MECHANICAL ENGINEERING (ME-GY)

ME-GY 996X MS Project (3-6 Credits)
Typically offered Fall, Spring, and Summer terms
This course is an engineering project under faculty guidance. A written project proposal and final report must be submitted to the department head and the adviser and may be extended to a thesis with the project adviser's recommendation. Credit only upon completion of project. | Prerequisite: Graduate standing, advisor and instructor approval
Grading: Satisfactory/Unsatisfactory
Repeatable for additional credit: Yes

ME-GY 997X MS THESIS IN MECHANICAL ENGINEERING (3-9 Credits)
Typically offered Fall and Spring
The master's thesis presents results of original investigation in the student's specialty. This effort can be an extension of ME-GY 996X, with approval of the project advisor. Continuous registration is required. Maximum of 9 credits of ME-GY 996X / ME-GY 997X are counted toward the degree. | Prerequisite: Graduate standing, advisor and instructor approval.
Grading: Satisfactory/Unsatisfactory
Repeatable for additional credit: Yes
Prerequisites: Graduate standing.

ME-GY 999X PHD DISSERTATION IN MECHANICAL ENGINEERING (3-9 Credits)
Typically offered Fall, Spring, and Summer terms
The doctoral dissertation demonstrates independent study and original contributions in the specialization. Oral examination on subject of dissertation and related topics is required. Also required is a minimum of 24 credits and continuous registration at minimum of 3 credits per semester until the dissertation is completed. | Prerequisite: Passing grade for RE-GY 9990 PhD Qualifying Exam, graduate standing, and dissertation advisor approval
Grading: Satisfactory/Unsatisfactory
Repeatable for additional credit: Yes

ME-GY 5103 BIOMEDICAL DYNAMIC FLUIDS (3 Credits)
Typically offered occasionally
The course focuses on principles of fluid flow and transport in the human body, emphasizing vascular circulation and hemodynamics. Topics include: physics of ulsatile flow, introductory biology and physiology of the circulatory system, blood flow in vessels, microcirculation, blood rheology, fluid dynamics of vasculature under physiological and pathological conditions, mass transport to vessel walls, mechanics of blood cells, cellular mechanotransduction and biochemical signaling and microfluidics in biomedical devices. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 5243 COMPOSITE MATERIALS (3 Credits)
This course introduces modern polymeric, metallic and ceramic composite materials, fabrication techniques, mechanical property characterization. Topics: Introduction to matrix and reinforcement materials, material selection and composite design criteria. Mechanics based analysis of continuous fiber reinforced unidirectional plies and woven fabrics. Applications of advanced composites in car, aircraft, construction and sports industries. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 5253 Physics of Nanomaterials and Graphene (3 Credits)
An introductory graduate course for science and engineering students on the basic properties, preparations and applications of Nanomaterials and Graphene. This course will emphasize forms of carbon, including graphitic carbon composites that are a leading structural material in aircraft; and diamond, carbon black, activated charcoal, carbon nanotubes and graphene. Review of the Schrodinger equation as applied to carbon atoms, to diamond, to graphite and to graphene. Trigonal planar bonding as distinguished from tetrahedral bonding. Methods of making graphene including chemical vapor deposition, exfoliation of graphite. Application of graphene as transparent conductor in solar cells and opto-electronic devices. | Prerequisites: PH-UY 2033 or Graduate Standing.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 5443 Vibrations (3 Credits)
The course looks at the dynamics of one-, two- and multi-degree of freedom systems with and without damping. Topics: Vibrations of distributed parameter systems: bars, beams and plates. Numerical methods. Introduction to nonlinear oscillations. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 5643 Mechatronics (3 Credits)
Typically offered Fall
The course introduces theoretical and applied mechatronics, design and operation of mechatronics systems; mechanical, electrical, electronic and optoelectronic components; sensors and actuators, including signal conditioning and power electronics; microcontrollers, fundamentals, programming and interfacing; and feedback control. The course includes structured and term projects in designing and developing of prototype integrated mechatronic systems. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 5653 Microelectromechanical Systems (3 Credits)
Typically offered occasionally
The course covers materials for MEMS, fundamentalof solid mechanics, electrostatics and electromagnetics. Topics: Electromechanical modeling and design of micromachined sensors and actuators. Microscale physics of microsystems. Overview of MEMS applications. Packaging and testing. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 5813 RESEARCH & DESIGN METHODOLOGY & COMMUNICATION (3 Credits)
Typically offered occasionally
This course is targeted to students at the undergraduate senior level or graduate (Master of Science) level, who wish to enhance their skills in the methodology of research and design, and in communicating their results and ideas in multi-disciplinary settings. The course will present a unified approach to research, design, and communication; and show that there is a continuum from fundamental research to the art of technical promotion. Written assignments, individual presentations, role play, and class discussions will be used as vehicles for accomplishing the educational goals of this course. | Prerequisite(s): Senior or Graduate standing
