

MECHANICAL ENGINEERING (ME)

Mechanical Engineering (ME) Courses

ME 5013. Topics in Mechanical Engineering. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Current topics in mechanical engineering, such as advanced fracture mechanics, lean manufacturing, advanced manufacturing engineering and advanced energy systems. May be repeated for credit with consent of Graduate Committee as topics vary. Differential Tuition: \$165.

ME 5143. Advanced Dynamics. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Review of Newtonian mechanics, 3-D particle kinematics, dynamics of a system of particles, analytical mechanics, Lagrange's equations, kinematics and rigid-body dynamics, Eulerian angles, computational analysis using a symbolic language. Differential Tuition: \$165.

ME 5183. Advanced Mechanical Vibration. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Free and forced vibration of single and multi-degree-of-freedom systems; response to harmonic, periodic, and nonperiodic excitations; continuous systems; computational techniques for the response. Differential Tuition: \$165.

ME 5243. Advanced Thermodynamics. (3-0) 3 Credit Hours.

Prerequisite: ME 3293. Concepts and postulates of macroscopic thermodynamics; formulation of thermodynamic principles; exergy stability of thermodynamic systems, principles of irreversible thermodynamics, chemical equilibria. Differential Tuition: \$165.

ME 5263. Combustion. (3-0) 3 Credit Hours.

Prerequisite: ME 4293. Thermochemistry and transport theory applied to combustion; gas phase equilibrium; energy balances; reaction kinetics; flame temperatures, speed, ignition, and extinction; premixed and diffusion flames; combustion aerodynamics; mechanisms of air pollution. Differential Tuition: \$165.

ME 5273. Alternative Energy Sources. (3-0) 3 Credit Hours.

Prerequisite: ME 3293. Solar, nuclear, wind, hydrogen, and geothermal energy sources. Resources, production, utilization, economics, sustainability, and environmental considerations. (Same as CE 5643. Credit cannot be earned for both ME 5273 and CE 5643.) Differential Tuition: \$165.

ME 5283. Power Plant System Design. (3-0) 3 Credit Hours.

Prerequisites: ME 4293 and ME 4313. Application of thermodynamics and fluid mechanics to the design of vapor and gas-turbine power plant systems including boilers, condensers, turbines, pumps, compressors, cooling towers, and alternative energy power plants. Differential Tuition: \$165.

ME 5303. Advanced Heat and Mass Transfer. (3-0) 3 Credit Hours.

Prerequisite: ME 4313. Derivation of energy and mass conservation equations with constitutive laws for conduction, convection, radiation, and mass diffusion. Dimensional analysis, heat exchangers, boiling and condensation, steady and transient solutions. Differential Tuition: \$165.

ME 5343. Convection. (3-0) 3 Credit Hours.

Prerequisite: ME 4313. Derivation of equations of convection of mass, momentum, and energy; scale analysis; boundary layer solutions; classical, laminar convection problems; turbulent convection; natural convection. Differential Tuition: \$165.

ME 5353. Radiation. (3-0) 3 Credit Hours.

Prerequisite: ME 4313. Thermal radiation laws, geometric factors, black bodies, gray enclosures, nongray systems, combined conduction, convection, and radiation. Differential Tuition: \$165.

ME 5453. Advanced Strength of Materials. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Failure theories, energy methods, advanced topics in bending, torsion, and stress concentration. (Formerly EGR 5553. Credit cannot be earned for both ME 5453 and EGR 5553.) Differential Tuition: \$165.

ME 5463. Fracture Mechanics. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Introduction to failure and fracture of engineering materials, Griffith's energy balance, stress intensity and strain energy release rate approaches to brittle fracture, Dugdale and Irwin approaches to ductile fracture. Application to modern engineering materials. (Formerly EGR 5313. Credit cannot be earned for both ME 5463 and EGR 5313.) Differential Tuition: \$165.

