production planning and control policies. Contemporary manufacturing topics and research areas are emphasized.
- 5013 Topics in Mechanical Engineering: Lean Manufacturing and Lean Enterprises**
(3-0) 3 hours credit. Prerequisite: Graduate standing in engineering or consent of instructor
This course presents methodologies for transforming an enterprise into a lean enterprise. Topics include Lean Manufacturing basics and tools; Lean Implementation Guidelines; Lean Metrics and Performance Measures; Lean Extended Enterprise; Six-Sigma; and Lean Supply Chain Design and Management. Laboratory work includes lean simulation games and various Web-based applications.
- 5113 Advanced Controls**
(3-0) 3 hours credit. Prerequisite: ME 4523 or an equivalent.
Lyapunov theory of stability of a dynamic system, control of nonlinear systems, robust controller for nonlinear systems, design of adaptive control system, controllability and observability, state estimation and Kalman filter.
- 5133 Mechanical System Identification**
(3-0) 3 hours credit. Prerequisites: ME 4523 and STA 2303, or their equivalents
Review of digital signal processing, review of random processes, models of linear time-invariant systems, models of time-varying and nonlinear systems, nonparametric identification methods: frequency response analysis, spectral analysis; parameter estimation methods: least-square method, maximum likelihood methods; recursive estimation methods: recursive iv method, recursive prediction-error method.
- 5143 Advanced Dynamics**
(3-0) 3 hours credit. Prerequisite: EGR 2513 or consent of instructor.
Review of Newtonian mechanics, 3-D particle kinematics, dynamics of a system of particles, analytical mechanics, Lagrange's equations, kinematics and rigid-body dynamics, Eulerian angles, computational analysis using a symbolic language.
- 5153 Structural Dynamics**
(3-0) 3 hours credit. Prerequisite: EGR 2513 or consent of instructor.
Matrix methods for analysis of dynamics of complex structures, computer solutions, systems identifications, and experimental modal analysis.
- 5183 Mechanical Vibrations**
(3-0) 3 hours credit. Prerequisite: EGR 2513 or consent of instructor.
Free and forced vibration of single and multi-degree-of-freedom systems; response to harmonic, periodic, and nonperiodic excitations; continuous systems; computational techniques for the response.

- 5243 Advanced Thermodynamics**
(3-0) 3 hours credit. Prerequisite: ME 3293 or an equivalent.
Concepts and postulates of macroscopic thermodynamics; formulation of thermodynamic principles; stability of thermodynamic systems.
- 5263 Combustion**
(3-0) 3 hours credit. Prerequisite: ME 4293 or an equivalent and graduate standing in engineering or consent of instructor.
Thermochemistry and transport theory applied to combustion; gas phase equilibrium; energy balances; reaction kinetics; flame temperatures, speed, ignition, and extinction; premixed and diffusion flames; combustion aerodynamics; mechanisms of air pollution.
- 5303 Advanced Heat and Mass Transfer**
(3-0) 3 hours credit. Prerequisite: ME 4313 or an equivalent.
Derivation of energy and mass conservation equations with constitutive laws for conduction, convection, radiation, and mass diffusion. Dimensional analysis, heat exchangers, boiling and condensation, steady and transient solutions.
- 5333 Conduction**
(3-0) 3 hours credit. Prerequisite: ME 4313 or an equivalent.
Derivation of governing equations, steady and transient solutions, variable property effects, numerical methods.
- 5343 Convection**
(3-0) 3 hours credit. Prerequisite: ME 4313 or an equivalent.
Derivation of equations of convection of mass, momentum, and energy; scale analysis; boundary layer solutions; classical, laminar convection problems; turbulent convection.
- 5353 Radiation**
(3-0) 3 hours credit. Prerequisite: ME 4313 or an equivalent.
Thermal radiation laws, geometric factors, black bodies, gray enclosures, nongray systems, combined conduction, convection, and radiation.
- 5413 Advanced Solid Mechanics**
(3-0) 3 hours credit. Prerequisite: ME 3813 or an equivalent.
Variational mechanics, energy methods, elementary viscoelastic/plastic problems, and wave propagation. (Formerly EGR 5543. Credit cannot be earned for both ME 5413 and EGR 5543.)
- 5453 Advanced Strength of Materials**
(3-0) 3 hours credit. Prerequisite: ME 3813 or an equivalent.
Failure theories, energy methods, advanced topics in bending, torsion, and elastic stability. (Formerly EGR 5553. Credit cannot be earned for both ME 5453 and EGR 5553.)
- 5463 Fracture Mechanics**
(3-0) 3 hours credit. Prerequisites: ME 3243 and ME 3813, or their equivalents.
Introduction to failure and fracture of engineering materials, Griffith's energy balance, stress intensity and strain energy release rate approaches to brittle fracture, Dugdale and Irwin approaches to ductile fracture. Application to modern engineering materials. (Formerly EGR 5313. Credit cannot be earned for both ME 5463 and EGR 5313.)

