Aerospace Engineering (ASE)

ASE 102 Introduction to Aerospace Engineering 1 Hour
Introduction to aerospace engineering, including problem solving and study skills. Examines opportunities and responsibilities of careers in aerospace engineering.

ASE 119, 219, 319, 419, 519, 619, 719, 819, 919 Topics in Aerospace Engineering 1-9 Hours

ASE 119S, 219S, 319S, 419S, 519S, 619S, 719S, 819S, 919S Topics in Aerospace Engineering 1-9 Hours
Used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office or the school's International Engineering Education Programs.

ASE 320 Low-Speed Aerodynamics 3 Hours
Fundamental concepts, fluid statics; integral and differential analysis; detailed analysis of inviscid, incompressible flows; aerodynamics of airfoils and wings.

ASE 120K Low-Speed Aerodynamics Laboratory 1 Hour
Wind tunnel and water channel experiments at subsonic speeds; use of instrumentation and written reports.

ASE 324L Aerospace Materials Laboratory 3 Hours
Study of the deformation and fracture behavior of materials used in aerospace vehicles. Structure-property relations, methods of characterizing material behavior, use of properties in the design process. Case histories. Written reports.

ASE 128 Aerospace Engineering Projects Laboratory 1 Hour
Directed work on an organized student project in aerospace engineering or engineering mechanics.

ASE 330M Linear System Analysis 3 Hours
Explore the fundamentals of signals and systems; mathematical modeling of mechanical systems; transfer function; impulse response; Laplace transforms; response of linear, time-invariant systems; frequency response methods; time-domain analysis; introductory concepts for feedback control systems; multivariate linear dynamical systems; eigenvalues and eigenvectors; matrix exponentials. An introduction to fundamental elements of the theory of systems and signals and exposure to necessary concepts and tools required to perform modeling and analysis of linear dynamical systems. Demonstrate the theory through several simulation examples using MATLAB and Simulink relevant to applications of modern aerospace engineering systems.

ASE 339 Advanced Strength of Materials 3 Hours
Curved beams, shear deformation, beam columns, beams on elastic foundations; inelastic behavior of members; elementary plate bending.

ASE 346 Viscous Fluid Flow 3 Hours
Navier-Stokes equations, laminar and turbulent boundary layers, transition, effects of pressure gradients, heat transfer, and compressibility.

ASE 355 Aeroelasticity 3 Hours
Static aeroelastic phenomena; wing torsional divergence, control reversal, effect of wing sweep, flexibility effects on aircraft stability and control, and design implications; dynamic aeroelasticity; and galloping of transmission lines, flutter, and unsteady aerodynamics. Includes an introduction to experimental aeroelasticity.

ASE 357 Mechanics of Composite Materials 3 Hours
Anisotropic constitutive relationships, lamination theory, failure theories, micromechanical behavior of laminates; laminated composite plates–bending, vibration, and buckling; composite fabrication, sandwich and other composite lightweight structures.

ASE 361K Aircraft Design I 3 Hours
Introduction to systems engineering including the systems engineering process, requirements, design fundamentals, trade studies, cost and risk analyses, integration, technical reviews, case studies, and ethics.

ASE 361L Aircraft Design II 3 Hours
Examine aerospace systems characteristics, mission requirements, sensors, and consumables analyses; and mission phases, request for proposal, problem definition, ideation, proposal preparation, conceptual design review, preliminary design development and review, and design report preparation. Produce written reports.

ASE 362K Compressible Flow 3 Hours
Shock and expansion waves, quasi-one-dimensional flow, converging-diverging nozzles, diffusers, linearized flow, and compressibility effects on aerodynamics of airfoils and bodies.

ASE 162M High-Speed Aerodynamics Laboratory 1 Hour
Experiments using a variable-Mach number supersonic wind tunnel and shock tube. Aerodynamics of wedges, cones, spheres and diamond-shaped airfoils in supersonic flow. One-dimensional unsteady shock motion. High-speed flow measurement techniques.

ASE 364 Applied Aerodynamics 3 Hours
Detailed analysis of aerodynamics of compressible and incompressible flows about wings and airfoils; wing and airfoil parameters and force and moment coefficients; and thin-airfoil theory, lifting-line theory, panel methods, high-lift devices, delta wings, transonic flows, and supersonic flows over wings.

