MECHANICAL ENGINEERING (MECH)

MECH 98 Research
Prerequisites: permission
Description: Faculty-supervised research
Credit Hours: 0
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Pass No Pass

MECH 100 Introduction to Mechanical Engineering
Description: Overview of mechanical engineering. Introduction to problem layout, and development of basic skills required to solve mechanical engineering problems. Collection, manipulation and presentation of engineering data.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded

MECH 130 Introduction to Geometric Modeling and Mechanical Design Practices
Description: Principles and accepted practices of geometric design. Computer generation of 2D and 3D models for mechanical systems. Introduction to engineering design practices such as specifications, dimensioning, and tolerance.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 230; MECH 342; MECH 381
Course and Laboratory Fee: $25

MECH 200 Engineering Thermodynamics
Prerequisites: MECH 223.
Description: First and Second Laws of Thermodynamics, properties of gases and vapors, and cycles. Sources of energy and its conversion to work.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: AGEN 344; BSEN 344; AREN 310; AREN 404; MECH 300; MECH 330; MECH 446; MECH 446H; MECH 487

MECH 200H Honors: Engineering Thermodynamics
Prerequisites: Good standing in the University Honors Program or by permission; PHYS 212; MECH 223.
Description: First and Second Laws of Thermodynamics, properties of gases and vapors, and cycles. Sources of energy and its conversion to work. Honors students will be expected to study beyond the students in the normal sections and do a special project.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: AGEN 344; BSEN 344; AREN 310; AREN 404; MECH 300; MECH 330; MECH 446; MECH 446H; MECH 487

MECH 220 Statics
Prerequisites: MATH 106.
Description: Fundamental concepts, equilibrium of force systems, analysis of simple frames and trusses. Centroid and moments of inertia and friction.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: MECH 324
Course and Laboratory Fee: $10

MECH 223 Engineering Statics
Prerequisites: MATH 107 (grade of C or better), PHYS 211 (grade of C or better).
Description: Action of forces on engineering structures and machines. Force systems, static equilibrium of frames and machines. Friction, center of gravity, moment of inertia, vector algebra.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: AGEN 324; BSEN 324; CIVE 310; CIVE 310H; CIVE 361; CIVE 371; MATL 260; MATL 360; MECH 200; MECH 200H; MECH 324; MECH 325; MECH 325H; MECH 373; MECH 373H

MECH 223H Honors: Engineering Statics
Prerequisites: Good standing in the University Honors Program or by permission; MATH 107 and PHYS 211.
Description: Bodies in equilibrium. Vector algebra, equivalent force systems, distributed loads, and center of gravity. Analysis of trusses, frames, and machines. Friction, wedges, crews, and belts. Area moments of inertia.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: AGEN 324; BSEN 324; CIVE 310; CIVE 310H; CIVE 361; CIVE 371; MATL 260; MATL 360; MECH 200; MECH 200H; MECH 324; MECH 325; MECH 325H; MECH 373; MECH 373H

MECH 230 Introduction to Mechanical Engineering Design
Prerequisites: MECH 130, MECH 325
Description: Introduction to formalized engineering design processes and methodology, selection of common mechanical components, and practice of teamwork and problem solving in the context of mechanical engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: MECH 446; MECH 446H
MECH 250 Mechanics I
Prerequisites: PHYS 211.
Notes: Parallel: MATH 208. For electrical engineering majors.
Description: Force actions in static coplanar systems with applications to engineering structures and machines. Resultants, moments, couples, equivalent force systems, vector algebra. Static equilibrium conditions and equations.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
Offered: FALL/SPR

MECH 300 Thermal Systems and Design
Prerequisites: MECH 200, CSCE 155N
Description: Applications of control-volume analysis (mass, energy, and momentum), both transient and steady; mixtures of gases and vapors; introduction to combustion; thermodynamic relations and establishment of data banks of thermal properties; applications of computer-aided engineering to processes and cycles; methodologies and case studies for thermal systems design; execution of small-scaled design projects.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: SPRING

