

Mechanical Engineering (ME)

Courses

ME 118. Energy for Sustainable Society. 3 hours.

Focuses on how energy systems work today and how they can work in a decarbonized sustainable future, while still meeting the critical energy needs of global developed and developing societies. Course Information: Same as IE 118. *UIC GE Individual and Society course.*

ME 205. Introduction to Thermodynamics. 3 hours.

Principles of energy transport and work; properties of substances and equations of state; first and second laws of thermodynamics; applications to mechanical cycles and systems. Course Information: Prerequisite(s): PHYS 141 and MATH 181.

ME 210. Engineering Dynamics. 3 hours.

Dynamics of particles and rigid bodies. Introduction to Linear Algebra. Kinematics in different coordinate systems, coordinate transformations. Kinetics: Newton's second law, work energy relations, impulse-momentum relations, impact problems. Course Information: Prerequisite(s): CME 201. *IAI Major EGR course.*

ME 211. Fluid Mechanics I. 4 hours.

Fluid properties. Dimensional analysis. Statics and kinematics. Conservation equations. Inviscid and incompressible flows. Bernoulli's equation. Integral momentum theorems. Viscous flows. Boundary layer theories. Compressible Flows. Course Information: Prerequisite(s): PHYS 141 and MATH 220. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ME 250. Introduction to Engineering Design and Graphics. 3 hours.

Engineering design process, modeling, analysis. Product dissection, prototyping. Technical communication, AutoCAD, engineering graphics software, 3-D views, multiview projection, dimensioning and tolerancing, standards. Team design project. Course Information: Prerequisite(s): Eligibility to register for ENGL 160. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture.

ME 261. Materials for Manufacturing. 2 hours.

Introductory-level course in materials engineering to familiarize students with relationships between processing, structure and properties of materials used to manufacture devices. Course Information: Same as CME 261. Credit is not given for ME 261 if the student has credit for CME 260. Prerequisite(s): CHEM 122 and CHEM 123 and PHYS 141 and MATH 181.

ME 293. Special Problems. 1-4 hours.

Special problems, readings or research under close supervision of a faculty member in the area of engineering graphics. Course Information: May be repeated. Prerequisite(s): Consent of the instructor.

ME 308. Mechanical Vibrations. 3 hours.

Free and forced vibrations of damped linear single and multiple degree of freedom systems. Approximate methods, instrumentation, and applications. Course Information: Same as CME 359. Prerequisite(s): CS 109; and ME 210; and MATH 220.

ME 312. Dynamic Systems and Control. 3 hours.

Dynamics of linear systems. Modeling of mechanical, electrical, fluid, and thermal systems. Analysis and design of feedback control systems. Analytical, computer and experimental solution methods. Time and frequency domain techniques. Course Information: Same as IE 312. Prerequisite(s): CS 109 and ECE 210 and MATH 220; and sophomore standing or above; or approval of the department.

ME 318. Fluid Mechanics II. 3 hours.

Conservation equations for fluid mechanics, inviscid ideal flows, viscous flow solutions of Navier-Stokes equations, pipe flows and boundary flows, compressible flow, computer solutions and applications. Course Information: Prerequisite(s): ME 211.

ME 320. Mechanisms and Dynamics of Machinery. 3 or 4 hours.

Kinematic analysis and synthesis of mechanisms; linkages, cams, spur gears, gear trains. Dynamic forces in machines; bearing reactions, balancing, flywheel design, friction, efficiency. Course Information: Prerequisite(s): ME 210.

ME 321. Heat Transfer. 4 hours.

Modes of heat transfer, material properties, one- and two-dimensional conduction. Extended surfaces. Forced and free convection. Heat exchangers. Radiation. Shape factors. Laboratories in conduction, convection, and radiation. Course Information: Prerequisite(s): ME 205 and credit or concurrent enrollment in ME 211. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ME 325. Intermediate Thermodynamics. 3 hours.

In-depth study of thermodynamic principles, thermodynamics of state, vapor and gas power cycles, refrigeration cycles, thermodynamics of nonreacting and reacting mixtures, internal combustion engines, and thermodynamics of equilibrium. Course Information: Prerequisite(s): ME 205 and credit or concurrent registration in ME 211.

