Aerospace Engineering (AE)

COURSES

AE 5101. GRADUATE SEMINAR. 1 Hour.
The purpose is to acquaint graduate students with ongoing research at UTA, and outside in academia and industry. Seminars are given by graduate students of the department based on their ongoing research. Seminars are also given by external speakers from academia, industry and government.

AE 5191. ADVANCED STUDIES IN AEROSPACE ENGINEERING. 1 Hour.
Individual research or design project performed for fulfilling the requirements of the Master of Engineering degree option. Prior approval of the AE Graduate Advisor is required for enrollment. A written and/or oral report is required.

AE 5197. RESEARCH IN AEROSPACE ENGINEERING. 1 Hour.
Research in masters programs.

AE 5291. ADVANCED STUDIES IN AEROSPACE ENGINEERING. 2 Hours.
Individual research or design project performed for fulfilling the requirements of the Master of Engineering degree option. Prior approval of the AE Graduate Advisor is required for enrollment. A written and/or oral report is required.

AE 5297. RESEARCH IN AEROSPACE ENGINEERING. 2 Hours.
Research in masters programs.

AE 5300. PREPARATORY COURSE FOR AEROSPACE ENGINEERING. 3 Hours.
The course may be offered with multiple sections, wherein each section is paired with a corresponding UG course being offered that semester. The purpose of this course is to strengthen academic preparation of students who were found inadequately prepared for a graduate degree in Aerospace Engineering. Students can concurrently enroll in multiple sections and may need to enroll in this course multiple times until their academic preparation is deemed complete. In order to pass this class, the student has to earn at least a B grade in aggregate based on all the assignments and exams. The student will earn an R grade if the class aggregate is a C/D and will need to repeat the course until the student passes the class. The student will Fail the class if the aggregate is an F. The course may be repeated as often as required.

AE 5301. ADVANCED TOPICS IN AEROSPACE ENGINEERING. 3 Hours.
To provide formal instruction in special topics pertinent to Aerospace Engineering from semester to semester depending on the availability of faculty. May be repeated for credit as provided topics change.

AE 5302. ADVANCED FLIGHT MECHANICS. 3 Hours.
Rigid body motion. Kinematics and dynamics of aerospace vehicles. Linear and nonlinear control of aircraft and spacecraft. Advanced aircraft and spacecraft modeling and control issues. Prerequisite: MAE 3405 and MAE 4310.

AE 5303. CLASSICAL METHODS OF CONTROL SYSTEMS ANALYSIS AND SYNTHESIS. 3 Hours.
Equip the student with familiarity of significant tools of the control engineer. Topics covered include controllers and their effect on system performance and stability, block diagram algebra, stability and analysis, system performance definition, root locus, frequency techniques, and state variable methods. Digital simulation tools for design and simulation of control systems. Demonstration of controller design and performance in the laboratory. Also offered as ME 5303.

AE 5304. ADVANCED MECHANICS OF MATERIALS. 3 Hours.
This graduate level course will cover the calculation of stresses and strains in a body that experiences elastic, plastic and/or viscoelastic deformation. This course will also highlight nanoelasticity to show the size-dependent structure-property relations of nanomaterials and piezoelectricity to demonstrate the voltage-displacement relations of piezoelectric materials. Offered as AE 5304 and ME 5304. Credit will be granted only once. Prerequisite: MAE 2312 or equivalent.

AE 5305. DYNAMIC SYSTEMS MODELING. 3 Hours.
To equip the student with the capability of determining the necessary equations for distributed and lumped parameter modeling of mixed physical system types including mechanical, fluid, electrical, and thermal components. Models are formulated for computer simulation and analysis for systems with deterministic and stochastic inputs. Topics of random vibration and system identification are included. Offered as AE 5305 and ME 5305. Credit will be granted only once.

AE 5310. FINITE ELEMENT METHODS. 3 Hours.
Finite element method in the study of the static response of complex structures and of continua applications to field problems; analytical methods emphasized and digital computer application undertaken. Offered as AE 5310 and ME 5310. Credit will be granted only once.

AE 5311. STRUCTURAL DYNAMICS. 3 Hours.
Natural frequencies; forced response of complex structural systems studied through the use of the finite element method; computational aspects of these problems discussed, and digital computer applications undertaken. Offered as AE 5311 and ME 5311. Credit will be granted only once.

AE 5312. CONTINUUM MECHANICS. 3 Hours.
Study of the underlying physical and mathematical principles relating to the behavior of continuous media; interrelationships between fluid and solid mechanics. Offered as AE 5312 and ME 5312. Credit will be granted only once.

AE 5313. FLUID DYNAMICS. 3 Hours.
Basic conservation laws, flow kinematics, special forms of the governing equations, two-dimensional potential flows, surface waves and some exact solutions of viscous incompressible flows. Offered as AE 5313 and ME 5313. Credit will be granted only once.

AE 5314. FRACTURE MECHANICS IN STRUCTURAL DESIGN. 3 Hours.
Linear elastic fracture mechanics, general yielding fracture mechanics, damage tolerance and durability design, fail safe and safe life design criteria, analysis of fatigue crack growth, residual strength analysis. Offered as AE 5314 and ME 5314. Credit will be granted only once.