ASE 365 Structural Dynamics 3 Hours
Analysis of discrete and continuous vibrating systems; deriving equations of motion; determining response; and natural frequencies and modes of vibration.

ASE 366K Spacecraft Dynamics 3 Hours
Examine Newton's gravity law, Kepler's laws, basic orbit propagation, orbit properties, orbital elements, coordinate systems and transformations, radar observations, ground tracks, orbit maneuvers, and trajectory design principles.

ASE 366L Applied Orbital Mechanics 3 Hours
Selected subjects in satellite motion and satellite applications, including communication and navigation satellites, orbit selection/design for satellite applications, orbital coordinate systems, time, major perturbing forces, rendezvous and intercept, and interplanetary trajectories.

ASE 166M Spacecraft Systems Laboratory 1 Hour
Overview of spacecraft subsystems, mission design program library, numerical techniques, mission planning references, mission constraints, and mission design projects. Includes written reports.

ASE 367K Flight Dynamics 3 Hours
Equations of motion for rigid aircraft; aircraft performance, weight and balance, static stability and control, and dynamic stability; design implications.

ASE 370C Feedback Control Systems 3 Hours
Fundamentals of linear control analysis and design for single-input, single-output systems; stability and performance measures; Routh Hurwitz analysis; root locus methods; frequency response (Bode and Nyquist); introduction to full-state feedback.

ASE 372K Attitude Dynamics 3 Hours
Examine attitude representations, rotational kinematics, rigid-body dynamics, and torque-free motion. Explore satellite's sensors and actuators, attitude determination algorithms, and passive and active attitude control systems.

ASE 372N Satellite-Based Navigation 3 Hours
Satellite-based navigation systems, with focus on the Global Positioning System (GPS), ground and space segments, receiver location estimation, astrodynamics, satellite signal coordinate/time systems, differential techniques, GPS data analysis.

ASE 374D Aerospace Systems Senior Design I 3 Hours
Introduction to systems engineering including the systems engineering process, requirements, design fundamentals, trade studies, cost and risk analyses, integration, technical reviews, case studies, and ethics.

ASE 374E Aerospace Systems Senior Design II 3 Hours
Examine aerospace systems characteristics, mission requirements, sensors, and consumables analyses; and mission phases, request for proposal, problem definition, ideation, proposal preparation, conceptual design review, preliminary design development and review, and design report preparation. Produce written reports.

ASE 374K Space Systems Engineering Design 3 Hours
Introduction to systems engineering: the systems engineering process, requirements, design fundamentals, trade studies, cost and risk analyses, integration, technical reviews, case studies, and ethics. Includes written reports.

ASE 374L Spacecraft/Mission Design 3 Hours
Examine aerospace systems characteristics, mission requirements, sensors, and consumables analyses; and mission phases, request for proposal, problem definition, ideation, proposal preparation, conceptual design review, preliminary design development and review, and design report preparation.

ASE 375 Electromechanical Systems 3 Hours
Subjects include basic electronic circuits, operational amplifiers, concepts of impedance and feedback, sensors to measure temperature, displacement, strain, force and acceleration, impulse testing, shake testing, and triggered data acquisition. These concepts will be implemented via experiments that illustrate interesting phenomena in solids and structures.

ASE 376C Rocket Engineering Practicum I 3 Hours
An introduction to rocket engineering. Explore a high-level overview of the principles, systems, and design methodologies required to design a vehicle capable of going to space. Participate in project-based work embedded within actual systems of the Texas Rocket Engineering Laboratory.

ASE 376D Rocket Engineering Practicum II 3 Hours
Explore the industry-relevant design and production environment encountered when working on a rocket subsystem in depth. Participate in project work embedded within systems of the Texas Rocket Engineering Laboratory.

ASE 376F Rocket Fluid System Design 3 Hours
Discuss analysis and design of rocket fluid systems, including component selection and design; sensors; propellant loading, usage, and measurement; tank pressurization. Examine control theory.

ASE 376G Rocket Guidance, Navigation, and Control 3 Hours
Explore rocket trajectory design, statistics, signal processing, and various control strategies. Discuss classic GNC design problems and in-depth control software projects.