MECH 310 Fluid Mechanics
Prerequisites: MECH 373; MATH 221
Notes: Parallel: MECH 200, or BSEN 244 or by permission for non-ME students.
Description: Fluid statics, equations of continuity, momentum, and energy dimensional analysis and dynamic similitude. Applications to: flow meters; fluid pumps and turbines; viscous flow and lubrication; flow in closed conduits and open channels. Two-dimensional potential flow.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: MECH 310H Honors: Fluid Mechanics
Prerequisites: MECH 373; MATH 221
Notes: Parallel: MECH 200, or BSEN 244 or by permission for non-ME students.
Description: Fluid statics, equations of continuity, momentum, and energy dimensional analysis and dynamic similitude. Applications to: flow meters; fluid pumps and turbines; viscous flow and lubrication; flow in closed conduits and open channels. Two-dimensional potential flow. Advanced topics/project.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: MECH 380; MECH 446H

MECH 311 Fluid Mechanics Laboratory
Prerequisites: MECH/CIVE 310 or parallel.
Description: Fluid mechanics experiments and demonstrations. Conservation principles; determination of fluid properties, velocity, pressure, and flow measurements; pipe flow; open channel flow; and instrumentation techniques.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded
Course and Laboratory Fee: $20

MECH 318 Applied Linear Algebra and Computational Methods
Prerequisites: MATH 208; MATH 221 or parallel; CSCE 155N or equivalent.
Notes: This course is a substitute for MATH 314 for mechanical engineering students.
Description: Application-based linear algebra concepts and introduction to numerical computations using Matlab. Topics include: linear systems and numerical solvers; eigenvalue and eigenvector computations; methods for root finding and curve fitting; norms and convergence of numerical methods; numerical integration, differentiation, and initial-value ODE problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