ME 5473. Viscoelasticity. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Principle of fading memory, integro-differential constitutive laws, mechanical models, time and temperature superposition, and linear and nonlinear methods. Applications to polymers, composites, and adhesives. (Formerly EGR 5323. Credit cannot be earned for both ME 5473 and EGR 5323.) Differential Tuition: \$165.

ME 5483. Finite Element Methods. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Derivation and computer implementation of the finite element method for the solution of boundary value problems. (Same as CE 5023 and CE 5193. Credit cannot be earned for more than one of the following: ME 5483, CE 5023 and CE 5193.) Differential Tuition: \$165.

ME 5493. Fundamentals of Robotics. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Theoretical and analytic developments, Denavit-Hartenberg parameters, quaternions, state-space, linear and nonlinear analysis, classical and modern methods of mechanics, serial manipulators, parallel manipulators, and controls. Differential Tuition: \$165.

ME 5503. Lean Manufacturing and Lean Enterprises. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Methodologies for transforming an enterprise into a lean enterprise. Topics include Lean Manufacturing basics and tools; Lean Implementation Guidelines; Lean Metrics and Performance Measures; Lean Extended Enterprise; and Lean Supply Chain Design and Management. Hands-on Value Stream Mapping project is required. Differential Tuition: \$165.

ME 5513. Advanced Mechanism Design. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Advanced topics in kinematic synthesis of linkage, static and dynamic force analyses, and computer-aided design of mechanisms. Differential Tuition: \$165.

ME 5533. Advanced Machine Design. (3-0) 3 Credit Hours.

Prerequisite: ME 3823 or an equivalent. Advanced problems in machine design, including bearings, brakes, clutches, gears, shafts, springs, and advanced stress analysis. Differential Tuition: \$165.

ME 5543. Probabilistic Engineering Design. (3-0) 3 Credit Hours.

Prerequisite: STA 2303 or an equivalent. Development and application of probabilistic methods in engineering: random variable definitions, probability distributions, distribution selection, functions of random variables, numerical methods including Monte Carlo sampling, First Order Reliability Methods, and component and systems reliability. (Same as BME 6333. Credit cannot be earned for both BME 6333 and ME 5543.) Differential Tuition: \$165.

ME 5553. Advanced Design of Cams and Gears. (3-0) 3 Credit Hours.

Prerequisites: ME 3823 and ME 4543, or their equivalents. Advanced problems in design of cam follower systems, gear trains and spur, helical, bevel, and worm gears. Differential Tuition: \$165.

ME 5563. Computer Integrated Manufacturing. (3-1) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Advanced concepts and models related to computer-aided design, manufacturing, process planning, production planning and scheduling, and manufacturing execution systems. Laboratory work includes computer-based manufacturing applications and programming of automated production equipment. Differential Tuition: \$165.

ME 5573. Facilities Planning and Design. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Advanced concepts and fundamentals essential to understand, analyze, and solve problems related to manufacturing plant layout and material handling system selection. Topics include Product, Process, and Schedule Design; Flow, Space, and Activity Relationships; Material Handling; Layout Planning Models and Design Algorithms; and Warehouse Operations. The subjects included in this course are organized around integrated product, process, and manufacturing system design principles. Differential Tuition: \$165.

ME 5583. Process Improvement and Variability Reduction. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Concepts, methodologies, and tools for the design, engineering and continuous improvement of manufacturing systems and enterprise operations. Topics include Six Sigma for Process Improvement and Design, Lean Systems, Performance Evaluation, and other contemporary enterprise process engineering approaches. (Formerly titled "Advanced Enterprise Process Engineering.") Differential Tuition: \$165.

ME 5603. Advanced Manufacturing Systems Engineering. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Design, planning, scheduling, and control of manufacturing systems with emphasis on information flow and decision-making. After introducing students to system simulation, simulation models of manufacturing systems are developed and evaluated in terms of system performance under different production planning and control policies. Contemporary manufacturing topics and research areas are emphasized. Differential Tuition: \$165.

