MECHANICAL ENGINEERING ME

Department of Mechanical Engineering
College of Engineering

201 Thermodynamics
Fall, Spring, Summer. 3(3-0) P: (CEM 141 or CEM 151 or CEM 181H or LB 171) and ((MTH 234 or concurrently) or (MTH 254H or concurrently) or (LB 220 or concurrently)) and (PHY 183 or PHY 183B or PHY 193H or PHY 233B or LB 273) Not open to students with credit in BE 351 or CHE 321.
Basic concepts of thermodynamics. Property evaluation of ideal gases and compressible substances. Theory and application of the first and second laws of thermodynamics. Entropy and Carnot efficiency.

221 Statics
Fall, Spring. 3(3-0) Interdepartmental with Civil Engineering. Administered by Civil Engineering. P: {(PHY 183 or PHY 183B or PHY 193H) or (PHY 231 and PHY 233B)} and ((MTH 234 or concurrently) or (LB 220 or concurrently) or (MTH 254H or concurrently)) SA: MSM 205
Vector description of forces and moments. Two- and three- dimensional equilibrium of particles and rigid bodies. Analysis of trusses, frames, and machines. Coulomb friction.

222 Mechanics of Deformable Solids
Fall, Spring, Summer. 3(2-2) P: MTH 234 and CE 221 SA: MSM 211
Tension compression and shear stresses. Axially loaded bars. Torsion of circular shafts. Beam theory. Combined stresses. Mohr's circles. Columns.

280 Graphic Communications
Fall, Spring. 2(2-0) P: (EGR 100) and ((LB 118 or concurrently) or (MTH 132 or concurrently) or (MTH 152H or concurrently)) and ((EGR 102 or concurrently) or (CSE 231 or concurrently)) SA: ME 180
Computer-aided three-dimensional design. Free-hand sketching. Two-and-three-dimensional visualization. Blueprint reading.

300 Professional Issues in Mechanical Engineering
Fall, Spring. 1(1-0) P: Completion of Tier I Writing Requirement R: Open to juniors or seniors in the Mechanical Engineering Major.
Professional conduct and ethical behavior in the workplace. Practice in professional writing and oral presentation. Global, economic, environmental and societal context of engineering. Contemporary issues in engineering. Group dynamics and working in teams. Intellectual property.

332 Fluid Mechanics
Fall, Spring. 4(3-3) P: ME 361 and (CHE 321 or ME 201) and ((ME 391 or concurrently) and completion of Tier I writing requirement) R: Open to juniors or seniors in the Mechanical Engineering Major.
Statics, control volume equations, similitude, and exact fluid solutions. Turbulence, pipe flow, boundary layer flow, compressible flow, and Navier-Stokes equations.

361 Dynamics
Fall, Spring. 3(3-0) P: (CE 221) and (MTH 235 or MTH 340 or MTH 347H) R: Open to students in the College of Engineering. SA: MSM 306
Kinematics of particles, rigid bodies, and mass moments of inertia. Kinetics of particles and rigid bodies. Energy and momentum principles.

370 Mechanical Design and Manufacturing I
Fall, Spring. 3(3-0) P: (ME 222 and (ME 300 or concurrently) and (ME 391 or concurrently)) and completion of Tier I writing requirement R: Open to juniors or seniors in the Mechanical Engineering Major. SA: ME 471
Engineering design of machine elements and mechanical systems. Computer-based analysis in support of design. Design for static and fatigue strength, deflection, and reliability.

372 Machine Tool Laboratory
Fall, Spring. 1(0-2) R: Open to juniors or seniors in the Mechanical Engineering Major.
Principles and practice of machine tools. Safety, terminology, measurement, and working procedures for hand and machine tools.

385 Computer Aided Design Tools
Spring. 3(0-6) P: ME 280 R: Open to students in the College of Engineering. SA: ME 285
Advanced 3-D solid modeling

391 Mechanical Engineering Analysis
Fall, Spring. 3(3-0) P: (MTH 235 or MTH 340 or MTH 347H) and CSE 231 R: Open to juniors or seniors in the Biosystems Engineering Major or in the Mechanical Engineering Major.
Analytical and numerical methods for the modeling and analysis of mechanical engineering systems. Applications to vibrating elements, heat transfer, linear springs, and coupled spring-mass systems.

