AEROSPACE ENGINEERING (AE)

AE 6009. Viscous Fluid Flow. 3 Credit Hours.
Fundamental conservation laws. Laminar flows, wall-bound and free shear flows. Separation, heat transfer, and compressibility effects. Introduction to flow instability and transition to turbulence.

AE 6012. Turbulent Flows. 3 Credit Hours.
Basic characteristics of turbulence. Statistical methods. Reynolds averaging, kinetic energy budget, and scaling issues. Homogeneity and isotrophy. Free and wall bounded shear flows. Simulation and modeling.

AE 6015. Advanced Aerodynamics. 3 Credit Hours.
Introduce concepts, derivation and application of aerodynamic fundamentals. Emphasis on advanced knowledge in analysis and design of fixed-wing, launch/atmospheric return vehicles, and rotating systems.

AE 6020. High-Speed Flow. 3 Credit Hours.
Transonic small disturbance theory. Transonic potential flow modeling. Supercritical airfoil design. Physics of hypersonic flow. Newtonian flow. Modeling of hypersonic viscous and inviscid flow.

AE 6030. Unsteady Aerodynamics. 3 Credit Hours.
Unsteady potential theory for various speed ranges. Calculation of steady and unsteady aerodynamic loads on airfoils and wings. Vortex flows. Topics of current research interest.

AE 6042. Computational Fluid Dynamics. 4 Credit Hours.
Finite-difference, finite volume methods for solution of Navier-Stokes and Euler equations. Classification of equations, stability, grids, boundary conditions, implicit and explicit methods, turbulence modeling.

AE 6050. High-temperature Gas Dynamics I. 3 Credit Hours.
Defining equations for compressible flows, real gas properties and their effect on the behavior of equilibrium and non-equilibrium flows.

AE 6052. Flow Diagnostics and Control. 3 Credit Hours.
Introduction to experimental techniques; flow visualization; statistical methods; pressure, velocity, temperature, density, particle size, reaction rate measurements. Experiment design, data acquisition, and interpretation. Flow control.

AE 6060. Aeroacoustics. 3 Credit Hours.
Lighthill's theory of aerodynamic noise and extensions, flow/acoustic interactions, feedback phenomenon, supersonic jet noise, aeroacoustics of ducts, propeller noise, helicopter noise, sonic boom.

AE 6070. Rotary Wing Aerodynamics. 3 Credit Hours.
Vortex wake modeling; analytical inflow theories; modern computational methods for rotary wing aerodynamic analysis; aerodynamic noise.

AE 6080. Dynamics of Turbulence. 3 Credit Hours.
Fundamental physics of turbulent flows. Vorticity dynamics, Kolmogorov similarity hypotheses and nonlinear interactions. Mixing and dispersion. Direct and large-eddy simulations, Reynolds stress modeling. Advanced topics.

AE 6100. Advanced Structural Analysis I. 3 Credit Hours.
Stability of elastic systems under quasi-static loads. Classical, kinetic, and potential energy approaches through rigid member models. Buckling of elastic bars and frames. Energy methods.

AE 6101. Advanced Structural Analysis II. 3 Credit Hours.
Buckling of beams on elastic foundations, rings and arches; elasticity theory; torsional buckling of shafts, buckling of plates, circular cylindrical shells, rotating beams, nonconservative problems.

AE 6104. Computational Mechanics. 3 Credit Hours.
Development of finite element methods for linear, static structural analysis. The basic tools of the finite element method. The formulation of various structural elements.

AE 6106. Analysis of Aerospace Structural Elements. 3 Credit Hours.
This course focuses on the analysis of advanced aerospace structures. Beam theory is reviewed, plate theory is introduced. Classical and energy solutions are presented.

AE 6107. Analysis of Aerospace Structural Elements. 3 Credit Hours.
This course focuses on the analysis of advanced aerospace structures. Beam theory is reviewed. Examples of nonlinear behavior of materials are discussed. Plate theory is introduced; classical and energy solution methods are studied.