ME 5633. Gas Dynamics. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Integral and differential forms of the conservation equations, one-dimensional flow, oblique shock and expansion waves, and supersonic, transonic, and hypersonic flows. Differential Tuition: \$165.

ME 5643. Green and Sustainable Manufacturing and Enterprise Systems. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing, ME 5503, or consent of instructor. Advanced concepts, tools and topics in eliminating wastes from the processes and operations of manufacturing firms via the perspective of the environment. Topics include identifying, measuring, and minimizing environmental wastes related to energy, water, materials, garbage, transportation, emissions, and biodiversity, as well as ways to totally eliminate these environmental wastes from green value stream mapping techniques. Readings and survey of contemporary technologies and tools enabling green and sustainable manufacturing and enterprise systems are also required. (Formerly titled "Advanced Topics in Manufacturing and Enterprise Engineering.") Differential Tuition: \$165.

ME 5653. Computational Fluid Dynamics. (3-0) 3 Credit Hours.

Prerequisite: ME 3663 or an equivalent. The mathematical models for fluid-flow simulations at various levels of approximation, basic description techniques, and the nature of flow equations and their boundary conditions. Differential Tuition: \$165.

ME 5703. Lean Product Development and Service Systems. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Theory and applications of lean manufacturing and six-sigma to enterprise functions beyond production shop floor, with focus on lean product and process development, lean costing, and integration of IT and ERP systems to sustain continuous improvement. (Credit cannot be earned for both ME 5703 and ME 5583 taken prior to Fall 2011.) (Formerly titled "Advanced Enterprise Systems Engineering.") Differential Tuition: \$165.

ME 5713. Mechanical Behavior of Materials. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Mechanical behavior of engineering materials (metals, alloys, ceramics, and polymers) elasticity, dislocation theory, strengthening mechanism, fracture, fatigue, creep, and oxidation. Differential Tuition: \$165.

ME 5733. Advanced Medical Device Design. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Topics include classification of medical devices, the design process, implementation, and evaluation, IP protection, FDA approval process, and human factors in medical device design. Differential Tuition: \$165.

ME 5743. Composite Materials. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Introduction to mechanics of composites, micromechanics, macromechanics, lamination theory, design, and applications of fiber-reinforced composites and particulate composites. (Formerly EGR 5413. Credit cannot be earned for both ME 5743 and EGR 5413.) Differential Tuition: \$165.

ME 5753. Fluid Dynamics in Natural Systems. (3-0) 3 Credit Hours.

Prerequisite: ME 5613 or consent of instructor. Fundamental principles of turbulent fluid flows in natural systems with a focus on atmospheric flows, coastal flows, wind energy and physiological flows. Topics include classical and statistical theory of turbulence and energy cascading, spectral analysis of turbulence, atmospheric boundary layer, aerodynamics of wind turbines, flow dynamics in diseased and normal coronary artery. Differential Tuition: \$165.

ME 5803. Principles of Microfabrication. (1-6) 3 Credit Hours.

Prerequisite: EGR 3323 or consent of instructor. Photolithography, thin film deposition, doping, wet patterning, plasma etching, thin film characterization. Students will fabricate simple microstructures such as coplanar waveguides, micro-fluidic devices and nano-powder silica films. (Same as EE 5413. Credit cannot be earned for both ME 5803 and EE 5413.) Differential Tuition: \$165.

ME 5883. Introduction to Micro and Nanotechnology. (2-3) 3 Credit Hours.

Prerequisite: Graduate standing or completion of or concurrent enrollment in EE 3323. Survey of micro-fabrication techniques, scaling laws, mechanical, optical and thermal transducers, micro-fluidic applications, and nanostructures. (Same as EE 5503. Credit cannot be earned for both ME 5883 and EE 5503.) Differential Tuition: \$165.

ME 5963. Topics in Bioengineering. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Topics may include: biomechanics, biological systems, biosolid and biofluid, transport phenomena, biomaterials, medical devices, and medical imaging. May be repeated for credit as topics vary. Differential Tuition: \$165.

