MECHANICAL ENGINEERING (MECH)

MECH 801 Analytical Methods in Engineering I
Description: Basic topics in real analysis and linear algebra with examples of applications from diverse branches of engineering and applied physics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 802

MECH 802 Analytical Methods in Engineering II
Prerequisites: MECH 801 or permission
Description: Continuation of ENGM 801 topics in complex analysis, linear algebra, ordinary and partial differential equations, and other areas of applied mathematics. Examples of applications from diverse branches of engineering and applied physics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 803 Internal Combustion Engines
Crosslisted with: MECH 403
Prerequisites: MECH 300 or equivalent.
Description: Basic cycle analysis and engine types, fundamental thermodynamics and operating characteristics of various engines are analyzed, combustion processes for spark and compression-ignition engines, fuels, testing procedures, and lubrication systems are evaluated. Emphasis on the thermodynamic evaluation of the performance and understanding the basic operation of various engine types.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 804 Theory of Combustion
Crosslisted with: MECH 404
Prerequisites: MECH 300 and MECH 420/MECH 820.
Description: Stoichiometric analysis of combustion processes. Energy transfer, flame propagation, and transformation velocities during combustion. Combustor applications and design considerations. Emission formation and methods of control.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 904

MECH 805 Turbomachinery
Crosslisted with: MECH 405
Prerequisites: MECH 300 and MECH 310/CIVE 310.
Description: Thermodynamic analysis and design of axial and radial flow turbines, compressors, and pumps. Fundamentals of the operating characteristics and performance parameters of turbomachines will be evaluated. Cavitation and blade element theory.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 806 Air Conditioning Systems Design
Crosslisted with: MECH 406
Prerequisites: MECH 300 or equivalent.
Description: Application of thermodynamic and fluid dynamic principles to the design of air conditioning systems. Comprehensive design project is an integral part of the course.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 807 Power Plant Systems Design
Crosslisted with: MECH 407
Prerequisites: MECH 300 or equivalent.
Description: Application of thermodynamic and fluid dynamic principles to the design of Power Plants. Comprehensive design project is an integral part of the course.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 808 Heat Exchanger Design
Crosslisted with: MECH 408
Prerequisites: MECH 300 or equivalent.
Description: Design methodology for various heat exchangers employed in mechanical engineering. Introduction to computer-aided design as applied to heat exchangers. Practical exercises in actual design tasks.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 810 Viscous Flow I
Prerequisites: MECH 310 and MATH 821
Description: Dynamics and kinematics of laminar flows of viscous fluids. Development of the equations of motion in general and some exact solutions to them. Flows with small to large (laminar) Reynolds numbers including fundamental concepts of the boundary layer on a flat plate.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: AREN 918; MECH 812

MECH 812 Viscous Flow II
Prerequisites: MECH 810, MATH 822 or MATH 824 or MECH 890
Description: Vorticity dynamics. Ideal flows in a plane and in axisymmetric and three-dimensional geometries. Advanced boundary layer theory. Introduction to stability and turbulent flows.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 912; MECH 916

MECH 813 Aerodynamics
Crosslisted with: MECH 413
Prerequisites: MECH 200 and MECH 310/CIVE 310.
Description: Subsonic and supersonic air flow theory, dynamics of flight, performance parameters, rotoranalysis, and special topics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 814 Compressible Flow
Crosslisted with: MECH 414
Prerequisites: MECH 300 and MECH 310/CIVE 310.
Description: Analysis of the flow of compressible fluids by means of the momentum equation, continuity equation, and the laws of thermodynamics and some application of thermodynamic laws to incompressible fluids.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 815 Two-Phase Flow
Crosslisted with: MECH 415
Prerequisites: MECH/CIVE 310; MECH 380 or parallel.
Description: Transport phenomena of homogeneous and heterogeneous types of mixtures such as solid-liquid, liquid-liquid, and liquid-gas. Properties of components and mixtures. Flow induced vibrations and parameter distributions. Optimization and design problems in multiphase systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 816 Engineering Acoustics
Crosslisted with: MECH 416
Prerequisites: MECH 310 and MATH 221/MATH 821.
Description: Transverse and longitudinal traveling waves. Acoustic wave equation of fluids. The reflection, transmission, radiation, reception, absorption, and attenuation of sound. Acoustic cavities and waveguides. Sound propagation in pipes, resonators and filters.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 820 Heat Transfer
Crosslisted with: MECH 420
Prerequisites: MECH 310.
Description: Heat transfer by conduction, convection, and radiation. Correlation of theory with experimental data and engineering design.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 404, MECH 804; MECH 487; MECH 922; MECH 923; MECH 924