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 5913 Mechatronics (3 Credits)
Typically offered Fall
Introduction to theoretical and applied mechatronics, design and operation of mechatronics systems; mechanical, electrical, electronic, and opto-electronic components; sensors and actuators including signal conditioning and power electronics; microcontrollers—fundamentals, programming, and interfacing; and feedback control. Includes structured and term projects in the design and development of proto-type integrated mechatronic systems.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6003 Applied Mathematics in Mechanical Engineering (3 Credits)
Typically offered Fall
The course covers vector and tensor calculus. Topics: Ordinary differential equations. Laplace and Fourier Transforms. Sturm-Liouville problems. Partial differential equations. Applications to structural analysis, fluid mechanics and dynamical systems. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6013 THERMODYNAMICS (3 Credits)
The course covers availability functions, general thermodynamic relations, equations of state, general thermodynamic equilibrium criteria, power production, thermodynamics of reacting systems, energy of formation, chemical equilibrium, applications in combustion systems. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6043 Thermal Engineering Fundamentals (3 Credits)
Typically offered Fall
Presentation of basic scientific and engineering principles that all energy systems must satisfy, including thermodynamic, fluid mechanic and heat transfer principles that constrain or facilitate energy systems. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6153 THERMODYNAMICS OF HVAC SYSTEMS (3 Credits)
Typically offered Spring
Principles of thermodynamics. Description of HVAC systems. Vapor compression and adsorption cycles. Heat pump cycles. Geothermal systems. Solar heating and cooling systems. Phychometric analysis for design and off-design conditions. Indoor environmental quality analysis. Green and sustainable systems. | Prerequisite: ME-UY 3333 or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6163 FLUID MECHANICS FOR HVAC SYSTEMS (3 Credits)
Typically offered Spring
Fundamentals of fluid mechanics. Centrifugal pumps and system-pump characteristics. Piping systems fundamentals and design. Jets and air diffusers. Fans, fan performance, installation and testing. Duct sizing and design. Design of sprinkler systems. | Prerequisites: ME-UY 3313 or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6173 HEAT TRANSFER FOR HVAC SYSTEMS (3 Credits)
Typically offered Fall
Fundamentals of heat transfer. Solar radiation fundamental. Heat transmission in buildings and space heat load calculations. Space cooling load calculations. Energy calculations; degree by day procedure, bin methods and building simulation methods. Energy modeling and conformance with NYS Code. Extended surface heat exchangers. LEED Score sheet and design for green buildings. | Prerequisite: ME-UY 4313 or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6183 DESIGN OF HVAC SYSTEMS (3 Credits)
Typically offered Fall
This course involves the dynamic and sustainable design process to perform a complete design of HVAC systems for a commercial or residential building using state of the art software and processes. Design schematic phase. Design development phase. Construction documents phase. Students work on specific project, design a system through all stages. | Prerequisite: ME-UY 4313 or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6213 Introduction to Solid Mechanics (3 Credits)
Typically offered Spring
The course explores fundamentals of kinematics of solid bodies; displacement and strain measures, introduction to statics of solid bodies, stress tensor, equilibrium equations. Topics include analysis of columns, beams and beams on elastic foundations. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6223 Advanced Mechanics of Materials (3 Credits)
The course discusses two-dimensional stress and strain analysis, applications of energy methods, Reyleighitz method. Topics: Applications of energy methods to beams, frames, laminates and sandwich structures. Torsion of prismatic bars, open and closed thin-walled cylinders, unsymmetric bending and shear center, curved bars. | Prerequisite: ME-GY 6213 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6243 Atomistic and Electronic Simulation of Materials (3 Credits)
Typically offered Fall
Simulation is an important tool, which complements experimental characteristics of materials by providing fundamental details at electronic, atomic, mesoscale, and macroscale resolution. This fundamental understanding then guides the experimental approach to modify the properties of the materials with a rational approach rather than stochastic approach. This course primarily focuses on predicting structure-property correlation of various materials using electronic and atomic level simulations. The course will cover density functional theory (DFT), molecular dynamic (MD) and monte carlo (MC) simulations with hands on projects using available software. | Prerequisites: Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6253 MECHANICS OF NON MATERIALS (3 Credits)