ME 5971. Special Project. (0-0) 1 Credit Hour.

Prerequisites: Permission in writing (form available) from the instructor and the Graduate Advisor of Record. The directed research course is offered only for nonthesis option students and may involve either a laboratory or a theoretical problem. The course requires an oral presentation of the work done at the end of the semester. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree. Differential Tuition: \$55.

ME 5973. Special Project. (0-0) 3 Credit Hours.

Prerequisites: Permission in writing (form available) from the instructor and the Graduate Advisor of Record. The directed research course is offered only for nonthesis option students and may involve either a laboratory or a theoretical problem. The course requires an oral presentation of the work done at the end of the semester. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree. Differential Tuition: \$165.

ME 6043. Continuum Mechanics. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. The general purpose of the class is to introduce continuum mechanics, the equations of motion, various reference frames, and constitutive modeling. Topics covered in the class include the stress and strain tensors, equations of motion, finite elasticity, shock waves, plasticity theory, virtual displacements and nonlocal formulations. Differential Tuition: \$165.

ME 6113. Experimental Techniques in Engineering. (2-3) 3 Credit Hours.

Prerequisites: Graduate standing and consent of instructor. Laboratory-based course focused on experimental testing, accounting for sources of errors, and analysis including uncertainty, graphing, and curve fitting. Modern transducers and measurement and data acquisition techniques will be discussed and utilized in the context of engineering laboratories and a course project. Differential Tuition: \$165.

ME 6123. Advanced Systems Dynamics and Control. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Dynamic modeling of mechanical and multi-energy domain systems; state-space and frequency-domain analysis of dynamic systems; feedback control systems; multivariable state-feedback control; principles of controllability, observability, stability; computer-based simulation system dynamics. (Formerly ME 5113. Credit cannot be earned for both ME 6123 and ME 5113.) Differential Tuition: \$165.

ME 6133. Advanced Control of Mechanical Systems. (2-3) 3 Credit Hours.

Prerequisite: Graduate standing in engineering. Input-output and state space representation of discrete time mechanical systems; controllability, observability, and stability; design and analysis of digital control systems in transform and time domain; state observer; linear quadratic optimal control, stochastic state estimation, linear quadratic Gaussian problem, loop transfer recovery, adaptive control and model reference adaptive systems, self-tuning regulators, repetitive control, application to mechanical systems including hard disk drives, intelligent vehicle, motor drives, etc. Differential Tuition: \$165.

ME 6253. Bioheat Transfer. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Principles and applications of heat transfer in soft tissue. Topics may include fundamental conservation laws and governing equations of heat transfer, coupling of fluid and mass transport, and thermal activated nanoparticle transvascular transport. (Same as BME 6253. Credit can be earned for both ME 6253 and BME 6253.) Differential Tuition: \$165.

ME 6333. Advanced Conduction. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. This course covers methods to calculate the distribution of temperature and heat transfer in objects. Class topics include steady-state conduction in one or more dimensions, unsteady-state conduction in one or more dimensions, exact analytic methods, approximate analytic methods, numerical techniques, nonlinear conduction in one dimension, and inverse conduction in one dimension. Differential Tuition: \$165.

ME 6413. Elasticity. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Strain and stress, constitutive relations for linear elastic solids, plane problems, variational principles. (Formerly ME 5413. Credit cannot be earned for both ME 6413 and ME 5413.) Differential Tuition: \$165.

ME 6543. Machine Learning and Data Analytics. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Introduction to discovery and communication of meaningful patterns in data, including data description (descriptive/visualization techniques), prediction (predictive modeling using machine learning), improve performance (optimization/decision making). Differential Tuition: \$165.

ME 6563. Flexible Automation and Manufacturing Systems. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. This course focuses on major integration issues related with flexible manufacturing systems and their components. Introduces mathematical models related to design, planning, scheduling, and control of flexible manufacturing systems. Contemporary manufacturing topics and research areas are emphasized. Differential Tuition: \$165.