ASE 376K Propulsion 3 Hours
Review of control volume analysis and quasi-one-dimensional compressible flow. Simple propeller theory. Analysis and design of rocket nozzles and air-breathing engines, including performance and cycle analysis; flow in nozzles, diffusers, compressor, and turbine stages; combustion chamber processes and propellants. Includes an introduction to chemical rocket propulsion.

ASE 679H Undergraduate Honors Thesis 6 Hours
Research performed during two consecutive semesters under the supervision of an engineering faculty member; topics are selected jointly by the student and the faculty member with approval by the director of the Engineering Honors Program. The student makes an oral presentation and writes a thesis.

ASE 179K, 279K, 379K Research in Aerospace Engineering 1-3 Hours
Directed study or research in a selected area of aerospace engineering.

ASE 379L Topics in Aerospace Engineering 3 Hours
Current topics in aerospace engineering.

ASE 379L.1 Selected Topics in Fluid Mechanics 3 Hours

ASE 379L.2 Selected Topics in Structural Mechanics 3 Hours

ASE 379L.3 Selected Topics in Flight Mechanics 3 Hours

ASE 379L.4 Selected Topics in Orbital Mechanics 3 Hours

ASE 379L.5 Rocket Science 3 Hours
Review rocket thrust equation and non-ideal nozzle analysis for quasi one-dimensional perfect gas flow. Discuss thermochemistry; chemical equilibrium; kinetics; liquid, solid, and hybrid chemical rocket systems; and electric rocket propulsion.

ASE 379L.6 Low Earth Orbit for Earth Observation 3 Hours
Explore orbital geometry, approximate representation, and design of orbits in the secularly precessing ellipse model. Examine the motion of satellites, the sun, the moon and the Earth. Discuss the view of space from the ground, the view of ground from space, and the design and utilization of constellations.

ASE 379L.9 Selected Topics in Controls 3 Hours

ASE 179S, 279S, 379S, 479S, 579S, 679S, 779S, 879S, 979S Topics in Aerospace Engineering 1-9 Hours
Used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office or the school's International Engineering Education Programs.

ASE 479W Aerial Robotics 4 Hours
Comprehensive introduction to robotic aircraft. Examine rotorcraft dynamics modeling, feedback control, sensing, state estimation, path planning, machine vision, and decision-making under uncertainty. Design an automation protocol, written in C++, that commands a squad of quadcopters competing in a game.

ASE 380P Topics in Mathematical Analysis for Aerospace Engineers 3 Hours

ASE 380P.1 Analytical Methods I 3 Hours
Introduction to modern mathematics, real analysis of functions of one variable, linear algebra, elements of real analysis of functions of many variables, calculus of variations.

ASE 380P.2 Analytical Methods II 3 Hours
Elements of complex analysis, Fourier and Laplace transforms, ordinary and partial differential equations, perturbation methods.

ASE 381P Topics in System Theory 3 Hours

ASE 381P.1 Linear Systems Analysis 3 Hours
Linear dynamical systems; controllability and observability; stability; realization theory; state-feedback and observers.

ASE 381P.10 Learning for Dynamics and Controls 3 Hours

ASE 381P.11 Nonlinear Dynamics and Control 3 Hours
Analysis and synthesis of nonlinear control systems. Stability theory, Center manifold analysis, feedback linearization, backstepping, time-scale separations, nonlinear observers, Aeromechanical system applications.

ASE 381P.14 System ID and Adaptive Control 3 Hours
System identification, persistence of excitation, model reference adaptive control, projection operators, immersion and invariance techniques, applications to aeromechanical systems.

ASE 381P.15 Formal Methods for Robotics 3 Hours

ASE 381P.16 Networked Control Systems 3 Hours

ASE 381P.17 Introduction to Optimization 3 Hours
Introduction to convex optimization (linear, quadratic, second order cone, and semi-definite programming). Review linear and matrix algebra, singular value decomposition, least squares optimization. Discuss engineering applications of optimization.

ASE 381P.18 Modeling Multi-Agent Systems 3 Hours
Introduction to the mathematics of dynamic game theory, and the use of self-driving vehicles as an ongoing case study. Discuss static games and complementarity programming, dynamic game theory, and game theory and multi-agent control.