The course introduces nanosized and nanoscale materials: nanoparticles, nanotubes, nanowires, nanorods. Topics: Classical molecular dynamics, lattice mechanics, methods of thermodynamics and statistical mechanics, introduction to multiple scale modeling and introduction to bridging scale. Characterization techniques for nanomaterials. Applications in nanosystems such as nanocars, nanobots and nanoelectronics. | Prerequisite: Graduate standing or advisor approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6263 Mechanical Behavior of Materials (3 Credits)
Typically offered Fall
Analyze the effect of applied external load on the deformation of a material is critical for engineering design and the performance of materials during application. Response of the a material to the applied load at the atomic and microstructural level is analyzed. This course focuses on elastic vs. plastic deformation, defects and dislocations, various strengthening mechanisms, creep and fatigue response in materials. | Prerequisites: Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6323 MICROSCOPY & MICROANALYSIS (3 Credits)
Foundations of materials characterization. theory of scanning electron microscopy. Practical aspects, data collection, and imaging using Scanning Electron Microscope (SEM). Theory of X-ray Diffraction (XRD). Quantitative and qualitative phase analysis of materials using XRD. X-ray emission and chemical analysis using EDS. Sample preparation for SEM, EDS and XRD observations. Data analysis, image/data processing and data interpretation of electron microscopy and XRD spectra. | Prerequisite: Graduate standing
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6413 Additive Manufacturing Fundamentals (3 Credits)
Typically offered Spring
Additive manufacturing (AM), also known as 3D printing, is the fastest growing industrial field. Numerous examples are available where components manufactured by AM methods are now put into service. This course will focus on fundamentals of AM techniques and will take a broad view on the new possibilities enabled by the new manufacturing methods. | Prerequisite: Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6423 Additive Manufacturing of Metallic Materials (3 Credits)
Typically offered Fall
Additive manufacturing (AM), also known as 3D printing, is the fastest growing industrial field. Numerous examples are available where components manufactured by AM methods are now put into service. This course will focus on one of the largest share of materials used in current industrial scale 3D printing, i.e., metals. The topics will cover the basic characteristics of metals and alloys through discussion of powder characterization, phase diagram, and microstructure to relate them to additive manufacturing process and properties of the manufactured parts. The course will also discuss the applications of metal 3D printed parts and future opportunities. | Prerequisites: Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6433 CAD for Additive Manufacturing (3 Credits)
Typically offered Spring
The course will cover the topics of CAD solid modeling that are relevant to additive manufacturing (3D printing). SolidWorks software will be used in the class. The students will be able to understand how CAD models developed for additive manufacturing may differ from the models developed for visualization. Some of the developed models will be printed to examine the quality of the product and observe the effects of various concepts discussed in the class. Prior knowledge of any CAD software will be beneficial for the course. | Prerequisites: Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6453 SECURITY IN ADDITIVE MANUFACTURING (3 Credits)
Typically offered Fall
The course will cover the topics of security strategies in additive manufacturing (AM). A completely digital process chain is exposed to significant cybersecurity risks from internal or external malicious players for sabotage and intellectual property theft. Also, product counterfeiting is possible by reverse engineering. Such concerns require new security strategies that are unique to AM process chain. The course will cover threat models, security strategies and industrial scenarios related to security in AM. | Prerequisite: Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6513 Advanced Dynamics (3 Credits)
Typically offered Fall and Spring
The course covers kinematics and dynamics of a particle in space. Topics: Systems of particles. Two-body central force problem. Kinematics and dynamics of rigid bodies. Euler's equations. Euleragrange equations with holonomic and nonholonomic constraints. Stability analysis. Introduction to calculus of variations. Hamilton's principle. Hamilton's equations. | Prerequisite: Graduate standing or advisor approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6603 Digital Control Systems (3 Credits)
Typically offered Spring
The course introduces digital systems, signal conversion techniques, z-transform and inverse z-transform, transfer function and block diagrams, state-variable techniques, controllability, observability, stability and control design techniques. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6613 Sensor Based Robotics (3 Credits)
Topics in this course include robot mechanisms, robot arm kinematics (direct and inverse kinematics), robot arm dynamics (Euler Lagrange, Newton-Euler and Hamiltonian Formulations), six degree-of-freedom rigid body kinematics and dynamics, quaternion, nonholonomic systems, trajectory planning, various sensors and actuators for robotic applications, end-effector mechanisms, force and moment analysis and introduction to control of robotic manipulators. Co-listed as ME-GY 5223 | Prerequisite: Graduate standing or advisor approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6623 INTRODUCTION TO ROBOT MECHANICS (3 Credits)