MECH 821 Elements of Nuclear Engineering
Crosslisted with: MECH 421, ENGR 421
Prerequisites: ENGR 300 or ENGR 301 or ENGR 310; MATH 208/MATH 208H; and PHYS 212/PHYS 212H
Description: Survey of nuclear engineering concepts and applications. Nuclear reactions, radioactivity, radiation interaction with matter, reactor physics, risk and dose assessment, applications in medicine, industry, agriculture, and research.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ENGR 410; ENGR 420

MECH 822 Industrial Quality Control
Crosslisted with: MECH 422
Prerequisites: MECH 321 or STAT 380.
Description: Statistical process control and quality assurance techniques in manufacturing. Control charts, acceptance sampling, and analyses and design of quality control systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

MECH 824 Laser Material Processing with Compressible Flow Perspective
Crosslisted with: MECH 424
Prerequisites: Permission.
Description: Fundamentals of laser material processing. Laser material interactions from the compressible flow perspective. Analytical, semi-analytical, and numerical approaches.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 825 Solar Energy Engineering
Crosslisted with: MECH 425
Prerequisites: MECH 420 or permission.
Description: Conversion of solar energy into more useful forms with emphasis on environmental heating and cooling applications. Includes solar energy availability, solar collectors and design, solar systems and their simulation and solar economics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 826 Heat Transfer at Nanoscales and in Ultrashort Time Domains
Crosslisted with: MECH 426
Prerequisites: MECH 420.
Description: Heat transfer in nanoscale and nanostructured materials. Heat transfer in ultrafast laser materials processing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 828 Analysis of Thermal Data
Crosslisted with: MECH 428
Prerequisites: MECH 420 or parallel.
Description: Indirect measurement of thermal properties and heat flux are explored with various methods, and optimization, with examples drawn from engineering practice.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

MECH 831 Computational Heat Transfer and Fluid Flow
Crosslisted with: MECH 431
Prerequisites: MECH 310; MATH 314; MECH 420 or parallel.
Description: Finite difference methods for steady and transient diffusion and convection-diffusion problems. Finite volume technique for the solution of multi-dimensional fluid flow, and heat and mass transfer problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 932

MECH 833 Microscale Transport Phenomena in Biosystems
Crosslisted with: MECH 433
Prerequisites: MECH 310
Notes: Knowledge of engineering mathematics to describe physical systems, especially transport phenomena
Description: An introduction to transport phenomena with an emphasis on applying the principles of mass transfer and fluid dynamics to microscale biosystems including microorganisms. Topics include Brownian motion, diffusion-based mass transfer, cellular receptors, Taylor dispersion, bacterial diffusion, chemotaxis, low Reynolds number fluid dynamics, hydrodynamics of swimming microorganisms, surface tension and microfluidics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 835 Introduction to Cell Mechanics
Crosslisted with: MECH 435
Notes: Knowledge of calculus and basic physics to describe physical systems
Description: An introduction to cell mechanics with an emphasis on application of fundamental mechanics and various experimental methods to understanding cell mechanics. Topics include cell structure, basic solid/fluid/statistical mechanics, biopolymer mechanics, cytoskeletal network mechanics, cellular adhesion and motility, and mechanobiology.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 836 Introduction to Continuum Biomechanics
Crosslisted with: MECH 436
Prerequisites: Senior or graduate student standing
Notes: MATH 314 and MECH 325 are recommended.
Description: An introduction to continuum biomechanics with an emphasis on soft tissues. Case studies covering diverse applications of biomechanics in biology and medicine, including in the areas of mechanobiology, medical devices, and tissue engineering. Continuum mechanics concepts include kinematics, kinetics, balance laws, and constitutive relations. Includes some programming in MATLAB.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 837 Biomedical Device Design
Crosslisted with: MECH 437
Prerequisites: MECH 223, MECH 373
Notes: basic understanding of solid mechanics
Description: Design of devices intended for use in biomedical environments. Introduction to modeling of the bio-environment, biomaterials, and material selection. Overview of design methodologies and strategies used in biomedical device design from a material properties perspective. Introduction to federal regulation and other pertinent issues.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: SPRING

