MECHANICAL ENGINEERING

Jamie Ervin, Department Chairperson
Kimberly Bigelow, Graduate Program Director

Doctor of Engineering, Mechanical Engineering (MEE)

See the Doctoral Degree Requirements section on the School of Engineering page and consult with the department chair.

Doctor of Philosophy in Engineering, Mechanical Engineering (MEE)

See the Doctoral Degree Requirements section on the School of Engineering page and consult with the department chair.

Master of Science in Mechanical Engineering (MEE)

The program of study leading to the Master of Science in Mechanical Engineering degree, developed by the student in conjunction with her/his advisor, must include a minimum of 30 semester hours. Both a Thesis and Non-Thesis option are available.

EGR 500 Academic Integrity and Responsible Conduct of Research for Engineers 0

In consultation with your advisor or graduate program director: 1, 2, 4

Core Courses: Choose graduate-level Mechanical Engineering Courses: 12

Thesis Option: Choose two courses MEE 500 - 590 and six credit hours MEE 599 Thesis Courses. Work closely with your advisor when registering for Thesis. See Footnote. 3

Non-Thesis Option: Choose four courses MEE 500 thru MEE 595, with a maximum of three credits being MEE 595

Choose any two graduate-level MEE/AEE/RCL Courses: 4 6

MEE 501 thru MEE 595; AEE 500 thru AEE 570; or RCL 507 thru RCL 583

Choose one approved Mathematics course 5 3

Could include: MEE503, CME581, CME582, CME583, ECE503, ECE568, ECE569, ECE642, ENM500, ENM561, EOP503, MEE522, MTH403, MTH404, MTH430, MTH527, MTH531, MTH532, MTH535, MTH543, MTH544, MTH547, MTH551, MTH552, MTH555, MTH556, MTH558, MTH559, MTH563, MTH571 or MTH590

Additional Coursework 4 9

Choose any three graduate-level courses from Engineering, Mathematics, or STEM-related area

Total Hours 30

1 See also http://catalog.udayton.edu/graduate/schoolofengineering/masterstegreequirements/ in the catalog and consult with your advisor.

2 The program of study leading to the Master of Science in Mechanical Engineering degree, developed by the student in conjunction with their advisor, must include a minimum of 30 semester hours.

3 Thesis Hours should be registered for a maximum of three hours midway through your program. Consult with your advisor before registering for the final 3 credits to determine if the Thesis is a viable option or if an alternative may be necessary, such as additional coursework or a project. The Thesis includes both an oral defense and a written Thesis.

4 Elective courses can be used to earn certificates in other programs, such as Foundations of Engineering Management, Six Sigma, Sustainability and other offerings. A complete list of available certificates can be found in the graduate catalog: http://catalog.udayton.edu/certificatesaz/

5 A complete list of approved mathematics courses can be found here: https://porches.udayton.edu/group/engineering/grad

See also Master's Degree Requirements in School of Engineering section in the catalog and consult with the advisor.

Courses

MEE 500. Advanced Engineering Analysis. 3 Hours
Detailed analysis of engineering problems using laws of nature, fundamental engineering principles, mathematics, computers, and practical experience to construct, resolve, and test analytic models of physical events. Emphasis is on the use of the professional engineering approach which includes formulation of the problem, assumptions, plan or method of attack, solving the problem, checking and generalizing the results.

MEE 501. Principles of Materials I. 3 Hours
Structure of engineering materials from electronic to atomic and crystallographic considerations. Includes atomic structure and interatomic bonding, imperfections, diffusion, mechanical properties, strengthening mechanisms, failure, phase diagrams, phase transformations and processing. Prerequisite(s): MTH 219; college chemistry; college physics.

MEE 502. Principles of Materials II. 3 Hours
Structure, behavior and processing of metal alloys, ceramics, polymers, and composites to include: mechanical behavior, corrosion, electrical, magnetic, and optical properties. Prerequisite(s): MEE 501 or equivalent.

MEE 503. Introduction to Continuum Mechanics. 3 Hours
Tensors, calculus of variations, Lagrangian and Eulerian descriptions of motion. General equations of continuum mechanics, constitutive equations of mechanics, thermodynamics of continua. Specialization to cases of solid and fluid mechanics. Prerequisite(s): EGM 303 or ESM 330.

MEE 504. Fundamentals of Fluid Mechanics. 3 Hours
An advanced course in fluid mechanics with emphasis on the derivation of conservation equations and the application of constitutive theory. Navier-Stokes equations. Ideal fluid approximation. Exact and approximate solutions to classical viscous and inviscid problems. Compressible and incompressible flows. Prerequisites: MEE 308 or equivalent, or instructor permission.