AE 6111. Elasticity. 3 Credit Hours.
Stresses and deformations in continuum media. Stress and strain measures used in nonlinear elasticity. Equilibrium equations and energy principles. Nonlinear beam, plate, and shell applications.

AE 6112. Inelastic Response. 3 Credit Hours.
Fundamentals of inelastic response relevant to aerospace and composite structures. Viscoelastic constitutive relations. Isothermal boundary value problems. Foundations of plasticity theory. Solution of plastic-elastic problems.

AE 6114. Fundamentals of Solid Mechanics. 3 Credit Hours.
Unified overview of fundamental aspects of solid mechanics, from nonlinear continuum mechanics to linear elasticity, including an introduction to energy methods and other special topics.

AE 6115. Fundamentals of Aerospace Structural Analysis. 3 Credit Hours.
Overview and fundamentals of aerospace structural analysis, including virtual work and energy methods, buckling and advanced structural theories.

AE 6123. Design of Fiber-Reinforced Composite Structures. 3 Credit Hours.
Composite material systems, composite structures including anisotropic plate and shell theory, shear deformation, hygrothermal and interlaminar stresses. Finite element modeling. Design case studies and cost-effective applications for thin-walled sections.

AE 6161. Theory of Plates. 3 Credit Hours.
Development of isotropic and anisotropic plate theories. Classical and energy solutions for various geometrics and loadings. Aerospace applications including elastically coupled composite and sandwich plates.

AE 6162. Shell Structures. 3 Credit Hours.
Analysis of stresses and deformation of shells with and without bending, shells forming surfaces of revolution, asymptote methods, buckling of shells, nonlinear theories.

AE 6165. Principles of Fracture and Fatigue. 3 Credit Hours.
Brittle and ductile fracture. Determination of stress intensity factors. Analytics of fracture mechanics. Elastic-plastic fracture. Energy release rate. Mechanics of fatigue. Crack growth. Environmental effects.

AE 6170. Structural Optimization. 3 Credit Hours.
Mathematical methods of constrained optimization, sensitivity analysis, approximation concepts, decomposition techniques, shape optimization in the context of structural design.

AE 6200. Advanced Aeroelasticity I. 3 Credit Hours.
Understanding and analysis of aeroelastic phenomena in fixed-wing aircraft, static aeroelasticity, dynamic aeroelasticity, and dynamic response and transient stresses in aircraft structures.

AE 6210. Advanced Dynamics I. 3 Credit Hours.
Kinematics of particles and rigid bodies, angular velocity, inertia properties, holonomic and nonholonomic constraints, generalized forces.

AE 6211. Advanced Dynamics II. 3 Credit Hours.
A continuation of AE 6210. Equations of motion, Newtonian frames, consistent linearization, energy and momentum integrals, collisions, mathematical representation of finite rotation.

AE 6220. Rotorcraft Structural Dynamics and Aeroelasticity. 3 Credit Hours.
Elementary blade dynamics, flap-lag dynamics, ground resonance, structural dynamics of rotating beams, nonlinear elastic blade analysis, harmonic balance and trim, Floquet theory.

AE 6230. Structural Dynamics. 3 Credit Hours.
Dynamic response of single-degree-of-freedom systems, Lagrange's equations; modal decoupling; vibration of Euler-Bernoulli and Timoshenko beams, membranes and plates.

AE 6231. System Identification in Structural Dynamics. 3 Credit Hours.
System identification by complex exponential methods, poly ref techniques, eigen-realization methods and frequency domain methods. Effects of noise, generalized least squares, and recursive online identification.

AE 6240. Numerical Methods in Structural Dynamics. 3 Credit Hours.
Rayleigh quotient, Rayleigh-Ritz and Galerkin methods; extraction of eigenvalues and eigenvectors; analysis of forced harmonic response; direct time integration of large-scale systems.