MECH 838 Mechanics of Biomaterials
Crosslisted with: MECH 438
Prerequisites: MECH 325 or AGEN/BSEN 324 or parallel
Description: Theory, application, simulation, and design of biomaterials that apply mechanical principles for solving medical problems (case studies in artery, brain, bone, etc.). Tentative Topics include Mechanical characterization of biomaterials; Bio-manufacturing a tissue; Function-structure relationship; Design and analysis of medical implants; Active response of biomaterials: growth and remodeling mechanism; Cellular behavior and measurements, etc.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

MECH 839 Biomaterial Surface Patterning
Crosslisted with: MECH 439
Description: Biomaterials, biocompatibility, and biomaterial surface characteristics (chemistry, surface energy, topography, wettability, etc.). Protein adsorption on biomaterials. Microscale and nanoscale chemical patterning; anisotropic and isotropic micro/nanotopography; cell sensing and response to patterned substrates.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 842 Intermediate Kinematics
Crosslisted with: MECH 442
Prerequisites: MECH 342.
Description: Analytical cam design. Geometry of constrained plane motion and application to the design of mechanisms. Analysis and synthesis of pin-jointed linkage mechanisms.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 943

MECH 843 Introduction to Piezoelectricity with Applications
Prerequisites: MECH 325, MECH 373, or equivalent, or permission
Description: Electrostatics, equations of piezoelectricity, static solutions, propagation of plane waves, waves in plates, surface waves, equations for piezoelectric rods and plates in extension and flexure, finite element formulation, finite element analysis of static, time-harmonic, and transient problems with applications in smart structures and piezoelectric devices.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 844 Intermediate Dynamics of Machinery
Crosslisted with: MECH 444
Prerequisites: MECH 342 and MECH 350.
Description: Fundamentals of vibration, vibration and impact in machines, balance of rotors, flexible rotor dynamics and instabilities, parametric vibration, advanced dynamics and design of cam mechanisms, and dynamics of flywheel.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 845 Mechanical Engineering Design Concepts
Crosslisted with: MECH 445
Prerequisites: MECH 200, MECH 342, MECH 350, and MECH 310/CIVE 310.
Description: Development of design concepts. Introduction to synthesis techniques and mathematical analysis methods. Applications of these techniques to mechanical engineering design projects.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 945
Course and Laboratory Fee: $20

MECH 848 Advanced Mechanics of Materials
Crosslisted with: MECH 448
Prerequisites: MECH 373, MECH 325.
Description: Stresses and strains at a point. Theories of failure. Thick-walled pressure vessels and spinning discs. Torsion of noncircular sections. Torsion of thin-walled sections, open, closed, and multicelled. Bending of unsymmetrical sections. Cross shear and shear center. Curved beams. Introduction to elastic energy methods.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 915; MECH 930; MECH 933; MECH 935; MECH 937; MECH 938; MECH 939; MECH 940; MECH 941; MECH 952

MECH 849 Advanced Dynamics
Crosslisted with: MECH 449
Prerequisites: MECH 373 and MATH 221/821.
Description: Particle Dynamics usung Newton's laws, energy principles, momentum principles. Rigid body dynamics using Euler's equations and Lagrange's equations. Variable mass systems. Gyroscopic motion.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 915; MECH 935