MEE 506. Mechanical Behavior of Materials. 3 Hours
Fundamental relationships between the structure and mechanical behavior of materials. Includes fundamentals of stress and strain, the physical basis for elastic deformation, elementary dislocation theory and plastic deformation, strengthening mechanisms, yield criteria and their application to biaxial and multi-axial behavior and failure, fracture and toughening mechanisms, creep and creep rupture, behavior and failure of cellular solids and fatigue. Prerequisite(s): (MAT 501, MAT 502) or permission of instructor.
MEE 507. Materials for Advanced Energy Applications. 3 Hours
Successful long-term application of many advanced energy technologies is ultimately based on utilization of materials in ‘real world’ environmental conditions. The physical/mechanical properties and application of various materials (i.e. superalloys, refractory metal alloys, ceramics) being employed in advanced energy applications are discussed. Several advanced energy technologies (i.e. fuel cells, nuclear energy, and others) are covered with emphasis on how the selection of advanced materials enhances their commercial application. Prerequisite(s): MEE 501 and MAT 502 or permission of instructor.

MEE 508. Principles of Material Selections. 3 Hours
Basic scientific and practical considerations involved in the intelligent selection of materials for specific applications. Impact of new developments in materials technology and analytical techniques. Prerequisite(s): MEE 501 or permission of instructor.

MEE 509. Introduction to Polymer Science-Thermoplastics. 3 Hours
Broad technical overview of the nature of synthetic macromolecules, including the formation of polymers and their structure - property relationships, polymer characterization and processing, and the application of polymers. Fundamental topics such as viscoelasticity, the glassy state, time-temperature superposition, polymer transitions, and free volume will also be reviewed. The course focuses on thermoplastic polymers. Prerequisite(s): Organic chemistry; college physics, differential equations.

MEE 510. Biomaterials. 3 Hours
The course introduces students with engineering materials used in dentistry, manufacture of surgical devices, prosthetics, and repair of tissues. Topics include bonding and atomic arrangement in materials, material selection, testing, and characterization, biocompatibility, tissue response to materials, and failure analysis. A spectrum of materials including metals, polymers, ceramics, and composites used in biomedical applications will be considered.

MEE 511. Advanced Thermodynamics. 3 Hours
Equilibrium, first law, second law, state principle, and zeroth law; development of entropy and temperature from availability concepts; chemical potential, chemical equilibrium, and phase equilibrium. Thermodynamics of irreversible processes; Onsager reciprocal relations; application of these concepts to direct energy conversion.

MEE 514. Physical Gas Dynamics with Aerospace Applications. 3 Hours
Physical Gas Dynamics: The basic elements of kinetic theory, chemical thermodynamics, and statistical mechanics. Emphasis is placed on the application of these molecular theories for analyzing thermodynamic and transport phenomena, as they pertain to the modeling of ‘real gas effects’ in high temperature flows. The course assumes material media in local equilibrium in the gaseous state but some non-equilibrium behavior will also be considered. The equilibrium topics include kinetic theory and concepts related to microscopic, molecular collisions, macroscopic chemical thermodynamics, the law of mass action, internal molecular structure and quantum energy states, general statistical mechanics applied to the prediction of thermodynamic properties of monatomic and diatomic gases, chemically reacting mixtures, and the dissociation and ionization of gases. Prerequisite(s): Background in fluid mechanics, thermodynamics, and compressible flow or permission of instructor.

MEE 515. Conduction Heat Transfer. 3 Hours

MEE 516. Convection Heat & Mass Transfer. 3 Hours
Development of governing differential equations for convection. Methods of solution including similarity methods, integral methods, superposition of solutions, eigenvalue problems. Turbulent flow convection; integral methods, eddy diffusivities for heat and momentum. Extensions to mass transfer. Prerequisite(s): MEE 410 or equivalent.

MEE 517. Radiation Heat Transfer. 3 Hours

MEE 520. Theoretical Kinematics. 3 Hours
Introduction to the mathematical theory underlying the analysis of general spatial motion. Analysis of mechanical systems including robots, mechanisms, walking machines and mechanical hands using linear algebra, quaternion and screw formulations. Fundamental concepts include forward and inverse kinematics, workspace, Jacobians, and singularities.

