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, Anti-requisite: ME-GY 997X
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
Prerequisites: RE-GY 9990 AND Restriction: Academic Plan = PHD Mechanical Engineering-PHD.

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 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 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 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 6523 BIOMEMS AND MICROFLUIDICS (3 Credits)
Typically offered Fall
This course targets to: (1) introduce fundamental design and microfabrication concepts of BioMEMS, microfluidics and lab-on-chip systems, (2) expose students to the relevant biomedical and biological applications. The course is divided into four main sections: (i) BioMEMS/Microfluidic materials and microfabrication, (ii) Statistics and modeling for BioMEMS, (iil) BioMEMS sensors and actuators, and (iv) Microfluidic and Lab-on-chip systems. | Prerequisites: Adviser's approval
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 6783 BIOMECHANICS FOR BIOMEDICAL ENGINEERS (3 Credits)
Typically offered Spring
Biomechanics offers contemporary topics on applications of linear and nonlinear solid mechanics to biological tissues, biomedical device design and intervention. The course will be composed of two parts: (1) theoretical aspects of biomechanics including kinematics, stress, and elastic material models that are related to modeling of biological tissue behavior; 2) review and discussion of clinical and engineering journal papers related to disease treatment and modeling. | Prerequisites: Undergraduate biomechanics course or instructor's consent
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
Prerequisites: ME-GY 6823.

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 5913.

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
Prerequisites: ME-GY 6003 with a Minimum Grade of C AND ME-GY 6043 with a Minimum Grade of C.

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
Prerequisites: ME-GY 6003 with a Minimum Grade of C AND ME-GY 6043 with a Minimum Grade of C.

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
Prerequisites: ME-GY 6043 with a Minimum Grade of C.

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
Prerequisites: ME-GY 6003 with a Minimum Grade of C AND ME-GY 6043 with a Minimum Grade of C.

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
Prerequisites: ME-GY 6213 with a Minimum Grade of C.

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
Prerequisites: ME-GY 6003 with a Minimum Grade of C.

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 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 8153 Complex Urban Systems (3 Credits)
Typically offered Spring
This course offers an introduction to the broad field of complex urban systems, with a focus on project-based learning and computer coding. Using only basic concepts in probability and linear algebra, the course will introduce methods and principles of complex systems applied to urban systems, including geography laws, scaling principles, and mobility patterns.
Grading: Grad Poly Graded
Repeatable for additional credit: No

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 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