ME 6573. Robotics Design and Analysis. (3-0) 3 Credit Hours.

Prerequisites: ME 5113 and ME 5143. Serial manipulator design and controls; electromechanical issues at the actuator level; analytic modeling and synthesis techniques with emphasis on the influence of sensors, machine vision, and control at the actuator-level and robot system designs. Differential Tuition: \$165.

ME 6613. Advanced Fluid Mechanics. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Dynamics of incompressible fluid mechanics viscous flow, Navier-Stokes equations, boundary layer theory, and numerical operations for incompressible fluid flow. (Formerly ME 5613. Credit cannot be earned for both ME 6613 and ME 5613.) Differential Tuition: \$165.

ME 6663. Advanced Fatigue and Fracture. (3-0) 3 Credit Hours.

Prerequisites: ME 5463 and graduate standing in engineering or consent of instructor. Application of engineering concepts in fatigue and fracture mechanics to actual structural failure issues faced by various industries, such as aerospace, powerplant, oil/gas, and others. Review of concepts in fatigue, damage tolerance, and probabilistic fracture mechanics. Application of concepts to modern engineering problems. Differential Tuition: \$165.

ME 6813. Biomaterials. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Fundamentals in applications of material science and engineering principles and concepts to repairing, replacing, and protecting human tissues and organs. (Formerly ME 5813 and ME 6013. Same as BME 6903. Credit can be earned for only one of the following: ME 6813, ME 6013, ME 5813 or BME 6903.) Differential Tuition: \$165.

ME 6833. Biomechanics. (3-0) 3 Credit Hours.

Prerequisite: Graduate standing in engineering or consent of instructor. Fundamentals in applications of engineering mechanics to modeling structures and functions of tissues, organs, joints, and human body. (Formerly ME 5833 and ME 6033. Same as BME 6803. Credit can be earned for only one of the following: ME 6833, ME 6033, ME 5833 or BME 6803.) Differential Tuition: \$165.

ME 6853. Advanced CFD and Heat Transfer. (3-0) 3 Credit Hours.

Prerequisite: ME 5613 or consent of instructor. Topics include large-scale simulation tools for turbulent flows including large-eddy-simulation (LES), direct numerical simulation (DNS) and turbulence modeling for range of incompressible, buoyancy driven and compressible flows. Generalized numerical framework for numerical solution of Navier-Stokes equations. Differential Tuition: \$165.

ME 6893. Topics in Biomechanics. (3-0) 3 Credit Hours.

Prerequisite: ME 6833 or BME 6803 or an equivalent. The biomechanics of biological tissues and organs. Topics may include constitutive equations, stress, and adaptation of hard and soft tissues. (Formerly ME 6023. Same as BME 6893. Credit cannot be earned for both ME 6893 and ME 6023. Credit cannot be earned for both ME 6893 and BME 6893 when the topic is the same.) Differential Tuition: \$165.

ME 6951. Independent Study. (0-0) 1 Credit Hour.

Prerequisites: Graduate standing and permission in writing (form available) of the instructor, the student's advisor, and the Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 3 hours, regardless of discipline, will apply to the Master's degree. Differential Tuition: \$55.

ME 6953. Independent Study. (0-0) 3 Credit Hours.

Prerequisites: Graduate standing and permission in writing (form available) of the instructor, the student's advisor, and the Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 3 hours, regardless of discipline, will apply to the Master's degree. Differential Tuition: \$165.

ME 6961. Comprehensive Examination. (0-0) 1 Credit Hour.

Prerequisite: Approval of the Mechanical Engineering Graduate Program Committee to take the Comprehensive Examination. Independent study for the purpose of taking the Comprehensive Examination. May be repeated for credit as many times as approved by the Mechanical Engineering Graduate Program Committee. Enrollment is required each term in which the Comprehensive Examination is taken if no other courses are being taken that term. The grade report for the course is either "CR" (satisfactory performance on the Comprehensive Examination) or "NC" (unsatisfactory performance on the Comprehensive Examination). Differential Tuition: \$55.