- 5473 Viscoelasticity**
(3-0) 3 hours credit. Prerequisite: ME 3813 or an equivalent.
Principle of fading memory, integro-differential constitutive laws, mechanical models, time and temperature superposition, and linear and nonlinear methods. Applications to polymers, composites, and adhesives. (Formerly EGR 5323. Credit cannot be earned for both ME 5473 and EGR 5323.)
- 5483 Finite Element Methods**
(3-0) 3 hours credit. Prerequisite: Graduate standing in engineering or consent of instructor.
Derivation and computer implementation of the finite element method for the solution of boundary value problems.
- 5513 Advanced Mechanism Design**
(3-0) 3 hours credit. Prerequisite: ME 3513 or an equivalent.
Advanced topics in kinematic synthesis of linkage, static and dynamic force analyses, and computer-aided design of mechanisms.
- 5533 Advanced Machine Design**
(3-0) 3 hours credit. Prerequisite: ME 3823 or an equivalent.
Advanced problems in machine design, including bearings, brakes, clutches, gears, shafts, springs, and advanced stress analysis.
- 5543 Probabilistic Engineering Design**
(3-0) 3 hours credit. Prerequisite: STA 2303 or an equivalent.
Development and application of probabilistic methods in engineering: random variable definitions, probability distributions, distribution selection, functions of random variables, numerical methods including Monte Carlo sampling, First Order Reliability Methods, and component and systems reliability.
- 5553 Advanced Design of Cams and Gears**
(3-0) 3 hours credit. Prerequisites: ME 3513 and ME 3823, or their equivalents.
Advanced problems in design of cam follower systems, gear trains and spur, helical, bevel, and worm gears.
- 5613 Advanced Fluid Mechanics**
(3-0) 3 hours credit. Prerequisite: ME 3663 or an equivalent.
Dynamics of incompressible fluid mechanics viscous flow, Navier-Stokes equations, boundary layer theory, and numerical operations for incompressible fluid flow.
- 5633 Gas Dynamics**
(3-0) 3 hours credit. Prerequisite: ME 3663 or an equivalent.
Integral and differential forms of the conservation equations, one-dimensional flow, oblique shock and expansion waves, and supersonic, transonic, and hypersonic flows.
- 5653 Computational Fluid Dynamics**
(3-0) 3 hours credit. Prerequisite: ME 3663 or an equivalent.
The mathematical models for fluid-flow simulations at various levels of approximation, basic description techniques, and the nature of flow equations and their boundary conditions.
- 5683 Advanced Design of Thermal and Fluid Systems**
(3-0) 3 hours credit. Prerequisites: ME 3663 and ME 4313, or their equivalents.
Development of energy systems, power systems, and the mechanics of combustion.
- 5713 Mechanical Behavior of Materials**
(3-0) 3 hours credit. Prerequisites: ME 3243 and ME 3813, or their equivalents.
Mechanical behavior of engineering materials (metals, alloys, ceramics, and polymers) elasticity, dislocation theory, strengthening mechanism, fracture, fatigue, creep, and oxidation.