MEE 522. Geometric Methods in Kinematics. 3 Hours
Introduction to the mathematical theory underlying the analysis of multi-parameter systems. Geodesics in spaces of more than three dimensions are analyzed to study singularity avoidance and joint limitations.

MEE 523. Engineering Design Optimization. 3 Hours
Introduction to the theory and algorithms of nonlinear optimization with an emphasis on applied engineering problems. Fundamentals include Newton’s method, line searches, trust regions, convergence rates, and linear programming. Advanced topics include penalty, barrier, and interior-point methods.

MEE 524. Electrochemical Power. 3 Hours
The course will cover fundamental as well as engineering aspects of fuel cell technology. Specifically, the course will cover basic principles of electrochemistry, electrical conductivity (electronic and ionic) of solids, and development/design of major fuel cells (alkaline, polymer electrolyte, phosphoric acid, molten carbonate, and solid oxide). A major part of the course will focus on solid oxide fuel cells (SOFC), as it is emerging to be dominant among various fuel cell technologies. The SOFC can readily and safely use many common hydrocarbon fuels such as natural gas, diesel, gasoline, alcohol, and coal gas. Prerequisite(s): MEE 301, MEE 312, or permission of instructor.
MEE 525. Principles in Corrosion. 3 Hours
Theoretical and practical application of electrochemical principles to the field of corrosion covering thermodynamics, kinetics, forms of corrosion in areas of biomedical engineering, aerospace, automotive and marine environments. Prerequisite(s): MEE 501.

MEE 526. Aerospace Fuels Science. 3 Hours
Basic elements of hydrocarbon fuel production including petroleum based fuels and alternative fuels. Fuel properties, specifications, handling, and logistics. Introduction to chemical kinetics and the chemistry associated with liquid phase thermal-oxidative degradation of fuels. Introduction to the computational modeling of fuel thermal stability and fuel systems. Prerequisite(s): Permission of instructor.

MEE 527. Automatic Control Theory. 3 Hours
Stability and performance of automatic control systems. Classical methods of analysis including transfer functions, time-domain solutions, root locus, and frequency response methods. Modern control theory techniques including state variable analysis, transformation to companion forms, controllability, pole placement, observability, and observer systems. Prerequisites: ELE 432 or MEE 439 or Equivalent.

MEE 528. Robot Modeling. 3 Hours
This course covers the fundamentals of modeling the movement of spatial systems with a focus on robots, particularly industrial robots. Topics include planar and spatial robotics, forward kinematics including the Denavit-Hartenberg formalism, inverse kinematics, manipulator velocities and the robotics-specific Jacobian, static loads in robots, and the product-of-exponentials formalism. Prerequisites: MEE 321 (or instructor approval).

MEE 530. Biomechanical Engineering. 3 Hours
Application of engineering principles to clinical, occupational, and sports biomechanics topics. The course focuses on biomechanical analysis, particularly kinematics and kinetics of human movement, with emphasis on both research and product design. Prerequisite(s): EGM 202; EGR 201.

MEE 531. Experimental Methods in Biomechanics. 3 Hours
This course is focused on developing and applying advanced experimentation skills with a specific focus on techniques associated with the study of human movement. Emphasis on equipment and technology, data analysis and interpretation, statistical methods, and technical reporting.

MEE 533. Theory of Elasticity. 3 Hours
Three-dimensional stress and strain at a point; equations of elasticity in Cartesian and curvilinear coordinates; methods of formulation of equations for solution; plane stress and plane strain; energy formulations; numerical solution procedures. Prerequisite(s): EGM 303 or EGM 330. Corequisite(s): MEE 503.

MEE 534. Theory of Plates & Shells. 3 Hours
Theory of plates: small and large displacement theories of thin plates; shear deformation; buckling; sandwich plate theory. Thin shell theory: theory of surfaces; thin shell equations in orthogonal curvilinear coordinates; bending, membrane, and shallow shell theories. Prerequisite(s): MEE 533.

MEE 535. Advanced Mechanical Vibrations. 3 Hours
Review of undamped, damped, natural and forced vibrations of one and two degrees of freedom systems. Lagrange's equation, eigenvalue/ eigenvector problem, modal analysis for discrete and continuous systems. Computer application for multi-degree of freedom, nonlinear problems. Prerequisite(s): MEE 319; computer programming.