ME 328. Numerical Methods in Mechanical Engineering. 3 hours.

Introduction to numerical solution methods for problems in mechanical engineering. Example problems include heat transfer, fluid mechanics, thermodynamics, mechanical vibrations, dynamics, stress analysis, and other related problems. Course Information: Previously listed as ME 428. Extensive computer use required. Prerequisite(s): CS 109 and Credit or concurrent registration in MATH 218 or MATH 310. Open only to juniors and seniors.

ME 341. Experimental Methods in Mechanical Engineering. 3 hours.

Introduction to the theory and practice of experimental methods, measurement techniques, instrumentation, data acquisition and data analysis in mechanical and thermal-fluid systems. Experiments and reports. Course Information: Prerequisite(s): CME 203; and ME 211. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture.

ME 347. Engineering Design and Graphics with Computer-Aided Design and Simulation. 3 hours.

Conventional and computer-assisted methods in design. Geometric manipulation. Computer-aided modeling with curves, surfaces, and solids. Design with finite-element analysis. Course Information: Previously listed as ME 447. Extensive computer use required. Prerequisite(s): MATH 220 and CME 203 and ME 250. Recommended background: Credit in MATH 218 or MATH 310. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture.

ME 348. Artificial Intelligence and Data Mining for Engineering Applications. 3 hours.

Provides a comprehensive understanding of artificial intelligence (AI), data analytics, and ethics in AI in the context of Operations and Industrial Engineering Applications. Course Information: Same as IE 348. Extensive computer use required. Prerequisite(s): IE 342.

ME 370. Mechanical Engineering Design. 3 hours.

Mechanical design concepts, failure prevention under static and variable loading, application of engineering mechanics and materials to analysis, selection and design of mechanical elements such as shafts, fasteners, springs, bearings, and gears. Course Information: Prerequisite(s): CME 203 and ME 250. Recommended background: ME 320.

ME 380. Materials and Manufacturing Process Principles. 3 hours.

Behavior of common engineering materials, such as metals, polymers, ceramics, and composites, and their attributes in the context of manufacturing processes. Interaction between materials, design, and manufacturing. Economics of manufacturing. Course Information: Same as IE 380. Prerequisite(s): CME 203 and CHEM 122 and CHEM 123.

ME 391. Mechanical Engineering Practicum. 1 hour.

Provides students with the opportunity to apply the skills and knowledge gained in previous engineering courses within a professional, working environment. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. A maximum of 1 hour awarded toward degree requirements. Prerequisite(s): Approval of the Department.

ME 392. Undergraduate Research. 1-3 hours.

Research under close supervision of a faculty member. Course Information: May be repeated to a maximum of 6 hours. Prerequisite(s): Consent of the head of the department.

ME 394. Senior Capstone Design. 4 hours.

Systematic approach to the design process. Creative problem solving. Design methodology and engineering principles applied to open-ended design problems with inherent breadth and innovation. Course Information: Same as IE 394. Credit is not given for ME 394 if the student has credit for ME 396 or IE 396. Prerequisite(s): Senior standing or above; or approval of the department.

ME 396. Senior Design I. 3 hours.

Systematic approach to the design process. Creative problem solving. Design methodology and engineering principles applied to open-ended design problems with inherent breadth and innovation. Course Information: Same as IE 396. Credit is not given for ME 396 if the student has credit in IE 444 or ME 444 or IE 445 or ME 445. Prerequisite(s): ME 347 and IE 201 and Credit or concurrent registration in ME 211 and Credit or concurrent registration in ME 370; or IE 201 and Credit or concurrent registration in IE 345 and Credit or concurrent registration in IE 365. Open only to seniors. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ME 397. Senior Design II. 2 or 3 hours.

The systematic approach to the design process; creative problem solving; design methodology and engineering principles learned in ME 396 are applied to complete the Senior Design project. Course Information: Same as IE 397. Credit is not given for ME 397 if the student has credit for IE 444 or ME 444 or IE 445 or ME 445. Prerequisite(s): ME 396; or IE 396; and senior standing or above. Requires concurrent registration in ME 499 or IE 499.

ME 401. Applied Stress Analysis I. 3 or 4 hours.