MECH 850 Mechanical Engineering Control Systems Design
Crosslisted with: MECH 450
Prerequisites: MECH 350.
Description: Applications of control systems analysis and synthesis for mechanical engineering equipment. Control systems for pneumatic, hydraulic, kinematic, electromechanical, and thermal systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Course and Laboratory Fee: $20

MECH 851 Introduction to Finite Element Analysis
Prerequisites: MECH 325 and MECH 880 or permission.
Description: Matrix methods of analysis. The finite element stiffness method. Computer programs. Applications to structures and soils. Introduction to finite element analysis of fluid flow.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: MECH 950; MECH 951
Course and Laboratory Fee: $25

MECH 852 Experimental Stress Analysis I
Crosslisted with: MECH 452
Prerequisites: MECH 325.
Description: Investigation of the basic theories and techniques associated with the analysis of stress using mechanical strain gages, electric strain gages, brittle lacquer, photoelasticity, and membrane analogy.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 952
Course and Laboratory Fee: $25

MECH 853 Robotics: Kinematics and Design
Crosslisted with: MECH 453
Description: Robotics synthesize some aspects of human function by the use of mechanisms, sensors, actuators, and computers.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 854 Introduction to Continuum Modeling
Crosslisted with: MECH 454
Prerequisites: MATH 221/821, MECH 325 and MECH 373.
Description: Basic concepts of continuum modeling. Development of models and solutions to various mechanical, thermal and electrical systems. Thermo-mechanical and electro-mechanical coupling effects. Differential equations, dimensional methods and similarity.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 855 Vehicle Dynamics
Crosslisted with: MECH 455
Prerequisites: MECH 343 and MECH 350.
Description: Introduction to basic mechanics governing automotive vehicle dynamic acceleration, braking, ride, handling and stability. Analytical methods, including computer simulation, in vehicle dynamics. The different components and subsystems of a vehicle that influence vehicle dynamic performance.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Course and Laboratory Fee: $20

MECH 856 Dynamics of Internal Combustion Engines
Crosslisted with: MECH 456
Prerequisites: MECH 342 and MECH 343.
Description: Basics of design of the internal combustion engines. Design of various engine parts such as pistons, connecting rods, valve trains, crankshafts, and the vibration dampers. Dynamics of the engine. The vibration of the crankshaft assembly and the valve train. Balancing of the engines.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 857 Mechatronic Systems Design
Crosslisted with: MECH 457
Prerequisites: ECEN 231; MECH 350 or parallel.
Notes: Lab sessions allow for constructing mechatronic systems. Lab time arranged. A comprehensive design project included.
Description: Theory, application, simulation, and design of systems that integrate mechanical, computer, and electronic components.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 958

MECH 858 Digital Control of Mechanical Systems
Crosslisted with: MECH 458
Prerequisites: MECH 450.
Description: Introduction to digital measurement and control of mechanical systems. Applications of analysis and synthesis of discrete time systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Course and Laboratory Fee: $20

MECH 870 Theory and Practice of Materials Processing
Crosslisted with: MECH 470
Prerequisites: MECH 370
Description: Theory, practice and application of conventional machining, forming and non-traditional machining processes with emphasis on tool life, dynamics of machine tools and adaptive control.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 970

MECH 872 Additive Manufacturing
Crosslisted with: MECH 472
Prerequisites: MECH 370 or parallel
Description: In-depth exploration of the physics governing metal additive manufacturing: (1) powder handling and laser-material interaction; (2) melt pool dynamics, defect mechanisms, and microstructure evolution; (3) residual stress development and strategies for post-processing. Emphasis on how these principles affect the quality and properties of additively manufactured metals.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 874 Manufacturing Systems I
Crosslisted with: MECH 474
Prerequisites: MECH 370 or equivalent.
Description: Principles of automated production lines; analysis of transfer lines; group technology; flexible manufacturing systems; and just-in-time; and optimization strategies for discrete parts manufacturing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 875 Introduction to Mechanical Vibrations
Crosslisted with: MECH 475
Prerequisites: MECH 373 and MATH 221.
Description: Review of rigid body dynamics; equations of motion, free vibration, damping; linear response of one, two, and multi-degree of freedom systems; forced vibrations, harmonic, periodic, impulse, and general responses; resonance and vibration isolation; rotating imbalance; Fourier transforms, digitization and analysis of experimental data.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
Prerequisite for: MECH 975
Course and Laboratory Fee: $25