MEE 537. Autonomous Systems. 3 Hours
At the intersection of mechanical engineering, electrical engineering, and computer science, autonomous systems involve the implementation of mechatronic technologies which operate independently (autonomously) from human intervention. This course emphasizes the practical implementation of modern control systems for the purposes of creating fully- or semi-autonomous systems. Topics include programming syntax and structure, integration of peripherals (sensors and actuators) with controllers, and data communications both within and external to the systems. Equal mix of lecture and laboratory with significant time dedicated to advanced design projects. Prerequisites: Undergraduate electronics course. Corequisites: Course in controls.

MEE 538. Introduction to Aeroelasticity. 3 Hours

MEE 539. Theory of Plasticity. 3 Hours
Fundamentals of plasticity theory including elastic, viscoelastic, and elastic-plastic constitutive models; plastic deformation on the macroscopic and microscopic levels; stress-strain relations in the plastic regime; strain hardening; limit analysis; numerical procedures. Prerequisite(s): MEE 503 or MEE 533.

MEE 541. Experimental Mechanics of Composite Materials. 3 Hours
Introduction to the mechanical response of fiber-reinforced composite materials with emphasis on the development of experimental methodology. Analytical topics include stress-strain behavior of anisotropic materials, laminate mechanics, and strength analysis. Theoretical models are applied to the analysis of experimental techniques used for characterizing composite materials. Lectures are supplemented by laboratory sessions in which characterization tests are performed on contemporary composites. Prerequisite(s): EGM 303 or EGM 330.

MEE 542. Advanced Composites. 3 Hours
Materials and processing. Comprehensive introduction to advanced fiber reinforced polymeric matrix composites. Constituent materials and composite processing will be emphasized with special emphasis placed on structure-property relationships, the role of the matrix in composite processing, mechanical behavior and laminate processing. Specific topics will include starting materials, material forms, processing, quality assurance, test methods and mechanical behavior. Prerequisite(s): (MEE 501 or MEE 509) or permission of instructor.

MEE 543. Analytical Mechanics of Composite Materials. 3 Hours
Analytical models are developed to predicting the mechanical and thermal behavior of fiber-reinforced composite materials as a function of constituent material properties. Both continuous and discontinuous fiber-reinforced systems are considered. Specific topics include basic mechanics of anisotropic materials, micromechanics, laminate theory, free-edge effects, and failure criteria. Prerequisite(s): EGM 303 or EGM 330.

MEE 544. Mechanics of Composite Structures. 3 Hours
Comprehensive treatment of laminated beams, plates, and sandwich structures. Effect of heterogeneity and anisotropy on bending under lateral loads, buckling, and free vibration are emphasized. Shear deformation and other higher-order theories and their range of parametric application are also considered. Prerequisite(s): MEE 543 or permission of instructor.
### MEE 545. Computational Methods for Design. 3 Hours
Modeling of mechanical systems and structures, analysis by analytical and numerical methods, development of mechanical design criteria and principles of optimum design, selected topics in mechanical design and analysis, use of the digital computer as an aid in the design of mechanical elements. Prerequisite(s): Computer programming.

### MEE 546. Finite Element Analysis I. 3 Hours
Fundamental development of the Finite Element Method (FEM), and solution of field problems and comprehensive structural problems, variational principles and weak-forms; finite element discretization; shape functions; finite elements for field problems; bar, beam, plate, and shell elements; isoparametric finite elements; stiffness, nodal force, and mass matrices; matrix assembly procedures; computer dosing techniques; modeling decisions; program output interpretation. Course emphasis on a thorough understanding of FEM theory and modeling techniques. Prerequisite(s): MEE 503 or MEE 533.

### MEE 547. Finite Element Analysis II. 3 Hours
Advanced topics: heat transfer; transient dynamics; nonlinear analysis; substructuring and static condensation; effects of inexact numerical integration and element incompatibility; patch test; frontal solution techniques; selected topics from the recent literature. Prerequisite(s): MEE 546.

### MEE 548. Energy Methods in Solid Mechanics. 3 Hours
Development of fundamental energy principles; virtual displacements, strain energy, Castiglione’s theorems, minimum potential energy principles. Applications to engineering problems; redundant structures, buckling, static and dynamic analysis. Prerequisite(s): MEE 503 or MEE 533.

### MEE 549. Theory of Elastic Stability. 3 Hours
Introduction to stability theory: buckling of plates and shells; influence of initial imperfections; nonlinear analysis: numerical solutions methods. Prerequisite(s): MEE 533.

### MEE 550. Noise & Vibration Control. 3 Hours
The concepts of noise and vibration control applied to mechanical systems. Methodologies covered will include: passive treatments using resistive elements (sound absorbers, vibration damping) and reactive elements (tailoring of material stiffness and mass); active control of sound and vibration; and numerical analysis. Prerequisites: MEE 439.

### MEE 551. Boundary Layer Theory. 3 Hours
Development of the Prandtl boundary layer approximation in two and three dimensions for both compressible and incompressible flow. Exact and approximate solutions for laminar flows. Unsteady boundary layers. Linear stability theory and transition to turbulence. Empirical and semi-empirical methods for turbulent boundary layers. Higher-order boundary layer theory. Prerequisite(s): MEE 504 or equivalent.

### MEE 553. Compressible Flow. 3 Hours
Fundamental equations of compressible flow. Introduction to flow in two and three dimensions. Two-dimensional supersonic flow, small perturbation theory, method of characteristics, oblique shock theory. Introduction to unsteady one-dimensional motion and shock tube theory. Method of surface singularities. Prerequisite(s): MEE 504 or equivalent.

### MEE 554. Biomechanical Modeling. 3 Hours
The course will focus on biomechanical modeling, specifically, computational modeling of the human body’s bones, joints, and muscles and the motion of the human body. Emphasis on representing aspects of the body computationally (through equations and as mechanical systems) and applying modeling and simulation to analyze the motion of a human.

### MEE 555. Turbulence. 3 Hours
Origin, evolution, and dynamics of fully turbulent flows. Description of statistical theory, spectral dynamics, and the energy cascade. Characteristics of wall-bounded and free turbulent shear flows. Reynolds stress models. Prerequisite(s): MEE 504 or equivalent.

### MEE 556. Applied Robotics. 3 Hours
Within this course, focus will be on project-based learning with robotic systems. Extensive usage of student kits and industrial robotic platforms will enable hands-on learning experiences, which will encourage students to think critically and deepen their knowledge through experimentation. Using a combination of online learning content and classroom lectures, multiple comprehensive projects will be covered, such as a drawing robot, a webcam-controlled rover or industrial arm, and/or a self-balancing motorcycle. Students will use software (MATLAB, Simulink, ROS) programming to implement model-based design, control systems, image and signal processing, and more. The major learning objective is for students to get prepared for real-life environments by using the same tools as industry professionals.

### MEE 558. Computational Fluid Dynamics. 3 Hours
Numerical solution to Navier-Stokes equations and approximations such as the boundary layer equations for air-flow about a slender body. Numerical techniques for the solution of the transonic small disturbance equations. Numerical determination of fluid instabilities. Prerequisite(s): MEE 504 or permission of instructor.

### MEE 560. Propulsion Systems. 3 Hours
Introduction and history, types of propulsion systems, thermodynamics review and simple cycle analysis, thermodynamics of high speed gas flow, aircraft gas turbine engine, parametric cycle analysis of various types of gas turbine engines, component and engine performance analyses (inter-turbine burners), advanced cycles with regeneration, reheating, and inter-cooling, variable and inverse cycle engines, hybrid propulsion systems (turbo-ramjets, rocket-ram-scramjets, etc.) advanced propulsion systems, pulse detonation engine theory and concepts, thermal management of high-speed flight, energy management and vehicle synthesis. Prerequisite(s): (MEE 413 or MEE 513) or permission of instructor.

### MEE 565. Fundamentals of Fuels & Combustion. 3 Hours
Study of combustion and flame temperature calculations; rate of chemical reaction and Arrhenius relationship; theory of thermal explosions and the concept of ignition delay and critical mass; phenomena associated with hydrocarbon-air combustion; specific applications of combustion.

### MEE 568. Internal Combustion Engines. 3 Hours
Study of combustion and energy release processes. Applications to spark and compression ignition, jet, rocket, and gas turbine engines. Special emphasis given to understanding of air pollution problems caused by internal combustion engines. Idealized and actual cycles are studied in preparation for laboratory testing of internal combustion engines.

### MEE 569. Energy Efficient Buildings. 3 Hours
Provides knowledge and skills necessary to design and operate healthier, more comfortable, more productive, and less environmentally destructive buildings; A specific design target of E/3 (typical energy use divided by three) is established as a goal. Economic, thermodynamic, and heat transfer analyses are utilized. Extensive software development. Prerequisite(s): MEE 410.
MEE 570. Fracture Mechanics. 3 Hours
Application of the principles of fracture mechanics to problems associated with fatigue and fracture in engineering structures. The course will cover the development of models that apply to a range of materials, geometries, and loading conditions. Prerequisite(s): MEE 506 or permission of instructor.