AE 6251. Experimental Methods in Structural Dynamics. 3 Credit Hours.
Experimental methods for measurement of structural vibration, random vibration, analytical methods for analysis of vibration data, applications to single and multi-degree- of-freedom problems.

AE 6252. Smart Structures and Structural Control. 3 Credit Hours.
Modeling smart sensors and actuators, development of closed loop models, design of controllers, validation of controllers, application to vibration control, noise control, and shape control.

AE 6263. Flexible Multi-body Dynamics. 3 Credit Hours.
Nonlinear, flexible multi-body dynamic systems, parameterization of finite rotations, strategies for enforcement of holonomic and non holonomic constraints, formulation of geometrically nonlinear structural elements, time-integration techniques.

AE 6270. Applied Nonlinear Dynamics. 3 Credit Hours.
Nonlinear vibration methods through averaging and multiple scales, bifurcation, periodic and quasi-periodic systems, transition to chaos, characterization of chaotic vibrations, thermodynamics of chaos, chaos control.

AE 6280. Wave Propagation. 3 Credit Hours.
Dilational, equivalue mixed waves; Rayleigh and Lamb waves, reflection, refraction, impact problems, plastic waves, N.D.E, vibration control, numerical methods, finite deformation wave propagation, constitutive equations.

AE 6310. Optimization for the Design of Engineered Systems. 3 Credit Hours.
Introduction to optimization problem formulations for engineering design, algorithms for constrained nonlinear programming, multiobjective and multidisciplinary optimization, and robust design optimization.

AE 6322. Spacecraft and Launch Vehicle Design I. 4 Credit Hours.
Early design of spacecraft and launch vehicles. Emphasis on preliminary vehicle sizing and performance, effect of new technologies, and disciplinary interactions. Individual design projects.

AE 6323. Spacecraft and Launch Vehicle Design II. 3 Credit Hours.
Space Vehicle Design methodology further developed and applied. Teams formed to prepare competitive proposals in response to given mission requirements. Designs publicly presented and defended.

AE 6333. Rotorcraft Design I. 3 Credit Hours.
System approach to conceptual design of aerospace systems with emphasis on rotorcraft. Comprehensive methodologies for aerospace vehicle synthesis and sizing. Integration of technologies. Students cannot receive credit for both AE 6333 and AE 4343.

AE 6334. Rotorcraft Design II. 4 Credit Hours.
Students work together on this application to complete the preliminary design stage of a specific rotorcraft. Participants are exposed to disciplinary and interdisciplinary issues.

AE 6343. Aircraft Design I. 3 Credit Hours.
Stochastic approach to conceptual design of aerospace systems with emphasis on aircraft and missiles. Comprehensive methodologies for aerospace vehicle synthesis and sizing. Integration of technologies.

AE 6344. Aircraft Design II. 4 Credit Hours.
Students work together on this application to complete the preliminary design stage of a specific aircraft or missile. Participants are exposed to disciplinary and interdisciplinary issues.

AE 6353. Orbital Mechanics. 3 Credit Hours.
First graduate-level astrodynamics class that includes two-body orbital mechanics, orbit determination, orbit prediction, orbital maneuvers, lunar and interplanetary trajectories, orbital rendzvous and space navigation.

AE 6354. Advanced Orbital Mechanics. 3 Credit Hours.
Advanced concepts in orbital mechanics including orbit determination, orbital perturbations, time of flight, rendezvous, low thrust trajectories, and multi-body problems. Taught in alternate years.

AE 6355. Planetary Entry, Descent and Landing. 3 Credit Hours.
Entry flight mechanics and dynamics, aerothermodynamics, thermal protection systems, aerodynamic decelerators, descent and landing. Robotic and human exploration mission studies for aerobraking, planetary entry, aerocapture.

AE 6361. Air Breathing Propulsion System Design I. 3 Credit Hours.
Air breathing propulsion design with emphasis on multidisciplinary design issues related to system integration, cycle selection, performance, cost, reliability, maintainability, etc.