399 Special Topics in Mechanical Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Approval of department.
Topics selected to supplement and enrich existing courses.

410 Heat Transfer
Fall, Spring. 3(3-0) P: (ME 332 or CE 321 or CHE 311) and ME 391 R: Open to juniors or seniors in the Mechanical Engineering Major.
Steady state and transient heat conduction. Natural and forced convection based on boundary layer theory. Application of Nusselt number correlations. Radiant heat transfer principles and applications including radiation networks.

412 Heat Transfer Laboratory
Fall, Spring. 2(1-2) P: (ME 410 or concurrently) and completion of Tier I writing requirement R: Open to juniors or seniors in the Mechanical Engineering Major.
Practices and measurement techniques for heat transfer and thermal systems. Experimental problem solving applied to heat transfer.

413 Cryogenic-Thermal Systems
Spring. 3(3-0) P: ME 410 or concurrently R: Open to juniors or seniors in the Mechanical Engineering Major.
Low temperature properties of materials and fluids. Introduction to cryogenic liquefaction and refrigeration cycles, separation and purification systems, instrument systems for low temperature measurement, fluid storage and distribution, vacuum technology.

414 Mechanical Design of Cryogenic Systems
Fall. 3(3-0) P: ME 470 or concurrently R: Open to juniors or seniors in the Mechanical Engineering Major.
Engineering mechanical design of cryogenic refrigeration fluid systems. Design, analysis and introduction to ASME codes pertaining to piping systems/components, vacuum insulated transfer-lines, cold boxes, and super-conducting magnet cooling.

416 Computer Assisted Design of Thermal Systems
Fall. 3(4-0) P: (ME 410 or concurrently) R: Open to juniors or seniors in the Mechanical Engineering Major.
Classifying, cataloging and processing design information. Modeling of thermal equipment. Simulation and optimization of thermal systems. Computer based design projects.

417 Design of Alternative Energy Systems-
Spring. 3(3-0) P: ME 410 or concurrently R: Open to juniors or seniors in the Mechanical Engineering Major.
Analysis of alternative energy systems, including ocean, wind, fuel cells, solar, and nuclear. Predictive models for the systems. Design studies.

422 Introduction to Combustion
Fall. 3(3-0) P: (ME 332 or concurrently) R: Open to juniors or seniors in the Mechanical Engineering Major.
Thermodynamics, chemistry, fluid mechanics, and heat transfer principles applied to combustion.

423 Intermediate Mechanics of Deformable Solids
Fall. 3(3-0) P: ME 222 R: Open to students in the College of Engineering. SA: MSM 401
Stress, strain and linearly elastic behavior. Plane stress and plane strain. Torsion. Yield criteria. Elastoplastic behavior of beams, shafts and cylinders. Unsymmetrical bending. Curved beams.

425 Experimental Mechanics
Fall. 3(2-3) P: ME 222 R: Open to students in the College of Engineering. SA: MSM 405
Measurement of stress, strain, vibration, and motion using strain gauges, accelerometers, photoelasticity, holography, Moire patterns, laser speckle and electronic imaging. Transducer design.

426 Introduction to Composite Materials
Spring. 3(3-0) Interdepartmental with Materials Science and Engineering. Administered by Mechanical Engineering. P: ME 222 R: Open to juniors or seniors in the College of Engineering. SA: MSM 444
Constituents and interfacial bonding. Manufacturing techniques. Microstructure and micromechanics. Theory of anisotropy. Classical laminate theory. Material characterization. Failure and damage. Composite structure design.

433 Introduction to Computational Fluid Dynamics
Spring. 3(3-0) P: ME 410 or concurrently R: Open to juniors or seniors in the Department of Mechanical Engineering.
Theory and application of finite difference and finite volume methods to selected fluid mechanics and heat transfer problems developed based on Euler and Navier-Stokes equations. Application of commercial software to computational fluid dynamics problems.

440 Aerospace Propulsion
Fall. 3(3-0) P: ME 332 R: Open to juniors or seniors in the Mechanical Engineering Major.
Fundamentals of thrust and propulsion systems, including gas turbines, ramjets, rockets and electric devices. Compressible flow through nozzles and shocks. Cycle analysis of airbreathing jet propulsion and chemical rocket propulsion. Performance and design of propulsion components.