MECH 876 Manufacturing Information Systems
Crosslisted with: MECH 476
Prerequisites: Senior standing; CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T or equivalent.
Description: An exploration of information systems and their impact in a manufacturing environment. Software, hardware, database systems, enterprise resource planning, networking, and the Internet.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 880 Numerical Methods in Engineering
Crosslisted with: MECH 480
Prerequisites: MATH 221/MATH 821; CSCE 155N. Credit toward the degree may be earned in only one of the following: CSCE440/MATH 440 and MECH 480
Notes: MATH 314 recommended.
Description: Numerical algorithms and their convergence properties in: solving nonlinear equations; direct and iterative schemes for linear systems of equations; eigenvalue problems; polynomial and spline interpolation; curve fitting; numerical integration and differentiation; initial and boundary values problems for Ordinary Differential Equations (ODEs) and systems of ODEs with applications to engineering; finite difference methods for partial differential equations (potential problems, heat-equation, wave-equation).
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: CHME 496, CHME 896; MECH 851; MECH 888
Course and Laboratory Fee: $25

MECH 881 Introduction to Nuclear Engineering
Prerequisites: MATH 820 or 821
Description: Introduction to nuclear physics, radiation interaction with matter, reactor fundamentals, and the application of equipment and principles associated with reactor safety and operations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 883 Engineering Analysis with Finite Elements
Crosslisted with: MECH 483
Prerequisites: MECH 310; MECH 343; MECH 350; MECH 420 or parallel.
Description: Analysis of engineering systems using finite elements; a critical and challenging task performed during the design process for many engineering systems. Four very distinct domains are studied: Structural stress analysis, heat transfer, fluid flow, and modal analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

MECH 888 Nonlinear Optimization in Engineering
Prerequisites: MATH 208, MATH 314, MECH 480/MECH 880
Notes: Numerical analysis and computer programming recommended.
Description: Nonlinear optimization using gradient-based and evolutionary methods. Constrained and unconstrained nonlinear optimization, Karush-Kuhn-Tucker conditions, penalty and barrier methods. Applications to optimal design in sciences and engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: SPRING

MECH 890 Advanced Analysis of Mechanical Engineering Systems
Description: Engineering mathematics review. Formulation and solution of engineering problems including basic laws, lumped parameter models, and continuous systems. Examples drawn from all areas of mechanical engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 812; MECH 932

MECH 891 Special Topics in Engineering Mechanics
Crosslisted with: MECH 491
Prerequisites: Permission.
Description: Treatment of special topics in engineering mechanics by experimental, computational and/or theoretical methods. Topics vary from term to term.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded
Course and Laboratory Fee: $25

MECH 892 Special Topics
Crosslisted with: MECH 492
Description: Special topics in mechanical engineering and related areas.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 24
Grading Option: Graded

MECH 894 Independent Study
Crosslisted with: MECH 494
Prerequisites: Permission
Description: Faculty-supervised independent study.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 24
Grading Option: Graded

MECH 898 Research
Crosslisted with: MECH 498
Description: Faculty-supervised research.
Credit Hours: 0-6
Min credits per semester:
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded

MECH 899 Masters Thesis
Prerequisites: Admission to masters degree program and permission of major adviser
Credit Hours: 1-10
Min credits per semester: 1
Max credits per semester: 10
Max credits per degree: 99
Grading Option: Grade Pass/No Pass Option