AE 6362. Safety by Design. 4 Credit Hours.
Autonomous situational flight model allows students to examine complex behaviors in the "pilot-vehicle-operational conditions" system. Flight certification and airworthiness requirements are mapped into formal scenarios.

AE 6372. Aerospace Systems Engineering. 3 Credit Hours.
Introduction to aerospace systems engineering. Systems engineering and quality engineering methods and tools. Top-down design decision support processes, computer integrated environments, Integrated Product/Process Development (IPPD).

AE 6373. Advanced Design Methods I. 4 Credit Hours.
Introduction to modern probabilistic design methods and techniques. Design of experiments, Taguchi methods, response surface equations, robust design, risk and uncertainty, technology assessment and selection.

AE 6374. Advanced Design Methods II. 3 Credit Hours.
Introduction to modern multidisciplinary design optimization methods and techniques. Numerical optimization with applications, stochastic methods, Genetic Algorithms, multidisciplinary decomposition methods, multi-level optimization strategies.

AE 6380. Fundamentals of Computer-aided Design and Engineering. 3 Credit Hours.
Introduction to the principles of geometric modeling; 2-D systems; 3-D wireframe, surface and solid representations; mathematical representations of curves, surfaces, solids; application to aerospace design problems. Credit not allowed for both AE 4375 and AE 6380.

AE 6381. Software Development for Engineering Applications. 3 Credit Hours.
Introduction to the development of engineering analysis and visualization software for UNIX workstations with emphasis on rapid prototyping, information modeling, distributed processing, and client/server architectures.

AE 6382. Computing Systems for Engineering Research Laboratory. 1 Credit Hour.
Introduction to computational systems used for engineering research. Basics of Unix and Windows operating systems, survey of the major programming languages, and computing frameworks.

AE 6383. Applied Design Laboratory. 1 Credit Hour.
Introduction to computing tools and processes used in subsequent applied design courses in graduate fixed wing, rotary wing, and space systems design tracks.

AE 6393. Introduction to System of Systems Engineering Principles. 3 Credit Hours.
Introduce students to the development and analysis of complex System of Systems, and their practical application to formulate Grand Challenge projects.

AE 6394. System of Systems Engineering Applications. 4 Credit Hours.
Application of developed System of Systems analysis frameworks for the performance of Grand Challenge projects.

AE 6410. Combustion Dynamics. 3 Credit Hours.
Acoustic wave propagation in inhomogeneous flows, flame-acoustic wave interactions, and control of combustion-driven oscillations.

AE 6412. Turbulent Combustion. 3 Credit Hours.
Fundamentals of interaction between flow turbulence and reactive scalars. Theoretical, numerical, and experimental methods. Physics of premixed, non-premixed, and partially premixed turbulent combustion.

AE 6414. Multi-Phase Combustion. 3 Credit Hours.
Fundamentals of dispersed-phase dynamics of liquid-gas and soot aerosol flows. Fluid-particle-wall interactions. Numerical and experimental methods. Advances in spray combustion.

AE 6440. Turbine Engine Aerothermodynamics. 3 Credit Hours.
Analysis and design of gas turbine engine components including axial flow compressors, turbines, inlets, and nozzles. Heat transfer and turbine blade cooling.

AE 6445. Combustor Fundamentals. 3 Credit Hours.
Examination of the chemical and aerothermodynamic processes that govern gas turbine combustor performance and design. Also fuel injection, noise, emissions, and testing methodologies.

AE 6450. Rocket Propulsion. 3 Credit Hours.
Analysis and design of rocket engines including liquid, solid, hybrid, and advanced propulsion systems.

AE 6451. Electric Propulsion. 3 Credit Hours.
The course provides a solid background of the operating principles, performance characteristics, and design features of the state-of-the-art electric propulsion systems.