ASE 381P.19 Architecting and Design of Autonomous Aerospace Systems 3 Hours
Introduction to the technical, operational, economic, market, environmental, regulatory, legal, manufacturing, and societal factors that must be considered; as well as the optimization problems and underlying mathematical solution approaches inherent to the architecting and design of systems with high levels of automation and autonomy. Discuss the framework and tools required to develop an appropriate architecture for a large, complex, multi-vehicle aerospace system.

ASE 381P.2 Multivariable Control Systems 3 Hours
Multivariable feedback systems; factorizations and controller parameterization; limitations and trade-offs of feedback; robust stability and performance; robust H2 and H-infinity control methods.

ASE 381P.3 Optimal Control Theory 3 Hours
Unconstrained and constrained finite-dimensional optimization, introduction to calculus of variations and optimal control, necessary and sufficient conditions for optimality, Pontryagin's Maximum Principle, minimum-time control, linear quadratic optimal control theory, introduction to dynamic programming, Hamilton-Jacobi-Bellman equation.

ASE 381P.4 Numerical Methods in Optimization 3 Hours
Numerical methods for solving parameter optimization, suboptimal control, and optimal control problems.

ASE 381P.6 Statistical Estimation Theory 3 Hours
Modeling static and dynamic systems, linear and nonlinear estimation, Bayesian estimation, batch least squares, Kalman filtering, square-root and information filtering, introduction to advanced estimation methods.

ASE 381P.7 Advanced Topics in Estimation Theory 3 Hours
Estimation in the presence of unmodeled accelerations; nonlinear estimators; continuous estimation methods.

ASE 381P.9 Human Centered Robotics 3 Hours

ASE 382Q Topics in Fluid Mechanics 3 Hours

ASE 382Q.1 Foundations of Fluid Mechanics 3 Hours
Fundamental equations; constitutive equations for Newtonian fluids; inviscid, incompressible potential flow; viscous flow including exact solutions and boundary layer theory; compressible flow.

ASE 382Q.10 Plasmas and Reactive Flows 3 Hours
Fundamental description of plasmas and reactive flows. Includes derivation of common governing transport equations for a broad class of electrically conducting and nonconducting reactive gases, and electromagnetic field interactions with gases, gas-phase and surface kinetics, transport properties, and applications.

ASE 382Q.11 Foundations of Computational Fluid Dynamics 3 Hours
Higher-order numerical methods for solving partial differential equations and ordinary differential equations. Focus on the numerical computation of fluid flows, with a variety of scientific applications.

ASE 382Q.12 Partially Ionized Plasmas and Gas Discharges 3 Hours

ASE 382Q.13 Viscous Fluid Flow 3 Hours
Discuss transport phenomena, conservation equations, Navier-Stokes equations, analytical solutions to Navier-Stokes equations, laminar and turbulent boundary layers, transition, and effects of pressure gradients, with a brief introduction to RANS, LES, DNS.

ASE 382Q.7 Advanced Problems in Compressible Flow 3 Hours
Physics and modeling of compressible fluids; types and structure of shock waves; heat conduction and secondary viscosity effects; exact nonlinear flow models.

ASE 382Q.8 Lagrangian Methods in Computational Fluid Dynamics 3 Hours
Particle-based methods of computational fluid dynamics: molecular dynamics, direct simulation Monte Carlo, cellular automata, lattice Boltzmann, particle in cell, point vortex, immersed boundary.

ASE 382Q.9 Turbulent Mixing 3 Hours
Fundamentals of turbulent scalar mixing relevant to turbulent combustion. Includes governing equations, mass diffusion, scalar transport, kinematics, chaotic advection, vortex dynamics, small-scale structure of vorticity and dissipative fields, scalar dissipation rate, scaling laws for canonical flows, heat release effects, and turbulent jet flame structure.

ASE 382R Topics in Aerodynamics 3 Hours

ASE 382R.3 Hypersonic Aerodynamics 3 Hours
Characteristics and assumptions of hypersonic flow; hypersonic similitude; Newtonian theory; constant density solutions.

ASE 382R.5 Advanced Computational Methods 3 Hours
Development and implementation of numerical methods for solution of transport equations; computational grid generation; applications to fluid flows, including shock waves.