Complex bending and torsion, curved flexural members, energy methods in design, theories of failure. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CME 203.

ME 408. Intermediate Vibration Theory. 3 or 4 hours.

Free and forced vibrations of multi-degree of freedom linear systems. Lagrangian dynamics, matrix, approximate and numerical methods. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 308.

ME 409. Advanced Kinematics I. 3 or 4 hours.

Kinematic synthesis of planar linkages. Higher-order, precision point and approximate synthesis. Unified treatment of position, function, and path-angle problems. Consideration of branching and rotatability. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 320.

ME 410. Automation and Robotics Applications. 3 or 4 hours.

Basic pneumatic and hydraulic systems. Design of sequential control circuits and ladder diagrams. Robot kinematics and dynamics. Robot design. Trajectory planning. Applications and demonstrations. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 210.

ME 411. Mechatronics I. 0-4 hours.

Elements of mechatronic systems, sensors, actuators, microcontrollers, modeling, hardware in the loop simulations, real time software, Electromechanical systems laboratory experiments. Course Information: Same as IE 411. 3 undergraduate hours. 4 graduate hours. Extensive computer use required. Prerequisite(s): Senior standing or above; or approval of the department. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture.

ME 412. Dynamic Systems Analysis I. 3 or 4 hours.

Classical control theory, concept of feedback, laplace transform, transfer functions, control system characteristics, root locus, frequency response, compensator design. Course Information: Same as IE 412. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 308.

ME 413. Dynamics of Mechanical Systems. 3 or 4 hours.

Degrees of freedom, generalized coordinates, principle of virtual work. D'Alembert's Principle, Lagrange's Equation, Hamilton's Principle. Equations of motion and Newton-Euler equations for rigid bodies. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 320.

ME 414. Theory of Gearing and Applications. 3 or 4 hours.

Classification of gear drives. Geometry of plane and spatial gears. Analysis and synthesis of gears with approximate meshing. Applications to spur, helical, worm and bevel gear drives. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 320.

ME 415. Propulsion Theory. 3 or 4 hours.

Thermodynamics and fluid mechanics of air-breathing engines, performance of rockets; chemical and nuclear rockets. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 419 or the equivalent.

ME 416. Railroad Vehicle Dynamics. 3 or 4 hours.

Introduces analytical and computational methods used for the computer aided dynamic and stability analysis of railroad vehicle systems. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 413; or consent of the instructor.

ME 417. Intermediate Fluid Mechanics. 3 or 4 hours.

Development of conservation equations for Newtonian-fluids; continuity, Navier-Stokes and energy equations. Some exact and approximate solutions of highly viscous, viscous and inviscid flows. Boundary layer flows, jets and wakes. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 321.

ME 418. Transport Phenomena in Nanotechnology. 3 or 4 hours.

Free surface flows, rheologically complex liquids, colloidal suspensions, emulsions, Brownian motion, flows in micro- and nanochannels, and multiple applications. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 325 and ME 211.

ME 419. Compressible Flow Theory. 3 or 4 hours.

Conservation laws, one-dimensional flows. Normal and oblique shock waves, Prandtl-Meyer expansion, flow over airfoils. Applications to nozzles, shock-tubes, wind-tunnels. Flow with friction and heat addition or loss. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 321.

ME 420. Combined Heat and Power, Design, and Management. 3 or 4 hours.

Presents fundamental issues of successfully integrating and implementing energy systems. Combined heat and power (e.g. CHP, cogeneration) strategies, integration of renewable with nonrenewable energy sources, and impacting policies are discussed. Course Information: Same as ENER 420. 3 undergraduate hours; 4 graduate hours. Prerequisite(s): Junior standing or above. Recommended background: ME 321 and ME 325.

ME 421. Intermediate Heat Transfer. 3 or 4 hours.

Topics in conduction, convection and radiation with emphasis on exact solutions: extended surfaces, internal and external flows, surface radiation, combined modes of heat transfer and selected topics. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 321 or consent of the instructor.

ME 422. Heating, Ventilation and Air Conditioning. 3 or 4 hours.

Refrigeration systems and heat-pump, mass transfer in humidification, solar heat transfer in buildings, heating and cooling loads, air-conditioning computer project. Course Information: Same as ENER 482. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Junior standing or above. Recommended background: ME 321.