Typically offered occasionally
Robot components and types, and their mathematical modeling. Spatial description of position and orientation. Types and modeling of robotic joints. Differential rotation and translations. Forward and inverse kinematics Homogeneous transformation. Denavit-Hartenberg kinematic convention. Jacobian and mapping. Manipulator statics and dynamics. Robot mechanism design. Power train and transmission. Motion planning and control. Kinematic/kinetic redundancy and optimaization. Locomotion and balancing. Biomimetics and humanoids. | Prerequisites: ME-UY 3223 and ME-UY 3413, or instructor's consent.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6703 LINEAR CONTROL THEORY AND DESIGN I (3 Credits)
Typically offered Fall
The course covers modeling of mechanical systems (e.g., mechatronic, vibrational, robotic and smart systems) in state-space. Topics: Description and analysis of linear mechanical systems, transform and transition matrix methods and properties such as stability, controllability/stabilizability, observability/detectability. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6713 LINEAR CONTROL THEORY AND DESIGN II (3 Credits)
The course considers fundamentals of system realizations and random processes. Topics: Performance objectives for mechanical systems (e.g., mechatronic, vibrational, robotic and smart systems). Optimal design of state feedback controllers, observers and output feedback controllers for mechanical systems. | Prerequisite: ME-GY 6703 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6813 Energy Conversion Systems (3 Credits)
Typically offered occasionally
This course provides description and analysis of current and future energy systems including fuel sources, energy harvesting, energy delivery to the point of conversion, energy conversion to heat or electricity, distribution to end users, basic economics of power plant and environmental impact. Security, reliability and life cycle cost considerations are reviewed and analyzed for impact on selecting the optimum energy systems. | Prerequisite: Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate Standing.

ME-GY 6823 Energy Policy, Regulations, and Incentives (3 Credits)
Typically offered occasionally
This course focuses on impact of local, state and national policy on energy choices. Regulatory limitations and incentives influencing energy options and economics. Quantitative trade off analyses of various technically feasible options when policies, regulations and incentives are considered. Environmental impact, positive as well as negative, of energy systems are analyzed. Costs of mitigating negative environmental impact are reviewed and their impact on the choice of a system is analyzed through case studies presented in term papers. | Prerequisite: Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate Standing.

ME-GY 6833 Energy Project Financing (3 Credits)
Typically offered occasionally
Analysis of current and projected fuel costs, capital costs, maintenance costs, operating and environmental costs, and infrastructure costs of various competing energy systems. A term project providing an in-depth analysis of one candidate system is required. Student teams present the results of their work advocating for their system. A panel of judges will decide which group makes the best case for its system. | Prerequisite: ME-GY 6823
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6843 Advanced Manufacturing of Biomedical Devices (3 Credits)
Typically offered Spring
This course aims to provide the essential knowledge in the biomedical product development (e.g. material properties, fabrication processes and design techniques for different applications) in order to provide ways to speed up the product development cycle. This course is multidisciplinary and covers the principles in its mechanical, chemical, biological, and physiological aspects. Students can learn the techniques for applying this acquired knowledge to particular applications in which they are interested. | Prerequisites: Knowledge in Material Science and Mechanics of Materials or equivalent
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6913 Introduction to Robot Mechanics (3 Credits)
Typically offered occasionally
Robot components and types, and their mathematical modeling. Spatial description of position and orientation. Types and modeling of robotic joints. Differential rotation and translations. Forward and inverse kinematics. Homogeneous transformation. Denavit-Hartenberg kinematic convention. Jacobian and mapping. Manipulator statics and dynamics. Robot mechanism design. Power train and transmission. Motion planning and control. Kinematic/kinetic redundancy and optimization. Locomotion and balancing. Biomimetics and humanoids. | Prerequisites: ME-UY 3223 and ME-UY 3413 or instructor's consent (for undergraduates) or Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 6923 Simulation Tools and Software for Mechatronics and Robotics (3 Credits)
Typically offered occasionally
The student who completes this course will gain an advanced understanding of the principles underlying simulation of dynamical systems, with particular reference to mechatronics and robotic systems. He/she will be able to use modern tools for simulation of mechatronics and robotic systems. Moreover, he/she will be able to design and implement control algorithms and assess their performance on the simulated systems. | Prerequisite: Graduate Standing
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate Standing.

