Aerospace Engineering (AE)

Courses numbered 100 to 299 = lower-division; 300 to 499 = upper-division; 500 to 799 = undergraduate/graduate.

AE 223. Statics 3 credit hours
Studies the condition of equilibrium of rigid bodies under the action of forces. Rigid bodies include beams, trusses, frames and machines. Considers both two- and three-dimensional bodies. Also studies centroids, centers of gravity and moments of inertia. Prerequisite: PHYS 313. Corequisite: MATH 243.

AE 227. Engineering Digital Computation 3 credit hours
2 Classroom hours; 2 Lab hours. MATLAB and Visual-Basic programming; introduction to linear algebra and matrix methods for engineers, selected numerical methods for approximating functions, solution of systems of equations, numerical integration, and numerical determination of the roots of polynomials. Corequisite: MATH 243.

AE 281I. Noncredit Internship 0 credit hours
Complements and enhances the student's academic program by providing an opportunity to apply and acquire knowledge in a workplace environment as an intern. Prerequisite: departmental consent.

AE 324. Fundamentals of Atmospheric Flight 3 credit hours
Studies the atmosphere, aircraft and aerodynamic nomenclature. Introduction to aerodynamic theory, airfoils, wings, aircraft performance, stability and control, and propulsion. Prerequisite: AE 223 (no grade lower than one that generates 2.000 or more credit points per credit hour will be accepted for this course). Corequisite: AE 227.

AE 333. Mechanics of Materials 3 credit hours
Studies the mechanical properties of materials, transformation of stresses and strains, stresses and deformations in structural elements of various shapes and loading, statically indeterminate structures, and buckling. Prerequisite: AE 223 (no grade lower than one that generates 2.000 or more credit points per credit hour will be accepted for this course). Corequisite: MATH 344.

AE 373. Dynamics 3 credit hours
A study of the kinematics and kinetics of particles and rigid bodies. Includes force-mass-acceleration, work-energy and impulse-momentum methods. Prerequisites: AE 223 (no grade lower than one that generates 2.000 or more credit points per credit hour will be accepted for this course), and MATH 344.

AE 415. Introduction to Space Dynamics 3 credit hours
Fundamentals of orbital mechanics and rigid body dynamics, two-body problems, orbital maneuvers and orbital determination, rigid body kinematics, and kinetics. Prerequisites: AE 227 and AE 373 (no grade lower than one that generates 2.000 or more credit points per credit hour will be accepted for AE 373). Corequisite: MATH 555.

AE 424. Aerodynamics I 3 credit hours
Studies the dynamics of incompressible potential flow, governing equations of motion in control volume form and differential form, rotation and vorticity, stream function and velocity potential, singularities and superposition, introduction to panel methods, various two-dimensional airfoil theories, finite wing theory, flow over axisymmetric bodies, application tools for aerodynamic design and analysis. Prerequisites: MATH 555, AE 324 (no grade lower than one that generates 2.000 or more credit points per credit hour will be accepted for these courses), and AE 373.

AE 460. Selected Topics 1-3 credit hours
New or special topics presented on sufficient demand. Repeatable for credit when subject material warrants. Prerequisite: instructor's consent.

AE 460A. Aerospace Colloquium 0 credit hours
A zero credit hour course specifically for freshmen aerospace engineering students. Includes faculty and industry engineer seminars and activities that promote academic success, hands-on aerospace relevant experiences, and career achievement. Prerequisite: freshman standing.

AE 460H. Selected Topics in Design - Honors 3 credit hours
An experiential based aerospace design course for honors students. Includes an introduction to basic Unmanned Air Vehicle (UAV) design methods, construction, and testing. The course meets concurrently with and includes interactions with seniors enrolled in the AE 528 aerospace design class. Includes design, construction and testing of a small UAV. Prerequisites: admitted to honors program, sophomore or junior standing, aerospace engineering major.

AE 481A. Cooperative Education 1 credit hour
Introduces the student to engineering practice by working in industry in an engineering-related job and provides a planned professional experience designed to complement and enhance the student's academic program. Individualized programs must be formulated in consultation with, and approved by, appropriate faculty sponsors and cooperative education coordinators. Intended for students who will be working full time on their co-op assignment and need not be enrolled in any other course. Graded Cr/NCr unless student has received permission before enrolling for course to be used as a technical elective. May be repeated. Prerequisites: junior standing and approval by the appropriate faculty sponsor.

AE 481I. Noncredit Internship 0 credit hours
Complements and enhances the student's academic program by providing an opportunity to apply and acquire knowledge in a workplace environment as an intern. Prerequisite: departmental consent.

AE 481N. Internship 1 credit hour
Complements and enhances the student's academic program by providing an opportunity to apply and acquire knowledge in a workplace environment as an intern. Graded Cr/NCr. Prerequisite: departmental consent.