ME 423. Heat Exchangers. 3 or 4 hours.

Classification; heat transfer and pressure drop analysis, flow distribution, transient performance, surface selection and geometrical properties, codes and standards. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 211 and ME 321.

ME 424. Energy Management Solutions for Industry: Theory and Practice. 3 or 4 hours.

Emphasis on real world applications including: understanding utility billing and identifying costs; identifying and quantifying energy savings opportunities at industrial facilities; determining investment payback scenarios and considerations. Course Information: Same as ENER 483. 3 undergraduate hours. 4 graduate hours. Extensive computer use required. Field work required. Extensive use of Microsoft Excel. Prerequisite(s): Junior standing or above.

ME 425. Second Law Analysis in Energy Engineering. 3 or 4 hours.

Fundamentals: lost available work. Entropy generation minimization, optimal thermal design of: heat transfer augmentation devices, thermal energy storage, cryogenics, heat exchangers, thermal insulations, solar collectors. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 321.

ME 426. Applied Combustion. 3 or 4 hours.

Topics in combustion, providing both a theoretical and applied understanding of combustion processes as they relate to furnaces. Internal and external combustion engines; pollutant formation. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 325.

ME 427. Solar Engineering. 3 or 4 hours.

Applications; solar geometry and intensities; applied heat transfer topics; flat plate and concentrating collectors; energy storage; analysis of heating and cooling systems. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 321 or consent of the instructor.

ME 429. Internal Combustion Engines. 3 or 4 hours.

Introduction to engine types, characteristics and performance. Combustion processes in spark and compression ignition engines; combustion abnormalities. Analysis of intake, exhaust and fuel system. Course Information: Same as ENER 484. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Junior standing. Recommended background: ME 325.

ME 433. Non-Equilibrium Thermal Processes. 3 or 4 hours.

Molecular engineering. Non-equilibrium statistical mechanics. Distribution functions. Molecular excitation and de-excitation. Ionization and dissociation. Laser engineering. Non-equilibrium chemical kinetics. Surface processes. Chemisorption and physisorption. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 325 or consent of the instructor.

ME 441. Optical Methods in Mechanical Engineering. 0-4 hours.

Optical measurement techniques in solid mechanics and thermal-fluid engineering. Fundamentals of optics. Use of holography, interferometry, LDV, lasers, light scattering, diffraction, and other relevant techniques. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Senior standing or consent of the instructor. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ME 444. Interdisciplinary Product Development I. 3 or 4 hours.

Systematic approach to the design process. Creative problem solving. Cross-functional teams (w/students from other departments/colleges) research and apply new product concepts to open-ended design problems. Course Information: Same as IE 444. 3 undergraduate hours. 4 graduate hours. Credit for ME 444 is not given if the student has credit in ME 396 or ME 397 or IE 396 or IE 397. Year-long (with IE/ME 445) project course. Prerequisite(s): ME 347 and IE 201; or IE 345 and IE 201; and senior standing or above; and consent of the instructor.

ME 445. Interdisciplinary Product Development 2. 4 hours.

Systematic approach to the design process. Creative problem solving. Cross-functional teams (w/students from other departments/colleges) research and apply new product concepts to open-ended design problems. Focus on solutions to the opportunities. Course Information: Same as IE 445. Credit is not given for ME 445 if the student has credit in ME 396 or ME 397 or IE 396 or IE 397. Year-long (with IE/ME 444) project course. Prerequisite(s): IE 444 or ME 444; and senior standing or above; and consent of the instructor.

ME 449. Microdevices and Micromachining Technology. 0-5 hours.

Microfabrication techniques for microsensors, microstructures, and microdevices. Selected examples of physical/chemical sensors and actuators. Simulation experiments. Course Information: Same as ECE 449. 4 undergraduate hours. 5 graduate hours. Laboratory. Prerequisite(s): ECE 347; or consent of the instructor. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ME 450. Air Pollution Engineering. 3 or 4 hours.

Environmental aspects of combustion processes, pollutant formation. Control of pollutants and particulates. Air quality control. Fundamentals of combustion. Course Information: Same as CHE 450 and ENER 485. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 321 or consent of the instructor.

