MECHANICAL ENGINEERING

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)) 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 (MTH 254H 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.

222 Mechanics of Deformable Solids

386 Computer Aided Product Design
Spring. 3(0-6) P: ME 285 R: Open to students in the 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 MTH 340 or MTH 347H 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.

401 Heat Transfer
Fall, Spring. 3(3-0) P: (ME 332 or ME 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.

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

440 Aerospace Engineering Fundamentals
Fall. 3(3-0) P: (ME 332 or concurrently) R: Open 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 to juniors or seniors in the Mechanical Engineering Major. Applying energy, momentum, and continuity equations of thermal-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.

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. 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, 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 of mechanical vibration phenomena found in linear discrete and continuous mechanical systems.

464 Intermediate Dynamics
Fall of even years. 3(3-0) P: (ME 361) R: Open to students in the College of Engineering. SA: ME 310

465 Computer Aided Optimal Design
Spring. 3(3-0) P: (ME 222 and ME 280) and (ME 371 or concurrently) R: Open to juniors or seniors in the Mechanical Engineering Major.

471 Mechanical Design II
Fall, Spring. 3(3-0) P: ME 222 and ME 371 and ME 391 R: Open 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
Fall. 3(3-0) P: ME 471 or concurrently 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.

480 Mechanical Engineering Design Projects
Fall, Spring. 3(3-0) P: ME 410 and ME 471 R: Approval of department; application required.

481 Mechanical Engineering Design Projects
Fall, Spring. 3(3-0) P: ME 410 and ME 471 R: Approval of department; application required.

489 Technical Communication for Engineers
Spring. 2(2-0) RB: Engineers R: Open to juniors or seniors in the College of Engineering. SA: ME 371
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.

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, Spring. 3(3-0) 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: ME 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 371 or concurrently R: Open to seniors or juniors in the Department of Mechanical Engineering. SA: ME 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 of even years. 3(3-0) P: ME 410 or concurrently R: Open to students in the College of Engineering.

810 Advanced Classical Thermodynamics
Fall. 3(3-0) P: ME 391 R: Open to graduate students in the College of Engineering. SA: ME 802

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

812 Conductive Heat Transfer

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.

818 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  

823 Fracture Mechanics and Fatigue  
Spring of even years. 3(3-0) RB: ME 821 SA: MSM 816  

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. 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  

834 Fundamentals of Turbulence  
Fall of odd years. 3(3-0)  

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(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  

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 LMIs.

854 Robust Control  

856 Adaptive Control  

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  

860 Theory of Vibrations  
Fall. 3(3-0)  

861 Advanced Dynamics  
Spring. 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  

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  
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.

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

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 masters 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.

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.

Nonlinear Elasticity
Fall of odd years. 3(3-0) RB: ME 821 SA: MSM 915

Thermoelasticity and Viscoelasticity
Spring of even years. 3(3-0) RB: ME 820 and MTH 443 SA: MSM 918

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.

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.

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.