AE 481P. Cooperative Education 1 credit hour
Introduces the student to engineering practice by working in industry in an engineering-related job and provides a planned professional experience designed to complement and enhance the student's academic program. Individualized programs must be formulated in consultation with, and approved by, appropriate faculty sponsors and cooperative education coordinators. Students must enroll concurrently in a minimum of 6 hours of coursework including this course in addition to a minimum of 20 hours per week at their co-op assignment. Graded Cr/NCr unless student has received permission before enrolling for course to be used as a technical elective. May be repeated. Prerequisites: junior standing and approval by the appropriate faculty sponsor.

AE 502. Aerospace Propulsion I 3 credit hours

AE 512. Experimental Methods in Aerospace 3 credit hours
A study of experimental methods and test planning, error analysis and propagation, model design, instrumentation and flow visualization. Uses electromechanical testing machines, subsonic and supersonic wind tunnels. Prerequisites: AE 333, 424.
AE 514. Flight Dynamics and Control  3 credit hours

AE 524. Aerodynamics II  3 credit hours
Continues the discussion of potential flow from AE 424. Introduces energy equation, fundamental concepts of high speed flow, normal and oblique shock waves, Prandtl-Meyer flow, nozzles and diffusers, linearized high speed potential flow, airfoils and wings in subsonic and supersonic flow, Navier-Stokes equation, boundary layer flow, momentum integral approximation and various laminar and turbulent flow solutions, introduction to convective heat transfer. Prerequisite: AE 424.

AE 525. Flight Structures I  3 credit hours
2 Classroom hours; 2 Lab hours. Stress analysis of flight vehicle components. Prerequisite: AE 333 (no grade lower than one that generates 2.000 or more credit points per credit hour will be accepted for this course). Corequisite: MATH 555.

AE 527. Numerical Methods in Engineering  3 credit hours

AE 528. Aerospace Design I  4 credit hours
2 Classroom hours; 4 Lab hours. Methodology of flight vehicle design; mission objectives, regulations and standards; use of hand and computer methods for configuration development and component sizing, ethics, and liability in design. Prerequisites: AE 502, 514, 525.

AE 607. Flight Control Systems  3 credit hours
Classical design methods for stability and control augmentation and guidance systems specifically for aerospace vehicles, including block diagrams, root locus and frequency response. Sensors used in aerospace systems. Flying qualities and performance specifications for closed loop systems. Includes a review of the aircraft and spacecraft dynamic model derivation. Prerequisite: AE 514.

AE 625. Flight Structures II  3 credit hours
2 Classroom hours; 3 Lab hours. Strength analysis and design of flight vehicle components. Introduction to energy methods and variational principles. Application of finite element method to the analysis of flight vehicle structures. Special projects in structural analysis and design. Prerequisites: AE 333, 525.

AE 628. Aerospace Design II  4 credit hours
2 Classroom hours; 4 Lab hours. Preliminary design of flight vehicles, design iteration, sensitivity studies, optimization, economic considerations and introduction to project management. Prerequisite: AE 528.

AE 660. Selected Topics  1-3 credit hours
New or special topics presented on sufficient demand. Repeatable for credit when subject material warrants. Prerequisite: instructor's consent.

AE 690. Independent Study  1-3 credit hours
Arranged individual independent study in specialized areas of aerospace engineering under the supervision of a faculty member. Repeatable for credit. Prerequisite: consent of supervising faculty member.

AE 702. Aerospace Propulsion II  3 credit hours
In-depth study of rocket and jet propulsion. Turbojet and rocket engine components. Effect of operating variables on turbojet cycles and rocket performance. Prerequisite: AE 502 or instructor's consent.

AE 703. Rotor Aerodynamics  3 credit hours
Aerodynamics of rotors, including propellers, wind turbines and helicopters; momentum, blade element and potential flow analysis methods; helicopter dynamics, control and performance. Prerequisite: AE 424.

AE 707. Modern Flight Control System Design I  3 credit hours
Modern multi-loop design methods for stability and control augmentation and guidance systems, specifically for aerospace vehicles. State variable model. Optimal state feedback gains and Riccati's equation, tracking systems, sensors and actuator, discretization of continuous dynamic systems, optimal design for digital controls, and effect of nonlinearities and trim conditions on design considerations. Prerequisites: AE 514 or 714, and AE 607 or EE 684 or ME 521.

AE 711. Intermediate Aerodynamics  3 credit hours
Studies potential flow equations of motion, singularity solutions, principle of superposition, conformal mapping, thin airfoil theory, finite wing theory, effects of fluid inertia, three-dimensional singularities, swept wing theory, delta wing theory, introduction to panel methods and an introduction to automobile aerodynamics. Prerequisite: AE 424 or ME 521.