ME 451. Electric Power Generation. 3 or 4 hours.

Comprehensive study of the fossil fuel fired power plants cycles with emphasis on their efficient performance and exergy analysis. Course Information: 3 undergraduate hours. 4 graduate hours. Same as ENER 451. Prerequisite(s): Junior standing or above. Recommended background: ME 321 and ME 325.

ME 453. Sustainable Energy Engineering and Renewable Energy. 3 or 4 hours.

An in-depth study of renewable energy systems, focusing on the principles, technologies, and applications. It focuses on various renewable energy sources, including solar, wind, hydro, biomass, and geothermal etc. Course Information: Same as ENER 453. 3 undergraduate hours; 4 graduate hours. Previously listed as ENER 553. Prerequisite(s): Junior standing or above. Recommended Background: ME 321 and ME 325.

ME 464. Virtual Automation. 0-4 hours.

Fundamentals of manufacturing and automation modeling using CAD/CAM and computer-integrated manufacturing methods; concepts of virtual manufacturing; industrial robots and automated factory models within virtual environments. Course Information: Same as IE 464. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CS 107 or CS 108. Class Schedule Information: To be properly registered, students must enroll in one Lecture-Discussion, and one Laboratory.

ME 468. Virtual Manufacturing. 3 or 4 hours.

Virtual reality applications in manufacturing systems design, manufacturing applications of networked virtual reality, virtual reality modeling of occupational safety engineering. Course Information: Same as IE 468. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CS 107 or CS 108.

ME 481. Additive Manufacturing Process. 3 or 4 hours.

Covers aspects of additive manufacturing. The types that are covered are generic process, design, vat photopolymerization, extrusion based, jetting, direct writing, 3D bio-printing, powder bed fusion, slicing, and data representation. Course Information: Same as IE 481. 3 undergraduate hours. 4 graduate hours. Recommended background: Manufacturing Processes.

ME 494. Special Topics in Mechanical Engineering. 3 or 4 hours.

Particular topics vary from term to term depending on the interests of the students and the specialties of the instructor. Course Information: 3 undergraduate hours. 4 graduate hours. May be repeated. Prerequisite(s): Consent of the instructor.

ME 496. Undergraduate Senior Design Thesis I. 0-8 hours.

Introduction to the principles and practice of product design: specifications, evaluation of design alternatives, technical reports, and oral presentations, through independent design projects. Course Information: Same as IE 496. Credit only given to nondegree students. No graduation credit given to students enrolled in Engineering. Extensive computer use required. Field trips required at a nominal fee. Prerequisite(s): Consent of the instructor.

ME 497. Undergraduate Senior Design Thesis II. 0-8 hours.

Introduction to engineering design and research methods: design tools, product conception and development, simulation, prototyping, technical reports and presentations, literature survey and undergraduate thesis. Course Information: Same as IE 497. Credit only given to nondegree students. No graduation credit given to students enrolled in Engineering. Extensive computer use required. Field trips required at a nominal fee. Prerequisite(s): Consent of the instructor.

ME 499. Professional Development Seminar. 0 hours.

Students are provided general information about their role as UIC MIE alumni in society and the role of the University in their future careers. Students provide evaluations of their educational experience in the MIE department. Course Information: Same as IE 499. Satisfactory/Unsatisfactory grading only. Prerequisite(s): Open only to seniors; and approval of the department. Must be taken in the student's last semester of study.

ME 501. Advanced Thermodynamics. 4 hours.

Thermodynamic laws of closed and open systems; exergy destruction; property relations, single phase systems, Gibbs-Duhem relations, multiphase systems, equilibrium; engineering applications. Course Information: Prerequisite(s): ME 325.

ME 502. Applied Stress Analysis II. 4 hours.

Concepts from theory of elasticity, stress-raisers such as notches and holes, mechanical behavior of materials including yielding and fractures, thick-walled cylinders and rotating disks, thermal stresses, and plastic behavior. Course Information: Prerequisite(s): ME 401.

ME 503. Advanced Solid Mechanics. 4 hours.