441 Aerodynamics and Aircraft Performance
Spring. 3(3-0) P: ME 332 R: Open to juniors or seniors in the Mechanical Engineering Major.
Solutions to inviscid and viscous fluid dynamical equations. Aerodynamics of airfoils, wing and fuselage. Aircraft performance parameters and basics of flight, including cruise, turning, takeoff and landing. Introduction to stability, including control surfaces, longitudinal and lateral stability and power effects.

442 Turbomachinery
Spring. 3(3-0) P: (ME 332) R: Open to juniors or seniors in the Mechanical Engineering Major.
Applying energy, momentum, and continuity equations of thermo-fluids to turbomachinery. Blade geometry and aerodynamics. Performance and design parameters. Turbomachine design.

444 Automotive Engines
Fall. 3(3-0) P: (ME 410 or concurrently) R: Open to juniors or seniors in the Mechanical Engineering Major.
Design and development of internal and external combustion engines for vehicular propulsion.

445 Automotive Powertrain Design
Spring. 3(3-0) P: (ME 444) R: Open to juniors or seniors in the Mechanical Engineering Major.
Design of powertrain systems including piston ring assembly, combustion and induction systems, and transmissions. Performance emission tradeoffs with emphasis on emission control. Detailed design study required.

451 Control Systems
Fall, Spring. 4(3-3) P: ME 461 and ECE 345 R: Open to juniors or seniors in the Mechanical Engineering Major.
Mathematical modeling of dynamic systems. Standard feedback control formulation. Transient and sinusoidal steady state analysis. Time and frequency domain controller synthesis.

456 Mechatronic System Design
Fall. 3(2-3) P: (ECE 345 or concurrently) and (ME 391 or concurrently) R: Open to juniors or seniors in the Department of Mechanical Engineering.
Application of imbedded microcontrollers to the design of mechatronic systems. Introduction to feedback and feedforward control concepts. Application to automotive, consumer, industrial and commercial systems.

461 Mechanical Vibrations
Fall, Spring. 3(3-0) P: ME 361 and ME 391 R: Open to juniors or seniors in the Mechanical Engineering major.
Modeling and analysis of oscillatory phenomena found in linear discrete and continuous mechanical systems.

464 Intermediate Dynamics
Spring. 3(3-0) P: (ME 361) R: Open to students in the College of Engineering. SA: MSM 403
Kinematics and kinetics of particle and rigid body systems. Virtual work, Lagrangian method, and Euler equations. Basic vibrations of discrete and continuous systems. Elementary wave propagation.

465 Computer Aided Optimal Design
Spring. 3(3-0) P: (ME 222 and ME 280) and (ME 370 or concurrently) R: Open to juniors or seniors in the Mechanical Engineering Major.
Modeling for mechanical design optimization. Algorithms for constrained and unconstrained optimization. Optimality criteria. Optimization using finite element models. Design projects.

470 Mechanical Design and Manufacturing II
Fall, Spring. 3(3-0) P: ME 361 and ME 370 R: Open to juniors or seniors in the Mechanical Engineering Major. SA: ME 371
Kinematic analysis of linkage mechanisms, spur gears and cam-follower systems. Completion of design project.

475 Computer Aided Design of Structures
Fall. 3(3-0) P: ME 370 R: Open to juniors or seniors in the Mechanical Engineering Major.
Computational methods for analysis, design, and optimization of structural components. Basic concepts in geometric modeling, finite element analysis, and structural optimization.

477 Manufacturing Processes
Fall, Spring. 3(3-0) Interdepartmental with Materials Science and Engineering. Administered by Mechanical Engineering. P: ME 222 and MSE 250 R: Open to students in the Applied Engineering Sciences Major or in the Materials Science and Engineering Major or in the Mechanical Engineering Major. SA: MSM 481
Fundamentals of manufacturing processes such as casting, heat treating, particulate processing, forming, machining, joining, and surface processing. Selection of manufacturing processes based on design and materials.

478 Product Development
Spring. 3(3-0) P: ME 477 R: Open to juniors or seniors in the Materials Science and Engineering Major or in the Mechanical Engineering Major. SA: MSM 482
Simulation of industrial environment for product development. Product concept, design, and manufacturing.

481 Mechanical Engineering Design Projects
Fall, Spring. 3(1-6) P: (ME 410 and ME 470) and completion of Tier I writing requirement R: Approval of department; application required.
Application of design concepts in mechanical engineering. Problem definition, design specifications. Modeling and analysis methods. Design optimization, economics, reliability. Manufacturing considerations in design. Capstone design projects.

489 Technical Communication for Engineers
Spring. 2(2-0) RB: Engineers R: Open to juniors or seniors or graduate students in the College of Engineering.
Investigation of technical communication in the engineering workplace. Drafting, revising, and editing communications directed at a variety of audiences. Includes team writing activities, presentations, style, and flow.

490 Independent Study in Mechanical Engineering
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open to seniors in the Department of Mechanical Engineering. Approval of department.
Independent study in mechanical engineering.

491 Selected Topics in Mechanical Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open to seniors in the Department of Mechanical Engineering. Approval of department.
Topics selected to supplement and enrich existing courses.

494 Biofluid Mechanics and Heat Transfer
Fall. 3(3-0) Interdepartmental with Biomedical Engineering. Administered by Mechanical Engineering. P: (ME 410 or concurrently) or (CHE 311 or concurrently) or (BE 350 or concurrently) R: Open to juniors or seniors or graduate students in the College of Engineering.
Applications of fluid mechanics, heat transfer, and thermodynamics to biological processes, including blood flow in the circulatory system, heart function, effects of heating and cooling on cells, tissues, and proteins. Pharmacokinetics.

495 Tissue Mechanics
Spring. 3(3-0) Interdepartmental with Biomedical Engineering. Administered by Mechanical Engineering. P: (ME 222) R: Open to students in the College of Engineering. SA: MSM 441
Application of solid mechanics to understanding mechanical responses of biological tissues. Microstructure and biological function for soft and hard connective tissues and muscle.

497 Biomechanical Design in Product Development
Spring. 3(3-0) Interdepartmental with Biomedical Engineering. Administered by Mechanical Engineering. P: ME 370 or concurrently R: Open to juniors or seniors in the Department of Mechanical Engineering. SA: BME 491A, MSM 445
Biomechanical product design with application to people or animals. Synthesis, prototyping, and analysis of designs. Project management. Market research.

800 Engineering Analysis
Fall. 3(3-0)
Use of analytical methods of mathematics in engineering applications. Applications of partial differential equations to thermal-fluid and vibration problems, vector calculus and tensor analysis in fluid and solid mechanics, and analytical function theory in mechanics.

810 Advanced Classical Thermodynamics
Fall. 3(3-0) P: ME 391 RB: ME 391 R: Open to graduate students in the College of Engineering. SA: ME 802
Postulational treatment of the laws of thermodynamics. Equilibrium and maximum entropy postulates. Principles for general systems.

811 Micro-Scale Fluid Mechanics and Heat Transfer
Spring of odd years. 3(3-0) RB: ME 332 SA: ME 804
Basic concepts of micro-scale processes. Molecular derivation of the conservation equations of fluid dynamics, Boltzmann equation and Monte-Carlo methods of modern micro-applied science. Theory of micro-scale heat transfer. Applications to fluid mechanics, heat transfer, combustion.

812 Conductive Heat Transfer
Fall. 3(3-0) RB: ME 391 and ME 410
Theory of steady and unsteady heat conduction. Derivation of describing equations and boundary conditions. Numerical methods. Nonlinear problems.

814 Convective Heat Transfer
Spring. 3(3-0)
Analysis of convective transfer of heat, mass and momentum in boundary layers and ducts. Thermal instability. Free convection.

819 Combustion
Spring. 3(3-1) RB: ME 822
Thermodynamics and chemical kinetics. Multicomponent systems. Premixed and diffusion flames. Flame radiation.

820 Continuum Mechanics
Fall. 3(3-0) SA: MSM 810
Mathematical tools of continuum mechanics, stress principles, kinematics of deformation and motion, fundamental laws and equations. Applications in linear elasticity and classical fluids.

821 Linear Elasticity
Spring. 3(3-0) RB: ME 820 SA: MSM 813
Fundamentals of isotropic linear elasticity. Solution of plane elasticity problems. St. Venant bending and torsion. Singular solutions. Basic three-dimensional solutions.

824 Plasticity
Spring of odd years. 3(3-0) RB: ME 821 SA: MSM 817
Yield conditions, stress-strain relations, plastic potential, hardening theories, torsion, bending. Thick walled shells under internal pressure. Limit analysis. Slip line theory.

825 Experimental Mechanics
Spring. 3(2-3) R: Open to graduate students in the College of Engineering. SA: MSM 805
Measurement of strain, displacement, velocity, and acceleration using resistance strain gages, accelerometers, and related methods. Detailed study of strain gages and accelerometers. Transducer design. Basic modal analysis.

826 Laminated Composite Materials
Fall of even years. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. P: (ME 820) SA: MSM 814
Fundamentals of anisotropic elasticity and their application to laminated composite plates. Unique states of deformation, stress, and failure not encountered in isotropic, homogeneous materials.

830 Fluid Mechanics I
Fall. 3(3-0)
Integral and differential conservation laws, Navier-Stokes' equations, and exact solutions. Laminar boundary layer theory, similarity solutions, and approximate methods. Thermal effects and instability phenomena.

832 Fluid Mechanics II
Spring of even years. 3(3-0) RB: ME 830 and MTH 425
Inviscid flow, vortex motion, flow past bodies. Complex variables and conformal mapping. One-dimensional steady and unsteady compressible flow, shock waves and Prandtl-Meyer expansion. Small perturbations theory and method of characteristics.

834 Fundamentals of Turbulence
Fall of odd years. 3(3-0)
Statistical descriptions of turbulent flows: isotropic, free shear and wall bounded. Correlation and spectral descriptions. Conditional probabilities and coherent motions. Experimental methods. Scaling relationships.

835 Turbulence Modeling and Simulation
Fall of even years. 3(3-0) RB: (ME 830) and familiarity with graduate-level fluid mechanics and mathematics.
Basic turbulence theory. Transport equations for calculations of turbulent flows. Current status of modeling and simulation of turbulent flows. Direct numerical simulation. Reynolds-averaged simulations. Large eddy simulation. Probability density function methods in turbulence.

836 Experimental Methods in Fluid Mechanics
Fall of even years. 3(2-2)
Modern techniques of fluid mechanics measurement and data analysis. Pressure, temperature and velocity measurement techniques. Optical diagnostics.

840 Computational Fluid Dynamics and Heat Transfer
Spring. 3(3-0) RB: ((ME 410) and programming experience.) and (ME 830 or ME 814)
Theory and application of finite difference and finite volume methods to selected fluid mechanics and heat transfer models including the full potential flow model, the systems of Euler and Navier-Stokes equations, and turbulence. Grid generation techniques.

842 Advanced Turbomachinery
Spring of even years. 3(3-0) RB: ME 442 R: Open only to seniors and graduate students in Mechanical Engineering and Chemical Engineering.
Application of energy, momentum, continuity and heat transfer equations to energy transfer and transformation in turbomachinery.

851 Linear Systems and Control
Fall. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering. RB: Undergraduate coverage of linear algebra, differential equations and control/systems
State models and their stability, controllability, and observability properties. Finding minimal realizations of transfer functions. Design of state and output feedback controllers. Design of state observers. LQ regulator and the Kalman filter. Time-varying systems.

853 Optimal Control
Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering.
Static optimization. Nonlinear optimal control of discrete and continuous systems, with specialization to the LQ regulator and tracking. Extending the deterministic results to the Kalman filter and the LQG regulator. Dynamic programming and inequality constraints. Convex optimization and LMI's.

854 Robust Control
Spring of even years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Mechanical Engineering. R: Open to graduate students in the College of Engineering.
Linear systems and norms for signals and systems. Investigation of stability and performance of control systems. Model reduction, uncertainty, and robustness. Parameterization of stabilizing controllers, Ricatti equations and related factorizations. Application to H-2, H-infinity, and L-1 control.

856 Adaptive Control
Fall of even years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering.
Real-time parameter estimation. Design of self-tuning regulators and model reference adaptive controllers. Investigation of robustness and robust adaptive controllers. Extension to nonlinear systems.

859 Nonlinear Systems and Control
Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Mechanical Engineering. RB: ECE 851 R: Open to students in the College of Engineering. SA: ECE 827
Second-order systems and fundamental properties of solutions. Lyapunov stability, input-output stability, passivity, absolute stability, and linearization. Design of feedback controllers using integral control, feedback linearization, sliding mode control, Lyapunov redesign, passivity-based control, and recursive methods. Applications to electrical and mechanical systems.

860 Theory of Vibrations
Fall. 3(3-0)
Discrete systems and continua. Analytical mechanics. Variational principles. Modal analysis. Function spaces. Eigenfunction expansions. Integral transforms. Stability. Approximations. Perturbations.

861 Advanced Dynamics
Fall. 3(3-0) SA: MSM 801
Dynamics of systems of particles and rigid bodies. Energy and momentum principles. Lagrangian and Hamiltonian methods. Euler angles. Applications in system dynamics and vibrations.

863 Nonlinear Vibrations
Spring of even years. 3(3-0) RB: ME 461
Perturbation methods. Weakly nonlinear partial and ordinary differential equations. Modal interactions, internal tuning, saturation, sub/super/combination resonances, jump phenomenon. Nonlinear normal modes.

872 Finite Element Method
Fall, Spring. 3(3-0) Interdepartmental with Civil Engineering. Administered by Mechanical Engineering. SA: AE 809, MSM 809
Theory and application of the finite element method to the solution of continuum type problems in heat transfer, fluid mechanics, and stress analysis.

874 Analysis of Metal Forming and Manufacturing Processes
Fall of odd years. 3(3-0) RB: ME 471 and MSM 809 and MSM 817 and MSM 810
Review of fundamental knowledge in mechanics, materials and numerical analysis. Modeling, simulation and analysis of metal forming and manufacturing processes.

875 Optimal Design of Mechanical Systems-
Spring of odd years. 3(3-0) RB: ME 461
Optimal design for static and dynamic response of mechanical and structural systems. Necessary and sufficient conditions for optimality. Discrete and continuous parameter problems. Sensitivity of response to design variations. Algorithms.

881 Cardiovascular Mechanics
Fall. 3 credits. RB: (ME 222 or ME 332) or undergraduate level of solid mechanics or fluid mechanics.
Solid and fluid mechanics of the cardiovascular system. Computational modeling tools for simulating hemodynamics and stress-mediated growth and remodeling in patient-specific geometry.

891 Selected Topics in Mechanical Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.
Special topics in mechanical engineering of current importance.

892 Mechanical Engineering Seminar
Fall, Spring. 1 credit.
Attend and present seminars in order to develop research and presentation skills relevant to mechanical engineering.

898 Master's Project Research
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 7 credits in all enrollments for this course. R: Open only to master's students in the Mechanical Engineering major. Approval of department.
Master's degree Plan B individual student project: original research, research replication, or survey and reporting on a topic such as system design and development, or system conversion of installation.

899 Master's Thesis Research
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 24 credits in all enrollments for this course.
Master's thesis research.

921 Nonlinear Elasticity
Fall of odd years. 3(3-0) RB: ME 821 SA: MSM 915
Kinematics and kinetics of large deformations. Incompressible and compressible finite elasticity. Solution of basic problems. Nonuniqueness, stability, and buckling. Singular fields near cracks and flaws.

922 Thermoelasticity and Viscoelasticity
Spring of even years. 3(3-0) RB: ME 820 and MTH 443 SA: MSM 918
Thermomechanics of solids. Theory of thermoelasticity. Boundary value problems in thermoelasticity. Linear and nonlinear viscoelasticity. Model representation. Boltzmann superposition. Correspondence principle.

940 Selected Topics in Thermal Science
Spring. 1 to 3 credits. A student may earn a maximum of 12 credits in all enrollments for this course. RB: ME 812 and ME 814 and ME 816 R: Open only to Mechanical Engineering majors.
Conduction, convection, radiation, phase change and interactive combined modes of heat transfer. Mass transfer. Irreversible thermodynamics.

960 Selected Topics in Vibrations
Fall. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. RB: ME 860
Current topics of interest to the student and faculty.

961 Nonlinear Dynamics and Chaos
Fall of even years. 3(3-0) RB: ME 857 or ME 860 or ECE 826 or MTH 441
Qualitative theory of dynamical systems applied to physical system models. Bifurcation theory for continuous and discrete-time systems, chaos, the Smale horseshoe, Melnikov's method, and nonlinear data analysis.

990 Independent Study in Mechanical Engineering
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course.
Individualized study of a current problem in mechanical engineering.

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course.
Doctoral dissertation research.