ME 6973. Special Problems. (3-0) 3 Credit Hours.

Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized studies not normally available as part of the regular course offerings. Special Problems courses may be repeated for credit when topics vary, but not more than 6 hours, regardless of discipline, may be applied to the Master's degree. Differential Tuition: \$165.

ME 6981. Master's Thesis. (0-0) 1 Credit Hour.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. Differential Tuition: \$55.

ME 6982. Master's Thesis. (0-0) 2 Credit Hours.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. Differential Tuition: \$110.

ME 6983. Master's Thesis. (0-0) 3 Credit Hours.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor. Thesis research and preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. Differential Tuition: \$165.

ME 7941. Independent Doctoral Study. (0-0) 1 Credit Hour.

Prerequisites: Graduate standing in Ph.D. in Mechanical Engineering program and permission in writing (form available) of the student's advisor. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For Ph.D. students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 3 hours, regardless of discipline, will apply to the Doctoral degree. Differential Tuition: \$55.

ME 7942. Independent Doctoral Study. (0-0) 2 Credit Hours.

Prerequisites: Graduate standing in Ph.D. in Mechanical Engineering program and permission in writing (form available) of the student's advisor. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For Ph.D. students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 3 hours, regardless of discipline, will apply to the Doctoral degree. Differential Tuition: \$110.

ME 7943. Independent Doctoral Study. (0-0) 3 Credit Hours.

Prerequisites: Graduate standing in Ph.D. in Mechanical Engineering program and permission in writing (form available) of the student's advisor. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For Ph.D. students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 3 hours, regardless of discipline, will apply to the Doctoral degree. Differential Tuition: \$165.

ME 7951. Doctoral Research. (0-0) 1 Credit Hour.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. Differential Tuition: \$55.

ME 7952. Doctoral Research. (0-0) 2 Credit Hours.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. Differential Tuition: \$110.

ME 7953. Doctoral Research. (0-0) 3 Credit Hours.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. Differential Tuition: \$165.

ME 7954. Doctoral Research. (0-0) 4 Credit Hours.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. Differential Tuition: \$220.

ME 7955. Doctoral Research. (0-0) 5 Credit Hours.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. Differential Tuition: \$275.

ME 7956. Doctoral Research. (0-0) 6 Credit Hours.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. Differential Tuition: \$330.

ME 7958. Doctoral Research. (0-0) 8 Credit Hours.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor. May be repeated for credit. A minimum of 18 credit hours of Doctoral Research is required. Differential Tuition: \$440.

ME 7981. Doctoral Dissertation. (0-0) 1 Credit Hour.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor, after being admitted for Ph.D. candidacy. May be repeated for credit. A minimum of 15 credit hours of Doctoral Dissertation is required. (Formerly ME 7993-8.) Differential Tuition: \$55.

ME 7982. Doctoral Dissertation. (0-0) 2 Credit Hours.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor, after being admitted for Ph.D. candidacy. May be repeated for credit. A minimum of 15 credit hours of Doctoral Dissertation is required. (Formerly ME 7993-8.) Differential Tuition: \$110.

ME 7983. Doctoral Dissertation. (0-0) 3 Credit Hours.

Prerequisites: Consent of the Graduate Advisor of Record and primary thesis advisor, after being admitted for Ph.D. candidacy. May be repeated for credit. A minimum of 15 credit hours of Doctoral Dissertation is required. (Formerly ME 7993-8.) Differential Tuition: \$165.

ME 7993. Research Seminar. (3-0) 3 Credit Hours.

Organized lectures and seminar presentations to facilitate the development of doctoral students' research skills and knowledge of current and emerging research. Required for all Ph.D. students in Mechanical Engineering. Differential Tuition: \$165.