ME-GY 6933 Advanced Mechatronics (3 Credits)
Typically offered Spring
Introduction to, applications of, and hands-on experience with microcontrollers and single-board computers for embedded system applications. Specifically, gain familiarity with the fundamentals, anatomy, functionality, programming, interfacing, and protocols for the Arduino microcontroller, multi-core Propeller microcontroller, and single-board computer Raspberry Pi. Includes mini-projects and term projects in the design and development of proto-type integrated mechatronic systems. | Prerequisites: ME-GY 5913
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: ME-GY 6823.

ME-GY 7003 Finite Element Methods (3 Credits)
Typically offered Fall and Spring
The course explores derivation of element stiffness matrices for spring, bar and beam elements. Topics: Finite element formulation to determine many unknowns such as displacements, forces and reactions. Application to trusses, frames and two-dimensional problems in plane stress and plane strain under static loading conditions. Applications in thermal, heat transfer and fluid mechanics. Interpreting the results, convergence of solution and effect of meshing and symmetry conditions. Introduction to modern meshless techniques. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7063 Convective Heat Transfer (3 Credits)
Typically offered occasionally
The course examines developments and applications of laminar hydrodynamic and thermal boundary layer equations for fluid media. Topics: Mechanics of turbulence; formulation and analysis of turbulent hydrodynamics and thermal applications; natural convection and film evaporation and condensation. | Prerequisite: ME-GY 6043 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7073 Conductive Heat Transfer (3 Credits)
Typically offered occasionally
This course covers theoretical development of transient and steady-state temperature distributions in finite and infinite solids. Topics: Pertinent mathematical techniques introduced as required. Solids undergoing phase change and two dimensional fields. | Prerequisite: ME-GY 6003 and ME-GY 6043 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7083 Radiative Heat Transfer (3 Credits)
Typically offered occasionally
This course covers fundamentals of radiative mechanisms of energy transfer. Topics: Definitions of basic qualities. Equations of transfer, radiative heat flux vector and conservation equations. Properties of surfaces and participating media. Applications to engineering systems. | Prerequisite: ME-GY 6003 and ME-GY 6043 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7113 Viscous Flow and Boundary Layers (3 Credits)
Typically offered occasionally
The course introduces molecular and macroscopic transport. Topics: Reynold's transport theorem.Concepts of stress and strain and derivation of the Navier-Stokes equations. Similarity principle. Exact solutions to the Navier-Stokes equations. Low Reynolds number flows. Boundary layer theory. Momentum integral equation. Introduction to turbulence. | Prerequisite: ME-GY 6003 and ME-GY 6043 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7123 Turbulent Flow (3 Credits)
The course covers nature and origin of turbulence. Topics: Instability and transition, Taylor and Grtler vortices. Vorticity dynamics, homogeneous and isotropic turbulence. Reynolds decomposition, turbulent stress tensor and Reynolds-averaged Navier-Stokes equations. Computational modeling of turbulence. Analysis of turbulent boundary layers. Turbulent heat and mass transfer, measurement of turbulence. | Prerequisite: ME-GY 6043 and ME-GY 7113 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7133 Compressible Flow (3 Credits)
Typically offered occasionally
The course examines fundamentals of compressible fluid flow, including subsonic, transonic, supersonic and hypersonic flows over two-dimensional and axisymmetric bodies. Topics: One-dimensional flows with friction and heat addition. Shock-wave development in both two-dimensional steady and one-dimensional unsteady flow systems, including flow in shock tubes. Quasi-one-dimensional compressible flow, including flows in inlets, nozzles and diffusers. Introduction to numerical solution of compressible fluid flow. | Prerequisite: ME-GY 6043 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7153 COMPUTATIONAL FLUID MECHANICS AND HEAT TRANSFER (3 Credits)
The course centers on engineering solution of thermo-fluid problems by finite-difference methods, error and stability analyses, numerical dispersion and damping, matrix inversion methods, solution of model equations: wave, heat, Laplace, viscous and inviscid Burger's equations. Also covered are implicit and explicit procedures, SOR, ADI, hopscotch and direct solvers for evaluating linear and nonlinear diffusion and convection problems. | Prerequisite: ME-GY 6003 and ME-GY 6043 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7163 Experimental Methods in Thermal-Fluid Sciences (3 Credits)
The course discusses basic measurement techniques in thermal and flow sciences and a survey of the modern developments in measurement technology, including optical methods. Topics: Planning of experimental programs, calibration, measurement uncertainty, noise, generalized performance characteristics, various devices for measuring mass and volume-flow rate, velocity, pressure, temperature, density and heat flux, computerized data acquisition and statistical analysis. | Prerequisite: ME-GY 6043 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7213 Elasticity I (3 Credits)
Typically offered occasionally