MECH 900 Advanced Thermodynamics
Prerequisites: Permission
Description: Classical thermodynamics providing precise and true understanding; advanced methodologies and applications to mechanical engineering tasks; axiomatic foundations of classical thermodynamics, engineering applications to working substances in motion; systematic generalizations to exotic substances; and selected topics as illustrations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 902 Optimal Control Theory
Prerequisites: MECH 350 or equivalent.
Description: Dynamic Programming, The Euler-Lagrange equation, Bang-bang principle in optimal control, Viscosity solutions to the Hamilton-Jacobi-Bellman equation, Pontryagin's Maximum Principle to solve optimal control problems, Linear Quadratic Regulator problems, Numerical solutions to optimal control problems, Calculus of variations to solve infinite dimensional optimization problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL

MECH 904 Advanced Combustion Theory
Prerequisites: MECH 804 or equivalent
Description: Detailed analysis of modern combustion wave theory, particularly chain reaction calculations and flame temperature determination. Gas dynamics of flames. Advanced mass transfer as applied to combustion. Aerodynamics of flame stabilization by vortices. Critical examination of present experimental techniques and results.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 910 Continuum Mechanics
Prerequisites: MECH 325
Notes: Linear Algebra I helpful
Description: The continuum. Geometrical foundations of continuum mechanics. Rectilinear and curvilinear frames. Elements of tensor analysis. Analysis of stress. Analysis of strain. Equations of motion. Constitutive equations. Fundamental laws. Applications to deformable systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 939

MECH 912 Advanced Topics in Fluid Dynamics
Prerequisites: MECH 812 or permission
Description: Selected topics from one or two of the following fields: magneto-fluid-mechanics, three-dimensional boundary layers, fluid-mechanical stability, hypersonic flow, theory of turbulence, rarefied gas dynamics or other current research interest area.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 915 Stress Waves in Solids
Prerequisites: MECH 848; MECH 849
Description: Waves in rods, beams, strings, and membranes. Sound waves in air. Dilational and distortional waves. Reflection and refraction of waves. Rayleigh surface waves. Love waves. Applications of transform theory and the method of stationary phase to wave analysis. Waves in anisotropic and viscoelastic media.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 916 Turbulent Flows
Prerequisites: MECH 812
Description: Methods of description and basic equations of turbulent flows. Isotropic and homogeneous turbulence, energy spectra and correlations. Introduction to measurements. Transition theory and experimental evidence. Wall turbulence, engineering calculations of turbulent boundary layers. Free turbulent jets and wakes.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 918 Fundamentals of Finite Elements
Description: Derivation and implementation of the finite element method. Introduction to the theory of finite element methods for elliptic boundary-value problems. Applications to time-independent physical phenomena (e.g., deformation of elastic bodies, heat conduction, steady-state fluid flow, electrostatics, flow through porous media). Basic coding techniques. A basic understanding of ordinary differential equations and matrix algebra as well as some programming skills are assumed.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 951