AE 6503. Helicopter Stability and Control. 3 Credit Hours.
Helicopter general equations of motion, rotor forces and moments, helicopter stability and control characteristics, handling qualities, flight control system design.

AE 6504. Modern Methods in Aircraft Flight Control. 3 Credit Hours.
Linear quadratic regulator design. Model following control. Stochastic control. Fixed structure controller design. Applications to aircraft flight control.

AE 6505. Random Processes and Kalman Filtering. 3 Credit Hours.
Probability and random variables and processes; correlation; shaping filters; simulation of sensor errors; Wiener filter; random vectors; covariance propagation; recursive least-squares; Kalman filter; extensions.

AE 6506. Aerospace Guidance and Navigation. 3 Credit Hours.
Earth's shape and gravity. Introduction to inertial navigation. GPS aiding. Error analysis. Guidance systems. Analysis of the guidance loop. Estimation of guidance variables. Adjoint analysis.

AE 6511. Optimal Guidance and Control. 3 Credit Hours.
Euler-Lagrange formulation; Hamilton-Jacobi approach; Pontryagin's minimum principle; Systems with quadratic performance index; Second variation and neighboring extremals; Singular solutions; numerical solution techniques.

AE 6520. Advanced Flight Dynamics. 3 Credit Hours.
Reference frames and transformations, general equations of unsteady motion, application to fixed-wing, rotary-wing and space vehicles, stability characteristics, flight in turbulent atmosphere.

AE 6530. Multivariable Linear Systems and Control. 3 Credit Hours.
Techniques for analysis and description of multivariable linear systems. Tools for advanced feedback control design for these systems, including computational packages. Credit will not be awarded for both AE 6530 and ECE 6550 or AE 6530 and ME 6401.

AE 6531. Aerospace Robust Control I. 3 Credit Hours.
Robustness issues in controller analysis and design. LQ analysis, H2 norm, LQR, LQG, uncertainty modeling, small gain theorem, H-infinity performance, and the mixed-norm H2/H-infinity problem.

AE 6532. Aerospace Robust Control II. 3 Credit Hours.
Advanced treatment of robustness issues. Controller analysis and design for linear and nonlinear systems with structured and non-structured uncertainty. Reduced-order control, stability, multipliers, and mixed-mu.

AE 6534. Control of Aerospace Structures. 3 Credit Hours.
Advanced treatment of control of flexible structures. Topics include stability of multi-degree-of-freedom systems, passive and active absorbers and isolation, positive real models, and robust control for flexible structures.

AE 6551. Cognitive Engineering. 3 Credit Hours.
Cognitive engineering addresses a range of technologies and work environments that will support human cognitive performance, including information systems, decision support, automation, and intelligent systems.

AE 6552. Advanced Topics in Humans and Autonomy. 3 Credit Hours.
Establish a deep understanding of the theoretical basis for functions performed by humans and by autonomous systems in dynamic, complex domains.

AE 6561. Reliable Control Software for Aerospace and Embedded Applications. 3 Credit Hours.
Basic principles of reliable control and embedded software design, with aerospace applications. Programming languages and their specific features covered in student projects.

AE 6571. Air Traffic Control and Management. 3 Credit Hours.
Funtionalities and technologies of air traffic control and management in the areas of communication, navigation, surveillance; decision aiding, automation; conflict detection resolution; collaborative decision-making.

AE 6580. Aerospace Nonlinear Control. 3 Credit Hours.
Advanced treatment of nonlinear robust control. Lyapunov stability theory, absolute stability, dissipativity, feedback linearization, Hamilton-Jacobi-Bellman theory, nonlinear H-infinity, backstepping control, and control Lyapunov functions.

AE 6694. Graduate Internship. 1-21 Credit Hours.
Graduate Internship for which the student is paid.

AE 6701. Wind Engineering. 3 Credit Hours.
An introductory course on wind energy and its potential; modeling and design of wind turbines; analysis of the economic benefits of wind turbine systems. Credit will not be awarded for both AE 6701 and ME 6701.