The course looks at stress and strain tensors, generalized Hooke's law. Topics: Formulation of elasticity problems. Plane stress and plane strain concepts; solution by complex variables; stress concentrations. Rotating Discs and cylinders of uniform thickness and variable thickness. Deformation symmetrical about an axis. | Prerequisite: ME-GY 6213 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7243 Advanced Composite Materials (3 Credits)
Typically offered occasionally
The course covers mechanics based analysis of fibrous (continuous and discontinuous) and particulate composites, generalized Hooke's law for anisotropic and orthotropic materials. Topics: Stress strain transformations and failure criterion for anisotropic materials. Analysis of composite beams in tension, flexure and torsion. Analysis of composite shells and grid-stiffened structures. | Prerequisite: ME-GY 5243 and ME-GY 6213 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7323 FAILURE MECHANCIS (3 Credits)
The course introduces fracture mechanics. Topics: Linear elastic, elastic-plastic and fully plastic fracture mechanics modeling and design. Fatigue and design against fatigue failures. Standard fracture mechanics testing procedures and related material properties. Micromechanics of fracture. Dynamic fracture. Continuum damage mechanics.| Prerequisite: ME-GY 6213 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7333 NON-DESTRUCTIVE EVALUATION (3 Credits)
The course introduces various NDE techniques used in engineering applications, xray radiography, ultrasonic imaging, acoustic emission, optical interferometry, magnetic resonance imaging. Also introduced are embedded optical and electromechanical sensors for continuous health monitoring and defect detection. | Prerequisite: ME-GY 6003 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7353 Fracture Mechanics (3 Credits)
The course introduces fracture mechanics. Topics: Linear elastic, elastic-plastic and fully plastic fracture mechanics modeling and design. Fatigue and design against fatigue failures. Standard fracture mechanics testing procedures and related material properties. Micromechanics of fracture. Dynamic fracture. Continuum damage mechanics. | Prerequisite: ME-GY 6213 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7443 Advanced Vibrations (3 Credits)
This course reviews analytical dynamics and vibrations of lumped parameter systems. Topics: Vibrations of distributed parameter systems. Approximate solution methods. Introduction to nonlinear vibrations and analysis tools. Advanced topics. | Prerequisite: ME-GY 5443 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7613 NON-LINEAR SYSTEMS: ANALYSIS & CONTROL (3 Credits)
Typically offered occasionally
The course introduces nonlinear phenomenon, behavior and analysis of second-order nonlinear systems, fundamental properties of solutions of nonlinear ordinary differential equations, Lyapunov stability theory, absolute stability theory, describing functions, dissipativity, advanced topics. | Prerequisite: ME-GY 6003 and ME-GY 6713 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7623 CO-OPERATIVE CONTROL (3 Credits)
The course examines fundamentals of set theory, metric spaces, linear spaces, matrix theory and differential equations. Topics: Lyapunov stability. Algebraic graph theory. Consensus theory. Linear switched systems. Stochastic convergence. Averaging methods. Synchronization problems. Applications to multivehicle robotic teams, epidemic spreading and opinion dynamics. | Prerequisite: ME-GY 6003 and ME-GY 6703 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7703 OPTIMAL ROBUST CONTROL (3 Credits)
Typically offered occasionally
The course looks at mathematical preliminaries, matrix theory fundamentals, linear system properties, stability theory, constrained optimization and performance characterization: deterministic/stochastic formulations, Lagrange multiplier versus linear-matrix-inequality formulation of linear quadratic regulation (LQR), state estimation and dynamic output feedback control problems, static output feedback, regulation versus tracking problems, robustness properties of LQR, on lack of robustness of LQG controllers, loop-transfer recovery, small-gain theorem, introduction to H-infinity and multi-objective robust control. | Prerequisite: ME-GY 6703 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7863 SPECIAL TOPICS (3 Credits)
Typically offered occasionally
These course numbers are reserved for special topics offered periodically by the Mechanical Engineering Program and are open to first-year graduate students. When offered, the subject matter is indicated as part of the title after the words "Special Topics," and the complete title appears on the student's transcript. | Prerequisite: tailored to the offering. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ME-GY 7873 SPECIAL TOPICS (3 Credits)
These course numbers are reserved for special topics offered periodically by the Mechanical Engineering Program and are open to first-year graduate students. When offered, the subject matter is indicated as part of the title after the words "Special Topics," and the complete title appears on the student's transcript. | Prerequisite: tailored to the offering. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ME-GY 7913 Robots for Disability (3 Credits)
Typically offered occasionally
This course will introduce personal, societal, and technological challenges related to physical disability, cognitive disability, and senior living. After an introduction to these challenges, students will learn about current state of art mechatronics and robotics solutions to handle these problems. Finally, they will apply their mechatronics and robotics learning to produce novel robotics solutions to address a specific problem related to a disability. | Prerequisite: ME-GY 5913 or permission of instructor.