MECH 921 Quality Engineering: Use of Experimental Design and Other Techniques
Description: Extension of industrial quality control methods and techniques. Off-line and online quality control methods. Development of quality at the design stage through planned experiments and analyses. Experimental design methods include factorial, 2k, 3k, and factional factorials designs. Includes applied project in design of quality.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 922 Conduction Heat Transfer
Prerequisites: MECH 820 or permission
Description: Theory of heat conduction; analytical, numerical, graphical and analog methods of solution.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 923 Convection Heat Transfer
Prerequisites: MECH 820 or permission
Description: Theory of heat transfer by convection. Analytical, numerical, and empirical solutions. Selected applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 924 Radiation Heat Transfer
Prerequisites: MECH 820 or permission
Description: Theory of heat transfer by thermal radiation. Formulation and analytical and numerical solutions. Selected applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 925 Manufacturing and Dynamic Systems Modeling
Prerequisites: MATH 821
Description: Difference and differential equation models directly from series of observed data. Underlying system analysis including impulse response, stability and feedback interpretation. Forecasting and accuracy of forecasts. Periodic and exponential trends in seasonal series. Modeling two series simultaneously. Minimum mean squared error control and forecasting by leading indicators. Illustrative applications to real life data in science and engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 929 Functional Tissue Engineering
Description: Functional tissue engineering and cellular mechanotransduction. Basic cell structure and cellular mechanosensors (membrane, cytoskeleton, cell-cell junction, cell-matrix adhesion). Role of RhoA/ROCK, FAK, and LINC signaling in mechanotransduction. Biomimetic substrate control of cell mechanotransduction.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 930 Mechanics of Composite Materials
Prerequisites: MECH 848 or permission
Description: Introduction to composite materials. Properties of an anisotropic lamina. Laminated composites. Failure theories. Analysis of composite structures.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 932 Advanced Finite Element Methods
Prerequisites: MECH 831, MECH 890
Description: Review of basic finite element methods including field problems and continuum solid mechanics problems. Advanced linear methods: eigenvalues and mode superposition, convection-diffusion problems, Stokes flow problems. Nonlinear methods for heat transfer, fluid flow, and solid mechanics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 933 Theory of Elasticity I
Prerequisites: MECH 848 and MATH 821
Description: Plane stress and strain. Solution of two-dimensional problems by polynomials. Two-dimensional problems in polar coordinates. Triaxial stress and strain. Torsion of noncircular cross section. Bending of prismatical bars. Hydrodynamical analogies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 934; MECH 942