AE 6705. Introduction to Mechatronics. 4 Credit Hours.
Modeling and control of actuators and electro-mechanical systems. Performance and application of microprocessors and analog electronics to modern mechatronic systems.

AE 6721. Evaluation of Human Integrated Systems. 3 Credit Hours.
Evaluation of human integrated systems including translating research questions into measurable objectives, overview of evaluation methods and data analysis techniques applicable to such systems. Credit not allowed for both AE 6721 and ISYE 6231.

AE 6760. Acoustics I. 3 Credit Hours.
Fundamental principles governing the generation, propagation, reflection, and transmission of sound waves in fluids. Crosslisted with ME 6760.

AE 6761. Acoustics II. 3 Credit Hours.
Radiation and scattering of sound waves in fluids, duct acoustics, dissipation phenomena. Crosslisted with ME 6761.

AE 6762. Applied Acoustics. 3 Credit Hours.
Mufflers, resonators, acoustic materials, barriers, industrial noise, room acoustics, active noise control. Crosslisted with ME 6762.

AE 6765. Kinetics and Thermodynamics of Gases. 4 Credit Hours.
Thermodynamics of nonreacting and reacting gas mixtures. Introductory quantum theory, statistical thermodynamics, and gas kinetic theory. Crosslisted with ME 6765.

AE 6766. Combustion. 3 Credit Hours.
Introductory chemical kinetics, detonations and deflagrations, laminar flame propagation in premixed gases, ignition and quenching, laminar diffusion flames and droplet burning, turbulent reacting flows. Crosslisted with ME 6766.

AE 6767. Topics in Combustion. 3 Credit Hours.
Turbulent combustion, combustion instability and control, solid propellants and explosives, chemical kinetics, pollutant formation and destruction, computational and experimental methods for reacting flows. Crosslisted with ME 6767.

AE 6769. Linear Elasticity. 3 Credit Hours.
Governing equations of linear elasticity, plane elasticity, boundary value problems, airy stress function and complex variable methods, simple three-dimensional solutions. Crosslisted with ME 6769.

AE 6770. Energy and Variational Methods in Elasticity and Plasticity. 3 Credit Hours.
Applications of energy and variational methods in engineering mechanics to elastic, plastic, and dynamical behavior of deformable bodies. Crosslisted with ME 6770.

AE 6779. Dynamic System Simulation and Modeling. 3 Credit Hours.
Models of dynamic systems, such as aircraft, ground vehicles and machinery, and manual control. Numerical simulation techniques and applications. Interactive simulators. Student programming project. Crosslisted with ISYE 6779.

AE 6XXX. Aerospace Engineering Elective. 1-21 Credit Hours.

AE 7000. Master's Thesis. 1-21 Credit Hours.

AE 7741. Robotics Professional Preparation. 1 Credit Hour.
Preparation for a professional career in Robotics. Local & visiting speakers. Program introduction. Technical resume preparation. GT Robotics labs & resources.

AE 7742. Robotics Professional Preparation 2. 1 Credit Hour.
Preparation for a professional career in Robotics. Local & visiting speakers. Selecting and applying for Internship. Developing capstone project proposal. Public speaking practice and preparation.

AE 7743. Robotics Professional Preparation 3. 1 Credit Hour.
Preparation for a professional career in Robotics. Local & visiting speakers. Interview preparation & career search. Technical report writing and presentation.

AE 7764. Acoustic Propagation. 3 Credit Hours.
Propagation of sound in inhomogeneous fluids; ray acoustics, ocean and atmospheric acoustics, nonlinear acoustics. Crosslisted with ME 7764.

AE 7772. Fundamentals of Fracture Mechanics. 3 Credit Hours.
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with CHE, CEE, ME, and MSE 7772.

AE 7773. Advanced Fracture Mechanics. 3 Credit Hours.
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with CEE, CHE, ME, and MSE 7773.