MECH 321 Engineering Statistics and Data Analysis
Prerequisites: MATH 208
Description: An applications-oriented course for formulating and solving engineering statistical problems. Includes Descriptive statistics, probability distributions, variability, sampling, confidence intervals, tests of significance, basics of statistical process control, and design of experiments.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 324 Strength of Materials
Prerequisites: MECH 220 or MECH 223.
Notes: For students in architecture and construction management.
Description: Stress and strain analysis in elastic materials. Use of properties of materials in the analysis and design of welded and riveted connections, statically determinate and indeterminate flexure members, columns. Combined stresses, axial, eccentric and torsional loading. Observations of laboratory tests for axially loaded specimens. Introduction to shear and moment diagrams.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
MECH 325 Mechanics of Elastic Bodies
Prerequisites: MECH 223 (grade of C or better), MATH 208
Description: Concept of stress and strain considering axial, torsional, and bending forces. Shear and moments. Introduction to combined stresses and column theory.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: AGEN 443; CIVE 331; CIVE 341; CIVE 342; MECH 230; MECH 330; MECH 343; MECH 370; MECH 910
MECH 325H Honors: Mechanics of Elastic Bodies
Prerequisites: Good standing in the University Honors Program or by permission; MECH 223 or 223H; MATH 208.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 350
MECH 330 Mechanical Engineering Analysis
Prerequisites: MATH 221; CSCE 155N; MECH 325; MECH 373; MECH 200.
Description: Conceptual modeling of mechanical engineering systems. Analytical exploration of engineering behavior of conceptual models. Case studies drawn from mechanical engineering problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 350
MECH 342 Kinematics and Dynamics of Machinery
Prerequisites: MECH 130 and MECH 373
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 343; MECH 488
Course and Laboratory Fee: $5
MECH 343 Elements of Machine Design
Prerequisites: MECH 325; MECH 342 or parallel; MATL 360; MECH 321 or STAT 380 or parallel.
Description: Design of machine elements under different conditions of loading. Design work includes a project of broader scope (done primarily out of class) requiring a breadth of knowledge. Failure theories for static and dynamic loading of bolts, springs, bearings, and shafts.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: SPRING
MECH 350 Introduction to Dynamics and Control of Engineering Systems
Prerequisites: MECH 373; ECEN 211; CSCE 155N; MATH 314 or parallel.
Description: Unified treatment of the dynamics and control of engineering systems. Emphasis on physical aspects, formulation of mathematical models, application of various mathematical methods, and interpretation of results in terms of the synthesis and analysis of real systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: MECH 380; MECH 446; MECH 446H
MECH 351 Mechanics II
Prerequisites: MECH 250.
Notes: For electrical engineering majors.
Description: Application of Newton's laws to engineering problems involving coplanar kinematics and kinetics of particles. Work, energy, impulse, and momentum. Conservative systems. Periodic motion.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
MECH 370 Manufacturing Methods and Processes
Prerequisites: MATL 360; and MECH 325.
Description: Introduction to traditional and modern manufacturing processes and methods to include: foundry; forming processes; welding; metal removal theory and practices; modern manufacturing systems and automation; and economics of process selection.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
MECH 373 Engineering Dynamics
Prerequisites: MECH 223 (grade of C or better), MATH 208.
Description: Force action related to displacement, velocity, and acceleration of rigid bodies. Kinematics of plane motion, kinetics of translation and rotation. Mass moment of inertia, vibration, work, energy and power, impulse and momentum.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: BSEN 410; MECH 310; MECH 310H; MECH 330; MECH 342; MECH 350
MECH 373H Honors: Engineering Dynamics
Prerequisites: Good standing in the University Honors Program or by permission; MECH 223 or 223H; MATH 208.
Description: Motion of particles and rigid bodies under the action of forces and moments. Kinematics of plane motion: displacement, velocity, and acceleration. Kinetics of translation and rotation; work, energy and power; impulse, momentum and impact. Introduction to vibration analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 310; MECH 310H; MECH 330; MECH 342; MECH 350
MECH 380 Mechanical Engineering Measurements
Prerequisites: ECEN 231; JGEN 200 or JGEN 300 or JGEN 120 or ENGL 151; MECH 321 or STAT 380 or parallel; MECH 350 and MECH 310, or parallel.
Description: Theory, statistics, applications and design of mechanical engineering experiments.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: MECH 487; MECH 488
Course and Laboratory Fee: $20

MECH 381 Elements of Computer-Aided Design
Prerequisites: MATH 221; MECH 130 or CSCE 155N
Description: Principles and techniques currently used for the computer-aided design (CAD). Applications of interactive graphics devices for drafting, design, and analysis. Modelling and analogy of engineering systems. Elementary finite element, Bode, and numerical analyses. CAD case studies and term project.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 399 Undergraduate Research and Thesis
Prerequisites: Permission.
Description: Engineering design or laboratory investigation that an undergraduate is qualified to undertake.
Credit Hours: 1-5
Min credits per semester: 1
Max credits per semester: 5
Max credits per degree: 6
Grading Option: Graded
Course and Laboratory Fee: $25

MECH 403 Internal Combustion Engines
Crosslisted with: MECH 803
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 404 Theory of Combustion
Crosslisted with: MECH 804
Prerequisites: MECH 300 and MECH 420/MECH 820.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 904

MECH 405 Turbomachinery
Crosslisted with: MECH 805
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 406 Air Conditioning Systems Design
Crosslisted with: MECH 806
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 407 Power Plant Systems Design
Crosslisted with: MECH 807
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 408 Heat Exchanger Design
Crosslisted with: MECH 808
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 413 Aerodynamics
Crosslisted with: MECH 813
Prerequisites: MECH 200 and MECH 310/CIVE 310.
Description: Subsonic and supersonic air flow theory, dynamics of flight, performance parameters, rotor analysis, and special topics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
MECH 414 Compressible Flow
Crosslisted with: MECH 814
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 415 Two-Phase Flow
Crosslisted with: MECH 815
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 416 Engineering Acoustics
Crosslisted with: MECH 816
Prerequisites: MECH 310 and MATH 221/MATH 821.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 420 Heat Transfer
Crosslisted with: MECH 820
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: AREN 810; MECH 404, MECH 804; MECH 487; MECH 922; MECH 923; MECH 924