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: ME-GY 5913 or permission of instructor.

ME-GY 7923 Robotic Gait and Manipulation (3 Credits)
Typically offered occasionally
Review of fundamental robot kinematics, dynamics, and control. Types of robotic manipulation. Design and control of robotic manipulators. Robotic hand and arm. Robotic manipulation modeling, simulation, and experiments. Gait types of legged systems. Biped and quadruped systems. Human walking and running, and passive dynamics. Design and control of biped walking robots. Robotic gait modeling, simulation, and experiments. Focus on hands-on experience in design, fabrication, and control of simple mechanisms. | Prerequisite: ME-GY 6913
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: ME-GY 6913.

ME-GY 7933 Fundamentals of Robot Mobility (3 Credits)
Typically offered occasionally
This course presents the concepts, techniques, algorithms, and state-of-the-art approaches for robot perception, mapping and localization. The course will show the theoretical foundations and will also have an experimental component based on Matlab/ROS. The course will start from basic concepts in probability and then introduce probabilistic approaches for data fusion such as Bayes Filters, Kalman Filter, Extended Kalman Filter, Unscented Kalman Filter, and Particle Filter. Then, the course will introduce the SLAM problem showing how this has recently been solved using batch optimization and graph methods. Finally, mapping algorithms will also be briefly discussed. | Prerequisite: ME-GY 6923 or ME-GY 6703 or permission from instructor
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: ME-GY 6923 or ME-GY 6703 or permission from instructor.

ME-GY 7943 Networked Robotics Systems, Cooperative Control and Swarming (3 Credits)
Typically offered occasionally
The student who completes this course will gain an advanced understanding of the analysis and control of networked dynamical systems, with a specific accent on networked robotic systems. He/she will be able to study the properties of networked robotic systems through the analysis of the intertwining properties of the network structure and of the individual dynamics of the single robot. Moreover, he/she will be able to understand and design algorithms for distributed control of teams of mobile agents and robots.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7953 Introduction to Smart Materials and Structures (3 Credits)
Typically offered occasionally
This course presents the fundamentals of fabrication, modeling, analysis, and design of smart materials and structures. Students will be exposed to the state of the art of smart materials and systems, spanning piezoelectrics, shape memory alloys, electroactive polymers, mechanochromic materials, and fiber optics. They will explore the application of such materials in structural systems from the aeronautic, automotive, biomedical, and nautical industry. They will gain familiarity with multiphysics phenomena taking place within smart materials. Such knowledge will, in turn, inform the use of commercial software to simulate smart materials and structures for application in sensing and actuation.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7963 MICROELECTROMECHANICAL SENSORS AND ACTUATOR FOR ROBOTS (3 Credits)
Typically offered occasionally
This course presents the fundamentals of fabrication, modeling, analysis, and design of micro/nano sensors and actuators. Students will be exposed to the state of the art of micro/nano fabrication. They will gain familiarity with multiphysics phenomena at the micro/nano scale toward an improved understanding of fundamental sensing and actuation principles. Such knowledge will, in turn, inform the use of commercial software to design and simulate micro/nano devices for real world application.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 7973 OPTIMAL AND LEARNING CONTROL FOR ROBOTICS (3 Credits)
Typically offered Spring
What kind of movements should a robot perform in order to walk, jump or manipulate objects? Can it compute optimal behaviors online? Can it learn this directly from trial and error? This course will introduce modern methods for robotics movement generation based on numerical optimal control and reinforcement learning. It will cover fundamental topics in numerical optimal control (Bellman equations, differential dynamic programming, model predictive control) and reinforcement learning (actor-critic algorithms, model-based reinforcement learning, deep reinforcement learning) applied to robotics. It will also contain hands-on exercises for real robotic applications such as walking and jumping, object manipulation or acrobatic drones. Recommended background in at least one of the following: linear systems; robotics; machine learning; convex optimization; programming (python or C++). | Prerequisites: ECE-GY 6253 or ME-GY 6703 or ME-GY 6923.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 8033 Combustion (3 Credits)