ASE 382R.6 Molecular Gas Dynamics 3 Hours
Kinetic theory, chemical thermodynamics, statistical mechanics. Applications: equilibrium gas properties, chemical kinetics, interaction of matter with radiation, rarefied gas dynamics.

ASE 382R.7 Optical Diagnostics for Gas Flows 3 Hours
Fundamentals of nonintrusive flowfield diagnostics for aerodynamics and combustion. Basics of lasers and optical detectors; interferometric methods; Rayleigh, Raman, and Mie scattering; absorption spectroscopy; laser-induced fluorescence.

ASE 384P Topics in Structural and Solid Mechanics 3 Hours

ASE 384P.1 Solid Mechanics I 3 Hours
Mathematical description of stress, deformation, and constitutive equations of solid mechanics; boundary value problems of elasticity.

ASE 384P.11 Mechanics of Composite Materials 3 Hours
Constitutive equations; micromechanical and macromechanical behavior of lamina; strength and stiffness in tension and compression, theory of laminated plates; strength of laminates; delamination.

ASE 384P.13 Rotary Wing Aircraft 3 Hours
Discuss the aerodynamics of rotors; typical helicopter rotor hubs and their operation; rotor forces and aircraft trim; rotary-wing aircraft performance; and rotating blade dynamics.

ASE 384P.2 Solid Mechanics II 3 Hours
Continuation of Engineering Mechanics 388. Additional topics in elasticity, plasticity, viscoelasticity, variational methods, and other areas of solid mechanics.

ASE 384P.3 Structural Dynamics 3 Hours
Free and forced vibration of single-degree-of-freedom, multiple-degree-of-freedom, and continuous systems. Lagrange's equations and Hamilton's principle; discretization of continuous systems; numerical methods for response and algebraic eigenvalue problems.

ASE 384P.4 Finite Element Methods 3 Hours
Derivation and implementation of the finite element method; basic coding techniques; application to problems of stress and diffusion.

ASE 384P.6 Advanced Structural Dynamics 3 Hours
Analysis of complex flexible systems; discretization of complex structures by the finite element method; advanced computational methods for large finite element models.

ASE 384P.8 Selected Topics in Aeroelasticity 3 Hours
Classical and contemporary topics in aeroelasticity; general introduction to aeroelastic phenomena, including flutter, divergence, control reversal, and flexibility effects on stability and control; aeroelastic tailoring; active control concepts; unsteady aerodynamic theories for lifting surfaces and bodies; aeroelastic system identification, including nonlinear systems (theory and laboratory applications).

ASE 387P Topics in Flight Mechanics, Guidance, Navigation, and Control 3 Hours

ASE 387P.2 Mission Analysis and Design 3 Hours
Mission design and mission constraints, launch windows; rendezvous analysis; orbital design interactions with thermal and structural analysis; design of a typical mission.

ASE 387P.6 Optimal Spacecraft Trajectories 3 Hours
Optimal control of spacecraft; primer vector theory; impulsive maneuvers; finite burn high/low thrust maneuvers; solar sails; numerical methods; applications to contemporary trajectory problems using single or multiple spacecraft.

ASE 387P.7 Sensors and Actuators 3 Hours
Students use LabVIEW to study aerospace devices such as inertial navigation systems, control-moment gyroscopes, optical navigation systems, torque coils and magnetometers, robots, and integrated satellites.

ASE 387P.8 Aerial Robotics 3 Hours
Comprehensive introduction to robotic aircraft. Examine rotorcraft dynamics modeling, feedback control, sensing, state estimation, path planning, machine vision, and decision-making under uncertainty. Design an automation protocol, written in C++, that commands a squad of quadcopters competing in a game.

ASE 388P Topics in Celestial Mechanics 3 Hours

ASE 388P.2 Celestial Mechanics I 3 Hours
N-body problem; three-body problem; restricted three-body problem; Jacobian integral; zero-velocity curves; equilibrium points; stability; linearized solutions; variational equations; periodic orbits; the two-body problem; variation of parameters; Lagrange's planetary equations; applications to near-earth and deep-space trajectories; numerical methods.