MECH 421 Elements of Nuclear Engineering
Crosslisted with: MECH 821, 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 422 Industrial Quality Control
Crosslisted with: MECH 822
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 424 Laser Material Processing with Compressible Flow Perspective
Crosslisted with: MECH 824
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 425 Solar Energy Engineering
Crosslisted with: MECH 825
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 426 Heat Transfer at Nanoscales and in Ultrashort Time Domains
Crosslisted with: MECH 826
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 428 Analysis of Thermal Data
Crosslisted with: MECH 828
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 431 Computational Heat Transfer and Fluid Flow**

**Crosslisted with:** MECH 831

**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 433 Microscale Transport Phenomena in Biosystems**

**Crosslisted with:** MECH 833

**Prerequisites:** MECH 830

**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 434 Facility Planning and Design**

**Notes:** introductory knowledge of ergonomics

**Description:** Design, analysis and layout of facilities: queuing, material handling systems, material flow analysis, systematic layout planning and design of warehouse facilities.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**MECH 435 Introduction to Cell Mechanics**

**Crosslisted with:** MECH 835

**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 436 Introduction to Continuum Biomechanics**

**Crosslisted with:** MECH 836

**Prerequisites:** MECH 835

**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 437 Biomedical Device Design**

**Crosslisted with:** MECH 837

**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 438 Mechanics of Biomaterials**

**Crosslisted with:** MECH 838

**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; Functionality-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:** Graded with Option

**MECH 439 Biomaterial Surface Patterning**

**Crosslisted with:** MECH 839

**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 442 Intermediate Kinematics
Crosslisted with: MECH 842
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 444 Intermediate Dynamics of Machinery
Crosslisted with: MECH 844
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 445 Mechanical Engineering Design Concepts
Crosslisted with: MECH 845
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 446 Mechanical Engineering Design I
Prerequisites: MECH 342 and MECH 350, professional admission to Mechanical Engineering BS program
Notes: This course should be taken in the fall semester of the final full academic year, followed immediately by MECH 447 in the spring semester.
Description: The first of two courses in the capstone sequence. Practical application of the engineering design process in a team project focused on a mechanical engineering problem, including design reviews and reports.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
Prerequisite for: MECH 446H
Experiential Learning: Student Teaching/Education Practicum
Course and Laboratory Fee: $15

MECH 446H Honors: Mechanical Engineering Design I
Prerequisites: MECH 446 or MECH 446H, professional admission to Mechanical Engineering BS program
Notes: This course should be taken in the fall semester of the final full academic year, followed immediately by MECH 447H in the spring semester.
Description: The first of two courses in the capstone sequence. Practical application of the engineering design process in a team project focused on a mechanical engineering problem, including design reviews and reports.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
Prerequisite for: MECH 447H
Experiential Learning: Student Teaching/Education Practicum

MECH 447 Mechanical Engineering Design II
Prerequisites: MECH 446, professional admission to Mechanical Engineering BS program
Description: Definition, scope, analysis, synthesis, and the design for the solution of a comprehensive engineering problem in any major area of mechanical engineering.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
Prerequisite for: MECH 447H
Course and Laboratory Fee: $15
Experiential Learning: Student Teaching/Education Practicum

MECH 447H Honors: Mechanical Engineering Design II
Prerequisites: MECH 446 or MECH 446H, professional admission to Mechanical Engineering BS program
Description: Definition, scope, analysis, synthesis, and the design for the solution of a comprehensive engineering problem in any major area of mechanical engineering.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
Offered: SPRING
Prerequisite for: MECH 447H
Experiential Learning: Student Teaching/Education Practicum

