**ME 419. Compressible Flow Theory. 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 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: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 211 and 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: 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 428. Numerical Methods in Mechanical Engineering. 3 or 4 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: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CS 108 and senior standing.

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: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): 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.
Cross-functional teams (w/students from AD 420/423 and MKTG 594) research and develop new product concepts. Focus on the identification of technologically appropriate product design problems. Course Information: Same as IE 444. 3 undergraduate hours. 4 graduate hours. Year-long (with IE/ME 445) project course. Prerequisite(s): Senior standing or above; and consent of the instructor.

ME 445. Interdisciplinary Product Development 2. 4 hours.
Cross-functional teams (w/students from AD 420 and MKTG 594) research and develop new product concepts. Focus on solutions to the opportunities identified in IE/ME 444 to functional prototypes. Serves as a replacement for IE/ME 396. Course Information: Same as IE 445. 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 447. Computer-Aided Design. 0-4 hours.
Conventional and computer-assisted methods in design. Geometry manipulation. Computer-aided modeling with curves, surfaces, and solids. Design with finite-element analysis. PRO/Engineer, PRO/Mechanica, ABAQUS, ANSYS. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): MATH 220 and CME 203 and ME 250; or consent of the instructor. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture.

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. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 321 or consent of the instructor.

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 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 499. Professional Development Seminar. 0 hours.
Students are provided general information about their role as UIC Mechanical Engineering 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: 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 504. Computer Aided Analysis of Multibody Systems I. 4 hours.

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

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 body guidance; applications to function-generators. Analyzes 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.

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 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 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. Boiling Heat Transfer and Two-Phase Flow. 4 hours.
Homogeneous and separated two-phase flow models for pressure drop and heat transfer. Pool boiling, nucleation and bubble dynamics, stability, condensation and engineering application problems. Course Information: Prerequisite(s): ME 421.

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 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, propogation, emission, and absorption of radiation.

ME 533. Plasma Engineering. 4 hours.

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 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 569. Advanced Virtual Manufacturing. 4 hours.
Manufacturing systems design optimization using virtual environments,
optimization of manufacturing decision support using virtual reality
interfaces, analysis and evaluation of virtual environments. Course
Information: Same as IE 569. Prerequisite(s): Consent of the instructor.

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 hours.
Advances in mechanical engineering research will be discussed in a
seminar setting. Course Information: Satisfactory/Unsatisfactory grading
only. Must be taken every semester by all registered MS and PhD
students in Mechanical Engineering. 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.