MECH 934 Theory of Elasticity II
Prerequisites: MECH 933
Description: Foundation of the theory of large deformation. Equations of linear elasticity. Complex representation of the general solution of the equations of plane theory of elasticity. Conformal mapping. Solutions of problems in three-dimensional elasticity in terms of potential functions. Axially symmetric problems. Variational methods.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 935 Nonlinear Mechanics
Prerequisites: MECH 848, MECH 849
Description: Physical systems in solid mechanics which lead to nonlinear differential equations. Graphical, numerical, and exact solutions of the governing differential equations. Physical interpretation of the solution.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 936 Theory of Elastic Stability
Prerequisites: MECH 325 or MECH 373 and MATH 821
Description: Lateral buckling of beams; failure of columns; bending and buckling of thin plates and shells. Consideration of classical and modern theories.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 937 Theory of Plates and Shells I
Prerequisites: MECH 848 and MATH 821
Description: Basic equations for the bending and stretching of thin plates with small deformations. General theory of deformation of thin shells with small deflections. Large deformations theories of plates and shells. Effect of edge conditions.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 938 Theory of Plates and Shells II
Prerequisites: MECH 848, MATH 821
Description: Large deflection shell theory. Critical examination of effects of boundary conditions. Additional topics from folded plates, orthotropic plates and shells, sandwich plates and shells, use of complex transformations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 939 Viscoelasticity
Prerequisites: MECH 848 or MECH 910, MATH 821 or MATH 822
Description: Introduction to linear and nonlinear viscoelastic material behavior. One dimensional response. Linearity of material response. Quasi-static and dynamic problems. Time-temperature superposition. Viscoelastic beams. Multidimensional response. Nonlinear response.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 940 Fracture Mechanics
Prerequisites: MECH 848 or permission
Description: Modes of failure. Elastic stress field near cracks. Theories of brittle fracture. Elastic fracture mechanics. Elastic-plastic analysis of crack extension. Fracture toughness testing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 941 Mechanics of Dislocations and Cracks
Prerequisites: MECH 848 or permission
Description: Mathematical theory of straight dislocations in isotropic and anisotropic elastic media. Dislocations on and near an interface. Dislocation interactions. Discrete and continuously distributed dislocations. Applications to mechanics of materials: grain boundaries and dislocation pile-ups. Applications to fracture mechanics: Griffith-Inglish crack, Zener-Stroh-Koehler crack, Bilby-Cottrell-Swinden-Dugdale crack.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 942 Theory of Plasticity
Prerequisites: MECH 933
Description: Basic concepts of plasticity. Yield conditions and yield surfaces. Torsion of cylindrical bars and Saint Venant-Mises and Prandtl-Reuss theories. General theory of plane strain and shear lines. Steady and pseudo-steady plastic flow. Extremum principles. Engineering applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 943 Machine Design
Prerequisites: MECH 842 or permission
Description: The student's competence in designing machine members to withstand various static and dynamic loads, to analyze failure, and to design members for optimum balance of weight, cost, and reliability is advanced to a level beyond that of MECH 843. Impact loading, fatigue, optimum design of mechanical components, lubrication, and environmental considerations (mechanical properties at high and low temperature, creep, stress corrosion, fretting corrosion, etc.) are tested. Laboratory includes completion of one or more realistic individual design projects and the use of engineering case studies to illustrate more complex interactive design than would be feasible to actually carry out in one semester.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 945 Probabilistic Design of Machine Elements
Prerequisites: MECH 845; STAT 880; or permission
Description: Application of probability to the design of machine elements. Rational determination of component factor of safety based on probability densities of strength and of in-service stress. Statistical study of cumulative damage resulting from varying magnitude stress cycles. Probability of survival of fatigue-life design.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 950 Impact Engineering
Prerequisites: MECH 851
Description: Design and analysis of structures that undergo impact. Nonlinear, large-deformation finite element analysis of structures. Vehicle crashworthiness, roadside safety design, sheet metal forming, and projectile impacts.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 951 Advanced Topics in Finite Element Methods
Prerequisites: MECH 851 or MECH 918, or permission
Description: Theory and application of finite element methods. Topic varies with interest of instructor and may include: finite elements for the analysis of fracture; mixed variational formulations; hybrid stress elements; plasticity; non-linear elasticity; large deformations of structures; plate and shell elements; transverse shear effects in beams, plates and shells; "locking" phenomena; treatment of singularities; dynamics of large systems; "enhanced" strain methods; methods for solving non-linear algebraic systems; architecture of computer codes for non-linear finite element analysis; and treatment of constraints arising in nearly incompressible material models.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 952 Experimental Stress Analysis II
Prerequisites: MECH 848 and MECH 852
Description: Surface strains and their measurement, principally by bonded wire resistance strain gages. Static and dynamic measurements using both oscilloscope and direct writing oscillograph, associated electrical circuits. Use of brittle coating in conjunction with strain gages. Evaluation of stresses from strain data.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 958 Advanced Mechatronics
Prerequisites: MECH 457/MECH 857
Description: Theory, application, simulation, and design of systems that integrate mechanical, computer, and electronics components. Analyze, design, simulate, and build mechatronic systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 970 Advanced Manufacturing Processes
Prerequisites: MECH 870
Description: Theory, practice and technology of advanced manufacturing processes, with emphasis on process mechanism, surface integrity, tool and machine design, adaptive control and expert systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 975 Advanced Vibrations
Prerequisites: MECH 875
Description: Variational mechanics, Hamilton's principle, and energy formulations for linearly elastic bodies. Eigenvalue and boundary value problems. Non-self adjoint systems. Approximate methods: Ritz and Galerkin. Gyroscopic systems. Nonconservative systems. Perturbation theory for the eigenvalue problem. Dynamics of constrained systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 991 Seminar
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 10
Grading Option: Graded

MECH 996 Advanced Laboratory and Analytical Investigations
Description: Semester projects involving research into a specific problem in any major area of mechanical engineering.
Credit Hours: 1-12
Min credits per semester: 1
Max credits per semester: 12
Max credits per degree: 12
Grading Option: Graded

MECH 999 Doctoral Dissertation
Prerequisites: Admission to doctoral degree program and permission of supervisory committee chair
Credit Hours: 1-24
Min credits per semester: 1
Max credits per semester: 24
Max credits per degree: 99
Grading Option: Grade Pass/No Pass Option