- 5743 Composite Materials**
(3-0) 3 hours credit. Prerequisites: ME 3243 and ME 3813, or their equivalents.
Introduction to mechanics of composites, micromechanics, macromechanics, lamination theory, design, and applications of fiber-reinforced composites and particulate composites. (Formerly EGR 5413. Credit cannot be earned for both ME 5743 and EGR 5413.)
- 5843 Security and Response Applications of Engineering**
(3-0) 3 hours credit. Prerequisite: Graduate standing in engineering or consent of instructor.
Application of engineering principles to the analysis of high consequence events. Use of analytical and computational modeling tools. Examination of various scenarios and demonstration of solution techniques.
- 5853 Simulation & Modeling Applications in Security**
(3-0) 3 hours credit. Prerequisite: ME 5483 or ME 5653 or consent of instructor
Application of computational modeling techniques in the solution of security problems. Will address scenarios such as chemical dispersion, explosion loads, and structural response.
- 5863 Risk Analysis for Security**
(3-0) 3 hours credit. Prerequisite: Graduate standing in engineering or consent of instructor.
Application of risk analysis techniques in the assessment of security problems. Hazard and consequence identification processes.
- 5873 Solid State Microfabrication Technology**
(3-0) 3 hours credit. Prerequisite: EGR 3323 or an equivalent.
Fundamentals of modeling and microfabrication schemes for semiconductor active devices and MEMS. Techniques for both silicon and compound semiconductor processing. Topics include: wafer growth, oxidation, diffusion, ion implantation, lithography, etch and deposition. Includes hands-on, clean-room exposure for fabrication of simple representative microdevices. (Same as EE 5393. Credit cannot be earned for both ME 5873 and EE 5393.)
- 5893 Advanced Topics in Sensors and Actuators**
(3-0) 3 hours credit. Prerequisite: ME 5843 or consent of instructor.
Explore advanced microfabrication approaches for a variety of sensors, such as magnetic, acoustic, mechanical, radiation, thermal, chemical and biological. Different actuation schemes are also covered (electrostatic, piezoelectric, thermal, magnetic and shape-memory-alloys). (Same as EE 5493. Credit cannot be earned for both ME 5893 and EE 5493 when the topic is the same.)
- 5973 Special Project**
3 hours credit. Prerequisite: Permission in writing (form available) from the instructor and the Graduate Advisor of Record.
The directed research course is offered only for nonthesis option students and may involve either a laboratory or a theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree.
- 5991 Graduate Seminar**
(1-0) 1 hour credit. Prerequisites: Graduate standing and consent of instructor.
May be repeated for credit up to a limit of 2 hours.
- 6813 Biomaterials**
(3-0) 3 hours credit. Prerequisite: ME 3243 or an equivalent.
Fundamentals in applications of biomaterial science and engineering principles and concepts to repairing, replacing, and protecting human tissues and organs. (Formerly ME 5813. Credit cannot be earned for both ME 6813 and ME 5813.) (Same as BME 6903. Credit cannot be earned for both ME 6813 and BME 6903.)

6833 Biomechanics

(3-0) 3 hours credit. Prerequisites: ME 3243, ME 3663, and ME 3813, or their equivalents.

Fundamentals in applications of engineering mechanics to modeling structures and functions of tissues, organs, joints, and human body. (Formerly ME 5833. Credit cannot be earned for both ME 6833 and ME 5833. Same as BME 6803. Credit cannot be earned for both ME 6833 and BME 6803.)

6893 Topics in Biomechanics

(3-0) 3 hours credit. Prerequisite: ME 6833 or BME 6833 or an equivalent.

The biomechanics of biological tissues and organs. Topics may include constitutive equations, stress, and adaptation of hard and soft tissues. (Same as BME 6893. Credit cannot be earned for both ME 6893 and BME 6893 when the topic is the same.)

6951-3 Independent Study

1 to 3 hours credit. Prerequisites: Graduate standing and permission in writing (form available) of the instructor, the student's advisor, and the Graduate Advisor of Record.

Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree.

6961 Comprehensive Examination

1 hour credit. Prerequisite: Approval of the Mechanical Engineering Graduate Program Committee to take the Comprehensive Examination.

Independent study for the purpose of taking the Comprehensive Examination. May be repeated for credit as many times as approved by the Mechanical Engineering Graduate Program Committee. Enrollment is required each term in which the Comprehensive Examination is taken if no other courses are being taken that term. The grade report for the course is either "CR" (satisfactory performance on the Comprehensive Examination) or "NC" (unsatisfactory performance on the Comprehensive Examination).

6971-3 Special Problems

(1-0, 2-0, 3-0) 1 to 3 hours credit. Prerequisite: Consent of instructor.

An organized course offering the opportunity for specialized studies not normally available as part of the regular course offerings. Special Problems courses may be repeated for credit when topics vary, but not more than 6 hours, regardless of discipline, may be applied to the Master's degree.

6983 Master's Thesis

3 hours credit. Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor.

Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress.