MECHANICAL ENGINEERING ME

Department of Mechanical Engineering
College of Engineering

180 Engineering Graphic Communications
Fall, Spring. 3(1-4) P: (MTH 116 or concurrently or LBS 117 or concurrently or MTH 132 or concurrently or MTH 152H or concurrently) or (MTH 103 and MTH 114 or concurrently) SA: MSM 160
Computer-aided design and drafting. Freehand sketching. Two and three dimensional visualization. Blueprint reading. Geometric dimensioning and tolerancing. Introduction to engineering design.

201 Thermodynamics
Fall, Spring. 3(3-0) P: (CEM 141 or CEM 151 or CEM 181H or LBS 171) and ((MTH 234 or concurrently) or (MTH 254H or concurrently) or (LBS 220 or concurrently)) and PHY 183 Not open to students with credit in CHE 321 or BE 351 or MSE 351.
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.

220 Introduction to Solid Mechanics
Spring. 4(4-0) P: (MTH 133 or MTH 153H or LBS 119) R: Not open to students in the Civil Engineering major or Engineering Arts major or Engineering Mechanics major or Manufacturing Engineering major or Materials Science and Engineering major or Mechanical Engineering major. SA: MSM 206 Not open to students with credit in ME 221 or ME 222.
Statics: moment and force resultants, equilibrium. Mechanics of deformable bodies: stress and strain, classification of material behavior, generalized Hooke's law. Engineering applications: axial loads, torsion of circular rods and tubes, bending and shear stresses in beams, deflection of beams, combined stresses, stress and strain transformation.

221 Statics
Fall, Spring, Summer. 3(2-2) Interdepartmental with Civil Engineering. Administered by Civil Engineering. P: (PHY 183 or PHY 183B or PHY 193H) 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. 4(3-2) P: (MTH 234 and ME 221) SA: MSM 211
Tension compression and shear stresses. Axially loaded bars. Torsion of circular shafts. Beam theory. Combined stresses. Mohr's circles. Columns.

285 Computer Aided Design Tools
Fall. 3(0-6) P: (ME 180) R: Open only to students in the Mechanical Engineering major. SA: MSM 260
Advanced 3-D solid modeling, CNC programming, and rapid prototyping.

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 only to juniors and 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: (ME 221) and (MTH 235 or MTH 255H or LBS 220) R: Open only 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.

371 Mechanical Design I
Fall, Spring. 3(3-0) P: (ME 361 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering major or Manufacturing Engineering major.
Analysis of displacement, velocity and acceleration in mechanical linkages. Kinematics and dynamics of machines.

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

385 Introduction to Product Design
Spring. 3(0-6) R: Open only to juniors or seniors in the Mechanical Engineering major. SA: MSM 360
Ideation methods, design methodology, 3-D model building, small-scale group and individual projects. Project presentations.

386 Computer Aided Product Design
Spring. 3(0-6) P: (ME 285) R: Open only to students in Mechanical Engineering major. SA: MSM 361
Freeform modeling techniques. Top-down product design. Use of computer tools to assist in the development of products.

391 Mechanical Engineering Analysis
Fall, Spring. 3(3-0) P: (MTH 235 or MTH 255H or LBS 220) R: Open only to juniors or seniors in the Mechanical Engineering major or Biosystems Engineering major or Engineering Mechanics 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 and completion of Tier I Writing requirement) R: Open only to juniors or seniors in the Mechanical Engineering major or Engineering Mechanics 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) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering major or Engineering Mechanics major.
Practices and measurement techniques for heat transfer and thermal systems. Experimental problem solving applied to heat transfer.

416 Computer Assisted Design of Thermal Systems
Fall. 3(4-0) P: (ME 410 or concurrently) R: Open only 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 only 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 only 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 only 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 of odd years. 3(2-3) P: (ME 222) R: Open only 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 Materials Science and Engineering. P: ME 222 R: Open only 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.

432 Intermediate Fluid Mechanics
Spring. 3(3-0) P: (ME 332) R: Open only to juniors or seniors in the Mechanical Engineering major.
Deformable control volumes, Navier-Stokes equations, vorticity and circulation. Exact solutions. Turbulence, boundary layer flows, compressible flows.

440 Aerospace Engineering Fundamentals
Fall. 3(3-0) P: (ME 332 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering major.
Aerodynamics, propulsion, and flight mechanics. Vehicle and propulsion engine performance and design characteristics.

442 Turbomachinery
Spring. 3(3-0) P: (ME 332) R: Open only 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 only 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 only 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 361 and ECE 345) and completion of Tier I writing requirement. R: Open only 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 and ME 451 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering major.
Application of imbedded microcontrollers to the design of mechatronic systems. Design of software and hardware for systems with mechanical, electrical and fluid components plus imbedded control systems. Laboratory exercises and design projects. Application to automotive, consumer and commercial systems.

457 Mechatronic System Modeling and Simulation
Spring. 3(3-0) P: (ME 451 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering major or Industrial Mathematics major.
Modeling and simulation of mechatronic systems, including mechanical, electrical, and fluid power effects. Transducer modeling, including pumps, motors, and valves. Application to automotive systems.