The course covers chemical characteristics of flames. Topics: Heat of formation and of reaction; phase and reaction equilibrium and adiabatic flame temperature; and special concentration in stationary and flowing reacting systems. Chemical kinetics of homogeneous and heterogeneous reacting systems. Branching chain reactions and explosion limits. Diffusion and remixed combustion systems. | Prerequisite: ME-GY 6043 and ME-GY 6013 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 8043 THEORY OF PROPULSION (3 Credits)
This course looks at principles of high-speed propulsion based on chemical energy sources. Topics: Air- breathing engines and their components: ramjet, scramjet, turbojet and turbofan, combustion thermodynamics, flows with chemical reactions, thermochemistry of solid and liquid rocket engines. Engineering parameters in engine design. | Prerequisite: ME-GY 7113.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 8213 ELASTICITY II (3 Credits)
This class continues studies in elasticity problems. Topics: Three dimensional problems; St. Venant problems, extension, flexure, tension. Energy principles and variational methods; approximation techniques. | Prerequisite: ME-GY 7213 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 8273 Mechanics of Cellular Materials (3 Credits)
The course looks at structure of cellular composites and natural cellular materials, including single phase open and closed cell foams and two-phase closed cell foams. Topics: Mechanics of honeycombs and foams, mechanics of wood and bones, effect of density, cell size and cell periodicity, introduction to homogenization techniques for cellular composites. | Prerequisite: ME-GY 7213 or adviser approval.
Grading: Grad Poly Graded
Repeatable for additional credit: No

ME-GY 8863 Advanced Topics (3 Credits)
These numbers are reserved for advanced topics offered periodically by the Mechanical Engineering Program and are open to second-year and more advanced graduate students. When offered, the specific subject matter is indicated as part of the title after the words "Advanced Topic," and the complete title appears on the student's transcript. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ME-GY 8873 Advanced Topics (3 Credits)
These numbers are reserved for advanced topics offered periodically by the Mechanical Engineering Program and are open to second-year and more advanced graduate students. When offered, the specific subject matter is indicated as part of the title after the words "Advanced Topic," and the complete title appears on the student's transcript. | Prerequisite: Graduate standing or advisor approval
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ME-GY 9013 Guided Readings I (3 Credits)
Typically offered Fall and Spring
These readings are open to qualified graduate students interested in special advanced topics. Directed study includes analytical work and/or laboratory investigations. | Prerequisite: Graduate standing, adviser and instructor approval.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ME-GY 9023 Guided Readings II (3 Credits)
Typically offered occasionally
These readings are open to qualified graduate students interested in special advanced topics. Directed study includes analytical work and/or laboratory investigations. | Prerequisite: Graduate standing, adviser and instructor approval.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ME-GY 9033 Guided Readings III (3 Credits)
These readings are open to qualified graduate students interested in special advanced topics. Directed study includes analytical work and/or laboratory investigations. | Prerequisite: Graduate standing, adviser and instructor approval.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ME-GY 9043 Guided Readings IV (3 Credits)
These readings are open to qualified graduate students interested in special advanced topics. Directed study includes analytical work and/or laboratory investigations. | Prerequisite: Graduate standing, adviser and instructor approval.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes

ME-GY 9990 SEMINAR IN MECHANICAL ENGINEERING (0 Credits)
Typically offered Fall and Spring
The purpose of this course is to enhance the research experience of the MAE PhD students by attending the MAE Seminar and other formal MAE research presentations in the department. The students are expected to attend at least four seminars. Attendance is monitored and recorded by the Course Coordinator. All PhD candidate, following the successful passage of the PhD Qualifying Examination will register for ME-GY 9990, every semester they are registered in the program.
Grading: Grad Poly Pass/Fail
Repeatable for additional credit: Yes