AE 712. Advanced Aerodynamics Laboratory  3 credit hours
2 Classroom hours; 2 Lab hours. Advanced topics in wind tunnel testing, including analysis and sensitivity, modeling techniques, flexible design and calibration, control surface loads and moments, laser velocimetry, hot film anemometry, dynamic signal processing, flow measurement probes, flow visualization using smoke tunnels and water tunnel. Prerequisite: AE 512 or instructor's consent.

AE 714. Advanced Flight Dynamics I  3 credit hours
Review of the equations of motion for aircraft. Nonlinear effects and aircraft response. Stability and control of elastic aircraft. Response to turbulence. Prerequisite: AE 514 or instructor's consent.

AE 715. Intermediate Space Dynamics  3 credit hours
Advanced topics in orbital mechanics-vector mechanics perspective of the two-body problem; fast transfers; interplanetary missions including gravity assist maneuver and intercept problem; atmospheric entry. Prerequisite: AE 415 or instructor's consent.

AE 716. Compressible Fluid Flow  3 credit hours
Analysis of compressible fluid flow for one- and two-dimensional cases, moving shock waves, one-dimensional flow with friction and heat addition, linearized potential equation, method of characteristics, conical shocks and subsonic similarity laws. Prerequisites: AE 424, ME 521 or equivalent.

AE 719. Introduction to Computational Fluid Dynamics  3 credit hours
Classification of partial differential equations, numerical solution of parabolic, elliptic and hyperbolic differential equations, stability analysis, boundary conditions, scalar representation of the Navier-Stokes equations, incompressible Navier-Stokes equations. Prerequisite: AE 424 or ME 521.

AE 722. Finite Element Analysis of Structures I  3 credit hours
Advanced treatment of the theoretical concepts and principles necessary for the application of the finite element method in the solution of differential equations in engineering. Prerequisites: AE 333, 625 or equivalent, or instructor's consent.
AE 731. Theory of Elasticity  3 credit hours
Develops the equations of the theory of elasticity and uses them to
determine stress and displacement fields in linear elastic isotropic
bodies; uses Airy stress functions to obtain solutions, and introduces
energy principles and variational methods. Prerequisite: instructor's
consent.

AE 733. Advanced Mechanics of Materials  3 credit hours
An extension of AE 333. Includes transformation of stress and strain in
two dimensions, noncircular torsional members, curved beams, beams
with unsymmetric cross sections, energy methods and the finite element
method of analysis, stress concentration, theories of failure and fracture
mechanics. Prerequisite: AE 333.

AE 737. Mechanics of Damage Tolerance  3 credit hours
An introduction to the mechanics of damage tolerance emphasizing
stress analysis oriented fracture mechanics. Includes stress intensity,
fracture toughness, residual strength, fatigue crack growth rate, fatigue
crack propagation and damage tolerance concepts. Prerequisite: AE 525
or instructor's consent.

AE 753. Mechanics of Laminated Composites  3 credit hours
A descriptive classification of advanced composite materials and
their constituents; mechanics of lamina and laminates, testing for
material properties, lamina and laminate failure criteria, laminate strain
allowables, structural analysis (beams and axially loaded members),
design guidelines, introduction to manufacturing methods, repair and
nondestructive testing. Prerequisites: AE 333, senior standing.

AE 759. Neural Networks for System Modeling and Control  3
credit hours
Introduces specific neural network architectures used for dynamic
system modeling and intelligent control. Includes theory of feed-
forward, recurrent, and Hopfield networks; applications in robotics,
aircraft and vehicle guidance, chemical processes and optimal control.
Prerequisite: AE 607 or ME 659 or EE 684 or instructor's consent.

AE 760. Selected Topics  1-3 credit hours
Prerequisite: instructor's consent.

AE 760AA. Micromechanics and Multi-Scale Modeling  3 credit
hours
Many materials and structures consist of multiple phases.
Micromechanics models can be used to homogenize a structure at
some appropriate scale for more practical modeling. Course covers the
classical mean-field homogenization models. Explores several state-of-
the-art numerical techniques used in micromechanics modeling, such
as the method of cells, variational methods and Fourier transforms in
addition to finite element techniques for periodicity.

AE 770BA. Badge: Composite Manufacturing Technology Safety
Awareness - I  0.5 credit hours
Students are provided with composite materials technologies
basic knowledge, an overview of different forms of composites
manufacturing, various factory workflows, and the associated
regulatory guidance documents. Repeatable for credit. Graded Bg/NBg.
Prerequisite: none.

AE 770BB. Badge: Composite Manufacturing Technology Safety
Awareness - II  0.5 credit hours
Educates students on the issues related to raw material manufacturing,
its transport, incoming quality control and storage of composite
materials. The preparation of tooling, cutting of composite preforms,
layup and bagging of composite parts, and curing are discussed in
detail. The use of procurement specifications and process control
documents are emphasized. Repeatable for credit. Graded Bg/NBg.
Prerequisite: AE 770BA.