461 Mechanical Vibrations
Fall, Spring. 4(3-3) P: (ME 451) and completion of Tier I writing requirement. R: Open only 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
Fall of even years. 3(3-0) P: (ME 361) R: Open only 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
Fall. 3(3-0) P: (ME 471 or concurrently) R: Open only 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.

471 Mechanical Design II
Fall, Spring. 3(3-0) P: ME 371 and ME 391 and ME 222 R: Open only to juniors or seniors in the Mechanical Engineering major.
Engineering design of machine elements and mechanical systems. Computer-based analysis in support of design. Design for static and fatigue strength, deflection, and reliability.

475 Computer Aided Design of Structures
Spring. 3(2-2) P: (ME 471 or concurrently) R: Open only to 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) and completion of Tier I writing requirement R: Open only to students in the Applied Engineering Sciences, Materials Science and Engineering, and Mechanical Engineering majors. 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) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering major or Materials Science and 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 471) and completion of Tier I Writing requirement R: Approval of department; application required. Open only to seniors in the Mechanical Engineering major.
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.

486 International Networked Teams for Engineering Design
Fall. 3(2-2) P: ME 371 or approval of department RB: Basic engineering design. R: Open to seniors in the College of Engineering. Not open to students with credit in EGR 475.
A multidisciplinary, multicultural, multinational design and manufacturing experience based on industry-sponsored projects. Dispersed teamwork, communications, and leadership within the multicultural environment.

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 only to juniors or 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 only to juniors or seniors in the Department of Mechanical Engineering. Approval of department.
Topics selected to supplement and enrich existing courses.

492 Senior Research and Design Project (W)
Fall, Spring, Summer. 2 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P: Completion of Tier I writing requirement. R: Open only to seniors in the Mechanical Engineering major. Approval of department.
Design and analysis to solve mechanics related problem. Preparation of written report, oral presentation, and defense of the project.

494 Biofluid Mechanics and Heat Transfer
Fall. 3(3-0) P: (ME 410 or concurrently) or (CHE 311 or concurrently) or (BE 350 or concurrently) R: Open only 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. Pharmaco-kinetics.

495 Tissue Mechanics
Spring. 3(3-0) Interdepartmental with Biomedical Engineering. Administered by Mechanical Engineering. P: (ME 222) R: Open only 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
Spring. 3(3-0) Interdepartmental with Biomedical Engineering. Administered by Mechanical Engineering. R: Open only to juniors or seniors in the College of 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.

802 Advanced Classical Thermodynamics
Fall. 3(3-0) RB: ME 391 and ME 411
Postulational treatment of the laws of thermodynamics. Equilibrium and maximum entropy postulates. Principles for general systems.

804 Micro-Scale Fluid Mechanics and Heat Transfer
Spring of odd years. 3(3-0) RB: ME 332 and ME 410
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 411
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.

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.

822 Combustion
Spring of even years. 3(3-1) RB: ME 490 and ME 802
Thermodynamics and chemical kinetics. Multicomponent systems. Premixed and diffusion flames. Flame radiation.

823 Fracture Mechanics and Fatigue
Spring of even years. 3(3-0) RB: ME 821 SA: MSM 816
Brittle and ductile fracture. Elastic stress fields near cracks. Elastic-plastic analysis of crack extension. Plastic instability. Cyclic crack propagation. Models of cyclic deformation and fatigue failure. Environmental effects. Case studies.

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.

828 Advanced Strength of Materials
Spring of odd years. 3(3-0) SA: MSM 815
General theory of torsion, nonsymmetric bending, transverse shear, thin-walled beams, beams on elastic foundations, thick-walled cylinders. Basic contact mechanics. Failure criteria for solids.

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 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(1-4)
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 students in the College of Engineering and approval of college.
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.

855 Digital Data Acquisition and Control
Spring of odd years. 3(2-3) RB: ME 451
Real-time digital measurement and control programming for mechanical engineering systems. Analog-to digital and digital-to-analog converters, timer/counters, and instrument interfaces. Open-loop and closed-loop control. Laboratory projects.

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 Control
Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering. RB: ECE 826 and ME 857 SA: ECE 827
Second-order systems. Fundamental properties of solutions. Lyapunov stability. Input-output stability. Passivity. Absolute stability. Linearization. Integral control. Feedback linearization. Sliding mode control. Lyapunov redesign. Passivity-based control. Recursive methods. Applications to electrical and mechanical systems.

859 Nonlinear Systems and Control
Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Mechanical Engineering. RB: ECE 826 and ME 857 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.

891 Selected Topics in Mechanical Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.
Special topics in mechanical engineering of current importance.

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.

925 Optical Methods of Measurement
Fall of even years. 3(2-3) R: Open to graduate students in the College of Engineering. SA: MSM 905
Measurement of dimension, position, motion, and strain, using optical methods including holography, speckle interferometry, Moire, photoelasticity, laser Doppler, electronic imaging, and model analysis. Relevant optics theory.

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.

941 Advanced Computational Fluid Dynamics and Heat Transfer
Fall of even years. 3(3-0) P: ME 840
High-resolution methods such as total variation diminishing and essentially non-oscillatory, for hyperbolic conservation laws. Unstructured grid generation methods and finite element methods on these grids. Convergence acceleration methods for steady problems and basic concepts in parallel computing.

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 72 credits in all enrollments for this course.
Doctoral dissertation research.