496   Capstone in Mathematics
Fall, Spring. 3(3-0) R: Completion of Tier I writing requirement. Approval of department.

A capstone course integrating several areas of mathematics.

MECHANICAL ENGINEERING   ME

Department of Mechanical Engineering College of Engineering

180   Engineering Graphic Communications
Fall, Spring. 3(1-4) P:M: (MTH 116 or concurrently or LBS 117 or concurrently or MTH 132 or concurrently or MTH 152H or concurrently) or (MTH 103 and MTH 114 or concurrently) SA: MSM 160

Computer-aided design and drafting. Freehand sketching. Two and three dimensional visualization. Blueprint reading. Geometric dimensioning and tolerancing. Introduction to engineering design.

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

Basic concepts of thermodynamics. Property evaluation of ideal gases and compressible substances. Theory and application of the first and second laws of thermodynamics. Entropy and Carnot efficiency.

220   Introduction to Solid Mechanics
Spring. 4(4-0) P:M: (MTH 133 or MTH 153H or LBS 119) R: Not open to students in the Civil Engineering or Engineering Arts or Engineering Mechanics or Manufacturing Engineering or Materials Science and Engineering or Mechanical Engineering major. SA: MSM 206 Not open to students with credit in ME 221 or ME 222.

Statics: moment and force resultants, equilibrium. Mechanics of deformable bodies: stress and strain, classification of material behavior, generalized Hooke's law. Engineering applications: axial loads, torsion of circular rods and tubes, bending and shear stresses in beams, deflection of beams, combined stresses, stress and strain transformation.

221   Statics
Fall, Spring. 3(3-0) P:M: (PHY 183) and (MTH 234 or concurrently or LBS 220 or concurrently or MTH 254H or concurrently) SA: MSM 205

Vector description of forces and moments. Two and three dimensional equilibrium of particles and rigid bodies. Analysis of trusses, frames and machines. Coulomb friction.

222   Mechanics of Deformable Solids
Fall, Spring. 4(3-2) P:M: (ME 221) SA: MSM 211

Tension compression and shear stresses. Axially loaded bars. Torsion of circular shafts. Beam theory. Combined stresses. Mohr's circles. Columns.

285   Computer Aided Design Tools
Spring. 3(1-4) P:M: (ME 180) R: Open only to students in Manufacturing Engineering and Engineering Arts-Product Design cognate. SA: MSM 260

Advanced 3-D solid modeling, CNC programming, and rapid prototyping.

332   Fluid Mechanics
Fall, Spring. 4(3-3) P:M: (ME 361) and (CHE 311 or ME 201 or MSE351) and (ME 391 or concurrently) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering or Engineering Mechanics major.

Statics, control volume equations, similitude, exact fluid solutions. Turbulence, pipe flow, boundary layer flow, compressible flow, and Navier-Stokes equations.

361   Dynamics
Fall, Spring. 3(3-0) P:M: (ME 221) and (MTH 235 or MTH 255H or LBS 220) R: Open only to students in the College of Engineering. SA: MSM 306

Kinematics of particles, rigid bodies, and mass moments of inertia. Kinetics of particles and rigid bodies. Energy and momentum principles.

371   Mechanical Design I
Fall, Spring. 3(3-0) P:M: (ME 361 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering or Manufacturing Engineering major.

Analysis of displacement, velocity and acceleration in mechanical linkages. Kinematics and dynamics of machines.

372   Machine Tool Laboratory
Fall, Spring. 1(0-2)

Principles and practice of machine tools. Safety, terminology, measurement, and working procedures for hand and machine tools.

385   Introduction to Product Design
Fall. 3(1-4) P:M: (STA 110) R: Open only to students in Manufacturing Engineering and Engineering Arts-Product Design cognate. SA: MSM 360

Ideation methods, design methodology, 3-D model building, small-scale group and individual projects. Project presentations.

386   Computer Aided Product Design
Spring. 3(1-4) P:M: (ME 285 or concurrently and ME 385) R: Open only to students in Manufacturing Engineering and Engineering Arts-Product Design cognate. 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:M: (MTH 235 or MTH 255H or LBS 220) R: Open only to juniors or seniors in the Mechanical Engineering or Biosystems Engineering or Engineering Mechanics major.

Analytical and numerical methods for the modeling and analysis of mechanical engineering systems. Applications to vibrating elements, heat transfer, linear springs, and coupled spring-mass systems.

410   Heat Transfer
Fall, Spring. 3(3-0) P:M: (ME 332 or CE 321 or CHE 311) and (ME 391) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering or Engineering Mechanics major.

Steady state and transient heat conduction. Natural and forced convection based on boundary layer theory. Application of Nusselt number correlations. Radiant heat transfer principles and applications including radiation networks.

412   Heat Transfer Laboratory
Fall, Spring. 2(1-2) P:M: (ME 410) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering or Engineering Mechanics major.

Practices and measurement techniques for heat transfer and thermal systems. Experimental problem solving applied to heat transfer.

414   Vehicle Thermal System Design
Spring. 3(2-2) Spring: Engineering Building. P:M: (ME 410) R: Open only to seniors in the Mechanical Engineering major.

Analysis and design of general heat exchange systems applied to automotive vehicle systems including heaters, air conditioning, electronic, and cabin systems. Students will work in teams to design, build, and test heat exchanger systems. A global engineering experience via the internet may be included.