MECH 448 Advanced Mechanics of Materials
Crosslisted with: MECH 848
Prerequisites: MECH 373, MECH 325.
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
Experiential Learning: Student Teaching/Education Practicum
MECH 449 Advanced Dynamics
Crosslisted with: MECH 849
Prerequisites: MECH 373 and MATH 221/821.
Description: Particle Dynamics using 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 450 Mechanical Engineering Control Systems Design
Crosslisted with: MECH 850
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: $25

MECH 451 Introduction to Finite Element Analysis
Prerequisites: Open to College of Engineering Students only.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Course and Laboratory Fee: $25

MECH 452 Experimental Stress Analysis I
Crosslisted with: MECH 852
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 453 Robotics: Kinematics and Design
Crosslisted with: MECH 853
Prerequisites: MECH 350.
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 454 Introduction to Continuum Modeling
Crosslisted with: MECH 854
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 455 Vehicle Dynamics
Crosslisted with: MECH 855
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 456 Dynamics of Internal Combustion Engines
Crosslisted with: MECH 856
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 457 Mechatronic Systems Design
Crosslisted with: MECH 857
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

MECH 458 Digital Control of Mechanical Systems
Crosslisted with: MECH 858
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 470 Theory and Practice of Materials Processing  
Crosslisted with: MECH 870  
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 472 Additive Manufacturing  
Crosslisted with: MECH 872  
Prerequisites: MECH 370 or parallel  
Description: Hands-on exposure to several aspects of Additive Manufacturing (AM): (1) design and experimentation; (2) process optimization; and (3) materials testing. Coverage of a variety of AM technologies, their advantages and limitations, and how to design for AM. Discussion of both polymer and metal technologies, and exploration of recent applications of AM across multiple industries.  
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

MECH 474 Manufacturing Systems I  
Crosslisted with: MECH 874  
Prerequisites: Open to College of Engineering Students only.  
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 475 Introduction to Mechanical Vibrations  
Crosslisted with: MECH 875  
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: Graded  
Prerequisite for: MECH 975

MECH 476 Manufacturing Information Systems  
Crosslisted with: MECH 876  
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 480 Numerical Methods in Engineering  
Crosslisted with: MECH 880  
Prerequisites: MATH 221/MATH 821; CSCE 155N.  
Notes: MATH 314 recommended. Credit towards the degree cannot be earned in both CSCE/MATH 440/840 and MECH 480/880.  
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: MECH 971

MECH 483 Engineering Analysis with Finite Elements  
Crosslisted with: MECH 883  
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: Graded with Option

MECH 487 Thermal Fluids Laboratory  
Prerequisites: MECH 200 and MECH 380; MECH 420/820 or parallel.  
Description: Design, execution, and evaluation of physical experiments in the areas of thermodynamics, fluid mechanics, and heat transfer.  
Credit Hours: 2  
Max credits per semester: 2  
Max credits per degree: 2  
Grading Option: Graded with Option

MECH 488 Kinematics and Machine Design Laboratory  
Prerequisites: MECH 342; MECH 380 or parallel.  
Description: Design projects and physical experiments in the area of machine design and kinematics.  
Credit Hours: 2  
Max credits per semester: 2  
Max credits per degree: 2  
Grading Option: Graded

MECH 491 Special Topics in Engineering Mechanics  
Crosslisted with: MECH 891  
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 492 Special Topics  
Crosslisted with: MECH 892  
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 494 Independent Study  
Crosslisted with: MECH 894  
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 498 Research  
Crosslisted with: MECH 898  
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 499H Honors Thesis  
Prerequisites: Senior standing in mechanical engineering; admission to the University Honors Program.  
Description: Honors thesis research project meeting the requirements of the University Honors Program. Independent research project executed under the guidance of a member of the faculty of the Department of Mechanical Engineering which contributes to the advancement of knowledge in the field. Culminates in the presentation of an honors thesis to the department and college.  
Credit Hours: 1-3  
Min credits per semester: 1  
Max credits per semester: 3  
Max credits per degree: 3  
Grading Option: Graded