AE 7774. Fatigue of Materials and Structures. 3 Credit Hours.
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, notch effects, cumulative damage, multiaxial loading, and fatigue crack propagation. Crosslisted with CEE, CHE, ME, and MSE 7774.

AE 7775. Topics in Fracture and Fatigue of Metallic and Composite Structures. 3 Credit Hours.
Brittle and ductile fracture criteria. Failrue prediction in composite structures. Free-edge and internal delamination. Anisotropic cracks. Fatigue behavior of composites and metal. New micromechanical models. Crosslisted with CHE, ME, and MSE 7775.

AE 7785. Introduction to Robotics Resesarch. 3 Credit Hours.
Familiarizes students with the core areas of robotics; mechanics, control, perception, AI, and autonomy. Provides an introduction to the mathematical tools required in robotics research.

AE 7791. Damage, Failure, and Durability of Composite Materials. 3 Credit Hours.
Analysis and failure of fiber-reinforced composite material systems. Mechanisms of toughening, multiple cracking mechanisms. Failure in woven fabric, braided, and special geometry composites. Crosslisted with CHE, CEE, ME, MSE, and PTFE 7791.

AE 7792. Advanced Mechanics of Composites. 3 Credit Hours.
Anisotropic elasticity, hygrothermal behavior, stress analysis of laminated composites including 3D effects, stress concentrations, free-edge effects, thick laminates, adhesive and mechanical connections, fracture of composites. Crosslisted with CHE, CEE, ME, MSE, and PTFE 7792.

AE 7793. Manufacturing of Composites. 3 Credit Hours.
Major manufacturing techniques of metal-ceramic and polymer-matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with CHE, CEE, ME, MSE, and PTFE 7793.

AE 8001. Design Seminar. 1 Credit Hour.
Case studies of existing aerospace systems; assessment of design payoffs and risks; industry experts provide case examples and knowledge transfer to course participants; field trips.

AE 8002. AE Graduate Seminar. 1 Credit Hour.
Introduce AE graduate students to world-class aerospace researchers and topics, discuss and demonstrate basic graduate student resources and skills.

AE 8740. Robotics Internship. 1-21 Credit Hours.
Graduate Internship at a partner company, GTRI or a GT Robotics lab.

AE 8741. Robotics Capstone Project. 3 Credit Hours.
Teams or individuals apply the knowledge and skills acquired throughout the MS program to a faculty supervised robotics project.

AE 8750. Robotics Research Foundation I. 3 Credit Hours.
Multidisciplinary research course supervised by two robotics faculty from different schools participating in the robotics Ph.D. program.

AE 8751. Robotics Research Foundation II. 3 Credit Hours.
Continuation of AE 8751 (Robotics Research Foundation I).

AE 8801. Special Topics. 1 Credit Hour.
Special topics of current interest.

AE 8802. Special Topics. 2 Credit Hours.
Special topics of current interest.

AE 8803. Special Topics. 3 Credit Hours.
Special topics of current interest.

AE 8804. Special Topics. 4 Credit Hours.
Special topics of current interest.

AE 8805. Special Topics. 5 Credit Hours.
Special topics of current interest.

AE 8883. Special Topics. 3 Credit Hours.

AE 8900. Special Problems. 1-21 Credit Hours.

AE 8901. Special Problems. 1-21 Credit Hours.

AE 8902. Special Problems. 1-21 Credit Hours.

AE 8903. Special Problems. 1-21 Credit Hours.

AE 8997. Teaching Assistantship. 1-9 Credit Hours.
For graduate students holding graduate teaching assistantships.

AE 8998. Research Assistantship. 1-9 Credit Hours.
For graduate students holding graduate research assistantships.

AE 8999. Preparation for Doctoral Dissertation. 1-21 Credit Hours.

AE 9000. Doctoral Thesis. 1-21 Credit Hours.