Linear elastic Governing equations, weighted residual method, variational principle, probability theory and stochastic processes, and stochastic finite element. Course Information: Prerequisite(s): Consent of the instructor. Recommended background: Knowledge in applied stress analysis and finite element analysis.

ME 504. Computer Aided Analysis of Multibody Systems I. 4 hours.

Kinematics, dynamics, analysis of flexible mechanisms. Constrained mechanical systems with flexible components. Numerical methods. Computer-Aided Analysis. Applications. Course Information: Prerequisite(s): ME 413 or consent of the instructor.

ME 505. Computer Aided Analysis of Multibody Systems II. 4 hours.

Large scale deformable bodies. Finite element method. Constrained motion of interconnected rigid and deformable bodies. Coordinate reduction. Computational methods. Applications. Course Information: Prerequisite(s): ME 504.

ME 508. Engineering Acoustics. 4 hours.

Fundamentals of acoustic energy generation, radiation and transmission (both aerodynamically and structurally). Theoretical, experimental and numerical techniques. Applications spanning from 1-D plane waves to more complex 3-D problems. Course Information: Prerequisite(s): ME 408 or CME 435; or approval of the department.

ME 509. Advanced Kinematics II. 4 hours.

Spatial transformation and displacements. Design for bodyguidance; applications to function-generators. Analyses utilizing various operators for closure; dualization; branching, rotatability; differential kinematics; numerical solutions. Course Information: Prerequisite(s): ME 409.

ME 510. Robotic Manipulators. 4 hours.

Description of robotic manipulator; gripper trajectory execution; manipulator design, degree-of-freedom, mobility, workspace, special link positions; static and dynamic force transmission. Course Information: Prerequisite(s): ME 409 or ME 410 or ME 413; or consent of the instructor.

ME 511. Mechatronics II. 4 hours.

Microcontrollers used in electro-mechanical systems for measurement and control purposes, interface hardware, real time software and development tools, applications in robotic motion control and factory automation. Course Information: Same as IE 511. Prerequisite(s): ME 411 and consent of the instructor. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture.

ME 512. Automatic Control of Mechanical Systems. 4 hours.

Modeling and analysis of mechanical systems. Performance specification and evaluation. Modern control system design and analysis techniques. Real-time computer control of engines, manufacturing processes, biomechanical systems. Course Information: Prerequisite(s): ME 412 or consent of the instructor.

ME 514. Mechanics of Viscous Fluids. 4 hours.

Fundamentals of fluid mechanics. Streamline and vorticity. Boundary layer analysis. Similarity solutions, integral methods, and other techniques for treating laminar and turbulent flows. Course Information: Prerequisite(s): ME 417.

ME 515. Micro- and Nano-Transport Phenomena. 4 hours.

Covers free surface flows, rheological complex liquids, colloidal suspensions and emulsions. Course Information: Prerequisite(s): ME 205 and ME 211; or consent of the instructor.

ME 517. Microfluidics: Fundamentals and Applications. 4 hours.

Fundamentals of microfluidics. Microflow. Microfluidic components and microfabrication. Digital microfluidics. Acoustofluidics. Microfluidic sensors, including optical and electrochemical sensors. Prerequisite(s): Graduate standing; or consent of the instructor.

ME 518. Fundamentals of Turbulence. 4 hours.

Mathematical description of turbulence field; kinematics of homogeneous turbulence; correlation and spectrum tensor, dynamic behavior of isotropic turbulence, universal equilibrium theory; nonisotropic turbulence. Course Information: Prerequisite(s): ME 417.

ME 519. Computational Compressible Flow. 4 hours.

Equations of fluid dynamics; nonlinear hyperbolic partial differential equations; some properties of the Euler Equations; the Riemann problem for the Euler Equations; notions on numerical methods; the method of Godunov for nonlinear systems. Course Information: Extensive computer use required. Prerequisite(s): ME 419; or consent of the instructor. Recommended Background: Compressible Flow Theory and knowledge of programming C++, Fortran, or Python.

ME 520. Elastography. 4 hours.

Theoretical foundations of elastography, viscoelasticity, propagation of mechanical waves, elastographic imaging techniques. Magnetic resonance imaging to magnetic resonance elastography data transformation, viscoelastic parameter reconstruction. Course Information: Same as BME 520. Extensive computer use required. Recommended background: BME 421 and BME 422 and BME 423.