MEE 571. Design of Thermal Systems. 3 Hours
Integration of thermodynamics, heat transfer, engineering economics, and simulation and optimization techniques in a design framework. Topics include design methodology, energy analysis, heat exchanger networks, thermal-system simulation, and optimization techniques.

MEE 572. Design for Environment. 3 Hours
Emphasis on design for environment over the life cycle of a product or process, including consideration of mining, processing, manufacturing, use, and post-life stages. Course provides knowledge and experience in invention for the purpose of clean design, life cycle assessment strategies to estimate the environmental impact of products and processes, and cleaner manufacturing practices. Course includes a major design project.

MEE 573. Renewable Energy Systems. 3 Hours
Introduction to the impact of energy on the economy and environment. Engineering models of solar thermal and photovoltaic systems. Introduction to wind power. Fuel cells and renewable sources of hydrogen.

MEE 575. Fracture & Fatigue of Metals & Alloys I. 3 Hours
This course will cover the effects of microstructure on the fracture and fatigue behavior of engineering metals and alloys, with a special emphasis on static and dynamic brittle and ductile failures and static fatigue crack initiation. Alloy fracture resistance, fracture toughness, fatigue behavior, and methods to improve fracture and fatigue behavior will be discussed in detail. The role of materials reliability in life management of advanced alloys in turbine engines and aircraft will be reviewed, and key practical aspects will be discussed. Various analytical techniques for failure analysis of structural components will be presented. Prerequisite(s): (MEE 501 or MEE 506) or permission of instructor.

MEE 576. Fracture & Fatigue of Metals & Alloys II. 3 Hours
This course will cover the areas of the effects of microstructure on fatigue crack propagation and on final fracture by fatigue. This will include fatigue life prediction, using damage-tolerance approach to component-design and microstructural and structural synthesis for optimum behavior. Specific material-related aspects of fatigue crack propagation mechanisms for optimum damage tolerant behavior, and the related reliability and failure analysis, will be covered. A comprehensive project in failure-analysis of aerospace metallic components will also be conducted. Prerequisite(s): MEE 575 or equivalent.

MEE 579. Computer Aided Mechanical Design. 3 Hours
Introduction to computer methods used to facilitate mechanical design. Design using the finite element method, mechanism design, and statistical techniques. Design of components (shafts, springs, etc.) using computer techniques will be combined with the design process to design mechanical systems. Integration of manufacturer’s literature into the design. Team design project will be included. Prerequisite(s): (MEE 427, MEE 432) or equivalent.

MEE 590. Special Problems in Mechanical Engineering. 1-6 Hours
Special assignments in mechanical engineering subject matter to be approved by the student’s faculty advisor and the department chair.

MEE 595. Mechanical Engineering Project. 0-3 Hours
Student participation in a departmental research, design, or development project under the direction of a project advisor. The student must show satisfactory progress as determined by the project advisor and present a written report at the conclusion of the project.

MEE 599. Mechanical Engineering Thesis. 1-6 Hours
Mechanical Engineering Thesis.

MEE 604. Nanostructured Materials. 3 Hours
Graduate-level course covering the fundamental physics, properties, and applications of nanostructured materials. Includes carbon nanotubes, nanostructured ceramics, metals, and semiconductor materials. Prerequisite(s): College physics; fundamental physical and chemical properties of materials.

MEE 605. Introduction to Carbon Nanotechnology. 3 Hours
Graduate-level course covering the fundamental and applied aspects of Carbon Nanoscale Science and Technology. The course has three goals: (1) an overview of the current development in carbon science and technology (2) an introduction to the surface science as a means to understand the surface interaction at molecular scale, and (3) to provide some explicit links between macro, micro, and nano scale technologies. Some of the medical field, structural and friction applications will be addressed. This course is aimed at both science and engineering students.

MEE 690. Selected Readings in Mechanical Engineering. 1-6 Hours
Directed readings in a designated area arranged and approved by the student's doctoral advisory committee and the department chair. May be repeated. (A) Materials, (B) Thermal Sciences, (C) Fluid Mechanics, (D) Solid Mechanics (E) Mechanical Design, or (F) Integrated Manufacturing.

MEE 698. DE Dissertation. 1-15 Hours
An original investigation as applied to mechanical engineering practice. Results must be of sufficient importance to merit publication.

MEE 699. PHD Dissertation. 1-15 Hours
An original research effort which makes a definite contribution to technical knowledge. Results must be of sufficient importance to merit publication.