416   Computer Assisted Design of Thermal Systems
Fall. 3(4-0) P:M: (ME 410 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering major.

Classifying, cataloging and processing design information. Modeling of thermal equipment. Simulation and optimization of thermal systems. Computer based design projects.

422   Introduction to Combustion
Fall. 3(3-0) P:M: (ME 332 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering major.

Thermodynamics, chemistry, fluid mechanics, and heat transfer principles applied to combustion.

423   Intermediate Mechanics of Deformable Solids
Fall. 3(3-0) P:M: (ME 222) R: Open only to students in the College of Engineering. SA: MSM 401

Stress, strain and linearly elastic behavior. Plane stress and plane strain. Torsion. Yield criteria. Elastoplastic behavior of beams, shafts and cylinders. Unsymmetrical bending. Curved beams.

424   Computational Mechanics
Spring. 3(3-0) P:M: (ME 423 or ME 471) R: Open only to students in the College of Engineering. SA: MSM 402

Energy methods with applications. Finite element methods. Buckling and stability. Green's functions.

425   Experimental Mechanics
Fall of odd years. 3(2-3) P:M: (ME 222) R: Open only to students in the College of Engineering. SA: MSM 405

Measurement of stress, strain, vibration, and motion using strain gauges, accelerometers, photoelasticity, holography, Moire patterns, laser speckle and electronic imaging. Transducer design.

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

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

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

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

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

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

451   Control Systems
Fall, Spring. 4(3-3) P:M: (ME 361 and ECE 345) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering or Engineering Mechanics major.
Mathematical modeling of dynamic systems. Standard feedback control formulation. Transient and sinusoidal steady state analysis. Time and frequency domain controller synthesis.

456   Mechatronic System Design
Fall. 3(2-3) P:M: (ECE 345 and ME 451 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering major.
Application of imbedded microcontrollers to the design of mechatronic systems. Design of software and hardware for systems with mechanical, electrical and fluid components plus imbedded control systems. Laboratory exercises and design projects. Application to automotive, consumer and commercial systems.

457   Mechatronic System Modeling and Simulation
Spring. 3(3-0) P:M: (ECE 345 and MSM 306) R: Open only to juniors or seniors in the Mechanical Engineering major and to students in the Master of Science degree in Industrial Mathematics.
Modeling and simulation of mechatronic systems, including mechanical, electrical, fluid, power, and other effects. Transducer modeling, including pumps, motors, and valves. Application to automotive systems.

461   Mechanical Vibrations
Fall, Spring. 4(3-3) P:M: (ME 451) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering or Engineering Mechanics major.
Modeling and analysis of oscillatory phenomena found in linear discrete and continuous mechanical systems.

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

465   Computer Aided Optimal Design
Fall. 3(3-0) P:M: (ME 471 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering major.
Modeling for mechanical design optimization. Algorithms for constrained and unconstrained optimization. Optimality criteria. Optimization using finite element models. Design projects.

471   Mechanical Design II
Fall, Spring. 3(3-0) P:M: (ME 371) and (ME 391) and (MSM 211) R: Open only to juniors or seniors in the Mechanical Engineering major.
Engineering design of machine elements and mechanical systems. Computer based analysis in support of design. Design for static and fatigue strength, deflection and reliability.

475   Computer Aided Design of Structures
Spring. 3(2-2) P:M: (ME 471 or concurrently) R: Open only to seniors in the Mechanical Engineering major.
Computational methods for analysis, design, and optimization of structural components. Basic concepts in geometric modeling, finite element analysis, and structural optimization.

477   Manufacturing Processes
Fall. 3(3-0) Interdepartmental with Materials Science and Engineering. P:M: (ME 222 and MSE 250) and completion of Tier I writing requirement. R: Open only to students in the Engineering Arts, Engineering Mechanics, Manufacturing Engineering and Materials Science and Engineering majors. SA: MSM 481
Fundamentals of manufacturing processes such as casting, heat treating, particulate processing, forming, machining, joining and surface processing. Selection of manufacturing processes based on design and materials.

478   Product Development
Spring. 3(3-0) P:M: (ME 361 and ME 477) and completion of Tier I writing requirement. SA: MSM 482
Simulation of industrial environment for product development. Product concept, design and manufacturing.

481   Mechanical Engineering Design Projects
Fall, Spring. 3(1-6) P:M: (ME 410) and (ME 471) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering major.
Application of design concepts in mechanical engineering. Problem definition, design specifications. Modeling and analysis methods. Design optimization, economics, reliability. Manufacturing considerations in design. Capstone design projects.

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

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

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

495   Tissue Mechanics
Spring. 3(3-0) Interdepartmental with Biomedical Engineering. P:M: (ME 222) SA: MSM 441
Application of solid mechanics to understanding mechanical responses of biological tissues. Microstructure and biological function for soft and hard connective tissues and muscle.

496   Biodynamics
Fall. 3(2-2) Interdepartmental with Biomedical Engineering. P:M: (ME 361) R: Open only to students in the Engineering Mechanics major.
Fundamentals of motion analysis of human movement and its application to the study of function and dysfunction of the musculoskeletal system. Solution methods of the inverse dynamics problem.

497   Biomechanical Design
Spring. 3(3-0) Interdepartmental with Biomedical Engineering. R: Open only to juniors or seniors in the College of Engineering. SA: BME 491A, MSM 445
Biomechanical product design with application to people or animals. Synthesis, prototyping, and analysis of designs. Project management. Market research.