ME 521. Heat Conduction. 4 hours.

Analysis of heat transfer in solids including separation of variables, superpositions, Du Hamel's theorem, integral transforms, similarity transformations, and approximate methods. Course Information: Prerequisite(s): ME 321 or consent of the instructor.

ME 522. Convective Heat Transfer. 4 hours.

Conservation equations. Momentum heat and mass transfer in laminar and turbulent boundary layers. Internal and external flows and heat transfer. Heat transfer with phase change. Special topics in convective heat transfer. Course Information: Prerequisite(s): ME 321 or consent of the instructor.

ME 524. Thermal Radiation. 4 hours.

Fundamentals of radiative transfer; energy exchange between surfaces and in enclosures; radiative transfer in the presence of an attenuating medium; combined radiation, conduction, convection problems. Course Information: Prerequisite(s): ME 421 or consent of the instructor.

ME 525. Multi-phase Heat Transfer. 4 hours.

Nucleate boiling, nucleation and bubble dynamics. Leidenfrost effect. Condensation and engineering application problems. Ice/Frost formation. Surface engineering for enhancing heat transfer. Course Information: Prerequisite(s): ME 421; and graduate standing; or consent of the instructor.

ME 528. Numerical Heat Transfer. 4 hours.

Numerical methods for solving conduction, convection and radiation problems in heat transfer. Iterative methods with shooting; local nonsimilarity methods perturbation methods; finite difference methods; grid generation. Course Information: Prerequisite(s): CS 108 and ME 421 or consent of instructor.

ME 529. Advanced Internal Combustion Engines. 4 hours.

Fundamentals of internal combustion engines. Combustion in homogeneous charged and compression ignition engines. Emission formation. Effect of design and operating variables, control, and instrumentation. Course Information: Prerequisite(s): ME 426 or ME 429.

ME 531. Thermophysics of Gas Flows. 4 hours.

Kinetic theory of gases. Transport properties, quantum mechanical analysis of atomic and molecular structures, atomic scale collision phenomena, propagation, emission, and absorption of radiation.

ME 533. Plasma Engineering. 4 hours.

Plasma-assisted applications. Kinetic theory of non-equilibrium processes. Plasma dynamics. Elementary processes-collisions. Diffusion and transport. Chemical reactions and surface treatment. Particle and energy balance in plasmas. Course Information: Prerequisite(s): ME 433 or consent of the instructor.

ME 534. Finite Element Analysis II. 4 hours.

Application of the finite element method to the analysis of complex continuum and structural linear systems. Introduction to error analysis and convergence of the finite element solutions. Course Information: Same as CME 534. Prerequisite(s): CME 434.

ME 535. Theory of Vibrations II. 4 hours.

Harmonic vibrations; vibrations of a string; vibrations of a beam; vibrations of a membrane; periodic systems; floquet waves; nonlinear vibrations. Course Information: Same as CME 535. Prerequisite(s): CME 435 or ME 408 or the equivalent.

ME 536. Chemically Reacting Flows. 4 hours.

Nonequilibrium states; chemical thermodynamics and kinetics. Multicomponent continuum equations for flow of nonequilibrium fluids. Inversed nonequilibrium flows. Boundary layer flows with surface and gas-phase reactions. Frozen and equilibrium criteria. Waves in relaxing media. Course Information: Prerequisite(s): ME 516; and ME 514 or ME 522.

ME 540. Design, Modeling, and Fabrication of Microsystems. 4 hours.

MEMS design approach, materials and mechanical properties, scaling laws, transduction methods, microfabrication techniques, modeling and simulation strategies, dynamics, domain-specific details-structures, fluids, dissipation, and system issues. Course Information: Prerequisite(s): Consent of the instructor.

ME 541. Microelectronic Fabrication Techniques. 4 hours.

Current fabrication techniques of microelectronic technology; plasma and CVD processes; etching techniques; ion implantation; surface analytical methods. Course Information: Same as ECE 541. Prerequisite(s): ECE 347 or ECE 449.

ME 542. Advanced Computational Methods for Product and Process Design. 4 hours.