ASE 388P.3 Celestial Mechanics II 3 Hours
Hamiltonian mechanics; dynamical systems; canonical transformations; invariant manifolds; Poincare surfaces of section; applications to restricted n-body problems; applications to sun-earth-moon or sun-planet-moon particle trajectory problems.

ASE 189, 289, 389, 489, 589, 689 Topics in Aerospace Engineering 1-6 Hours

ASE 389P Topics in Satellite Applications 3 Hours

ASE 389P.1 Determination of Time 3 Hours
Concepts of time; fundamental reference system; polar motion; practical methods in time determination and dissemination; historical and present-day time scales; atomic clocks; time transfer via satellite.

ASE 389P.10 Fundamentals and Geophysical Application of Imaging Radar Systems 3 Hours
Exploration of how radar images are formed and manipulated, as well as applications of the systems to problems such as measurement of the Earth crustal deformation. Focus on radar as a signal processing problem, radar image formation, polarimetric radars, and radar interferometry. Subjects include system design, scattering from natural surfaces, range and azimuth processing algorithms, and processor design.

ASE 389P.11 Advanced Satellite Geodesy 3 Hours
Examine kinematics and dynamics of displacement and Earth orientation. Investigate the determination of time and reference frames. Explore deformations of the Earth due to tides and mass loading. Study modern space geodetic applications.

ASE 389P.12 Orbital Debris 3 Hours
Discuss the orbital debris environment, space situational awareness, and space traffic management. Explore orbit determination, multiple-target tracking, uncertainty propagation, risk assessment, and evolution of the existing debris field.

ASE 389P.13 3D Remote Sensing Analytics and Applications 3 Hours

ASE 389P.14 Low Earth Orbit for Earth Observation 3 Hours
Explore orbital geometry, approximate representation, and design of orbits in the secularly precessing ellipse model. Examine the motion of satellites, the sun, the moon and the Earth. Discuss the view of space from the ground, the view of ground from space, and the design and utilization of constellations.

ASE 389P.15 Satellite System Signal Processing 3 Hours
Discuss fundamental theory and algorithms related to acquiring and processing radio signals from constellations of satellites for navigation and communication. Examine software-defined radio fundamentals, carrier and code tracking loops, and the effects of the space-to-earth communications channel.

ASE 389P.16 Computational Methods 3 Hours
Examine basics of vectors and matrices, linear equations, regression and classification, similarity measures, the Discrete Fourier Transform (DFT), linear filters, and power spectrum estimates. Focus on applying matrix methods to practical applications, such as tomography, image processing, data fitting, time series prediction, optimal control, finance, and machine learning. Utilize MATLAB or Python to do computations with vectors and matrices and run numerical experiments with real-world data sets.

ASE 389P.2 Satellite Geodesy 3 Hours
Explore theory of the gravitational potential, including its time-variations; spherical harmonics and other representations; space-based remote sensing of the geopotential and its gradients; mass flux variability and its applications.

ASE 389P.4 Methods in Orbit Determination 3 Hours
Variational methods of the orbit determination, Orbit parameter estimation, satellite tracking techniques and observables, modern precision orbit determination.

ASE 389P.8 Satellite Control Systems 3 Hours
Spacecraft equations of motion; linearization and stability, classical control methods; digital and sampled data systems; multivariable control; attitude determination and control; momentum management; coupled modes; and case studies in satellite control.

ASE 389P.9 Synthetic Aperture Radar: Principles and Applications 3 Hours
Synthetic Aperture Radar (SAR) imaging for Earth remote sensing, including image formation concepts and interpretation, radar interferometry processing and strategies, surface deformation, topographic mapping, and polarimetric applications.

ASE 397 Graduate Seminar 3 Hours
Student, faculty, and visitor presentations of current research topics.

ASE 197R, 297R, 397R, 497R, 597R, 697R, 797R, 897R, 997R Research in Aerospace Engineering 1-9 Hours

ASE 698 Thesis 6 Hours

ASE 398R Master's Report 3 Hours
Preparation of a report to fulfill the requirement for the master's degree under the report option.

ASE 398T Supervised Teaching in Aerospace Engineering 3 Hours
Teaching methods and objectives, criteria for evaluating teaching effectiveness, procedural rules and regulations, laboratory teaching.

ASE 399W, 699W, 999W Dissertation 3,6,9 Hours