Deterministic and statistical methods for modeling and optimizing engineering systems, in the broad context of product design, manufacturing process development, and designing for life cycle issues. Course Information: Same as IE 542. Prerequisite(s): Programming language experience.

ME 545. Wearable Robots for Assistance and Rehabilitation. 4 hours.

Introduces wearable robots to help humans with disabilities and control methods of electromechanical devices that interact with humans such as robotic prostheses and exoskeletons. Model-free intervention methods and human adaptation. Course Information: Same as IE 545. Extensive computer use required. Recommended background: Basic understanding of dynamic systems and control, mechatronics, and programming skills (matlab or python). Class Schedule Information: To be properly registered, students must enroll in one Lecture-Discussion and one Laboratory.

ME 547. Advanced Concepts in Computer-Aided Engineering. 4 hours.

Useful concepts in motion simulation of complex rigid multibody systems. Interactive computer solutions. Recursive formulation of kinematical and dynamical equations of open and constrained multibody systems. Course Information: Prerequisite(s): ME 413 and ME 447.

ME 548. Advanced Computer Aided Manufacturing. 4 hours.

Analysis and design of computer-integrated systems for process planning, production planning and control of discrete part manufacturing activities. Course Information: Prerequisite(s): ME 447.

ME 550. Dynamics of Floating Offshore Structures. 4 hours.

Covers environmental loads and dynamics of floating structures in fluid. Course Information: Same as CME 550. Prerequisite(s): ME 210 and CME 211 and ME 211 and MATH 220; or consent of the instructor.

ME 562. Biomedical Implants in Orthopedics and Dentistry. 4 hours.

Advanced aspects of implant design, including biomaterials, surface coatings, biomechanics, corrosion, tribocorrosion, failure mechanisms, implant monitoring, clinical and regulatory concerns, critical review of current research. Course Information: Same as BME 562 and CME 562. Credit is not given for ME 562 if the student has credit in BIOE 562 or BME 562 or CME 562.

ME 569. Virtual and Augmented Reality for Industrial Applications. 4 hours.

Principles and practices of virtual and augmented reality for industrial applications such as manufacturing, construction, transportation, worker training, and human-machine teaming; projects for the design and evaluation of VR/AR applications. Course Information: Same as IE 569. Extensive computer use required.

ME 574. Human Movement and Neural Control. 4 hours.

Musculoskeletal biomechanics and neural control of human movement. Measurement of activity (e. g. EEG, fMRI, EMG, force sensors, motion tracking). Engineering skills for rigid body dynamics, quantitative analysis, modeling, control theory, motor learning. Course Information: Same as ME 574. Extensive computer use required. One hands-on lab/homework project. Recommended background: Physiology; working knowledge of Matlab; system dynamics and frequency-domain analysis (e.g. BME 310, ECE 310, ME 312 or equivalent).

ME 591. Mechanical Engineering Internship. 1 hour.

Provides students with the opportunity to apply the skills and knowledge gained in previous engineering courses within a professional, working environment. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. A maximum of 4 hours awarded toward degree requirements. Prerequisite(s): Approval of the Department.

ME 594. Current Topics in Mechanical Engineering. 4 hours.

Particular topics vary from term to term depending on the interests of the students and the specialties of the instructor. Course Information: May be repeated. Prerequisite(s): Consent of the instructor.

ME 595. Mechanical Engineering Seminar. 0-1 hours.

Advances in mechanical engineering research will be discussed in a seminar setting. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. Must be taken every semester by all registered MS and PhD students in Mechanical Engineering. Students taking the course for one credit hour submit reflective summaries of the presentations. Prerequisite(s): Graduate standing in mechanical engineering.

ME 596. Independent Study. 1-4 hours.

Individual study under close supervision of a faculty member. Course Information: May be repeated to a maximum of 4 hours. Students may register in more than one section per term. Prerequisite(s): Consent of the instructor.

ME 598. M.S. Thesis Research. 0-16 hours.

Individual research in specialized problems under close faculty supervision. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. Prerequisite(s): Consent of the instructor.

ME 599. Ph.D. Thesis Research. 0-16 hours.

Individual research on specialized problems under close faculty supervision. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. Prerequisite(s): Consent of the instructor.