AE 5315. FUNDAMENTALS OF COMPOSITES. 3 Hours.
Fundamental relationships between the mechanical and hygrothermal behavior and the composition of multiphase media; failure criteria. Offered as AE 5315 and ME 5315. Credit will be granted only once.

AE 5320. DESIGN OPTIMIZATION. 3 Hours.
The purpose of this course is to present modern concepts of optimal design of structures. Basic ideas from optimization theory are developed with simple design examples. Analytical and numerical methods are developed and their applications discussed. Use of numerical simulation methods in the design process is described. Concepts of structural design sensitivity analysis and approximation methods will be discussed. The emphasis is made on the application of modern optimization techniques linked to the numerical methods of structural analysis, particularly, the finite element method. Prerequisite: AE 5310 or ME 5310.

AE 5322. AEROELASTICITY. 3 Hours.
A fundamental course addressing phenomena related to the time-independent interactions between structural flexibility and aerodynamic loads as relevant to flying vehicles. Emphasis is placed upon the development and use of simple analytical and/or interactive computational models that capture the essential aspects of the static aeroelastic phenomena investigated and provide insight into the response, including i) aeroelastic divergence; ii) aeroelastic change in control effectiveness; iii) aeroelastic distribution of lift; and iv) aeroelastic change in longitudinal static stability.

AE 5323. ENGINEERING RESEARCH METHODS. 3 Hours.
This hands-on course will teach the tools that are essential for conducting graduate research, with an aim to prepare the students for project-based graduate research. The course will be focused on the integration of engineering concepts to complete course projects that imitate mini research projects. Prerequisite: Undergraduate education in engineering or science.

AE 5325. COMBUSTION. 3 Hours.
Fundamental treatment of problems involving simultaneous occurrence of chemical reaction and transfer of heat, mass and momentum. Topics include kinetically controlled combustion phenomena; diffusion flames in liquid fuel combustion; combustion of solids; combustion of gaseous fuel jets; flames in premixed gasses. Offered as AE 5325 and ME 5325. Credit will be granted only once.

AE 5326. AIR-BREATHING PROPULSION. 3 Hours.
Development of thrust and efficiency equations, thermodynamic cycle analysis, cycle design methods of aerospace propulsion systems, component performance analysis methods, component matching and dynamic interactions, and vehicle/propulsion-system integration.

AE 5327. COMPUTATIONAL AERODYNAMICS I. 3 Hours.
Solution of engineering problems by finite-difference methods, emphasis on aerodynamic problems characterized by single linear and non-linear equations, introduction to and application of major algorithms used in solving aerodynamics problems by computational methods.

AE 5328. COMPUTATIONAL AERODYNAMICS II. 3 Hours.
Review of the fundamental equations of aerodynamics, development of methods for solving Euler, boundary-layer, Navier-Stokes, and parabolized Navier-Stokes equations, application to practical aerodynamic analysis and design problems.

AE 5329. ADDITIVE MANUFACTURING. 3 Hours.
The range of technologies and processes, both physical and digital, used to translate virtual solid model data into physical models using additive layering methods. Emphasis is given to application of these technologies to manufacture end use components and assemblies but rapid prototyping is also discussed. Metal, polymer, ceramic, and composite material applications of additive manufacturing are included. Discussion includes advantages and limitations of additive methods with respect to subtractive methods and to each other. Principles of design for additive manufacturing are covered along with discussion of applications. Students complete a project to design and build an engineering component or assembly for additive manufacturing. Offered as AE 5329 and ME 5329. Credit will be granted only once. Prerequisite: Graduate standing.

AE 5331. ANALYTIC METHODS IN ENGINEERING. 3 Hours.
Introduction to advanced analytic methods in engineering. Methods include multivariable calculus and field theory, Fourier series, Fourier and Laplace Transforms. Offered as AE 5331 and ME 5331. Credit will be granted only once. Prerequisite: Undergraduate degree in engineering, physics, or mathematics.

AE 5332. ENGINEERING ANALYSIS. 3 Hours.
Introduction to partial differential equations and complex variable theory with application to modeling of physical systems. Offered as AE 5332 and ME 5332. Credit will be granted only once.

AE 5333. THERMAL PHENOMENA IN MICROSYSTEMS. 3 Hours.
Introduction to experimental methods for microscale thermal transport, including experimental measurement techniques, design of experiments, data acquisition and analysis tools. Significant emphasis on carrying out mini-projects on related topics. Course learning outcomes are directly relevant for engineering jobs in semiconductors, energy conversion and other related industries. Offered as AE 5333 and ME 5333. Credit will be granted only once.

AE 5335. OPTIMAL CONTROL OF DYNAMIC SYS. 3 Hours.
Linear and nonlinear optimization methods; optimal control; continuous time Ricatti equation; bang-bang control; singular arcs; differential inclusions; collocation techniques; design of optimal dynamic system trajectories. Offered as AE 5335 and ME 5335. Credit will be granted only once.

AE 5336. OPTIMAL ESTIMATION OF DYNAMIC SYSTEMS. 3 Hours.
Kalman filter design and implementation. Optimal filtering for discrete-time and continuous-time dynamical systems with noise. Wiener filtering. State-space determination. Offered as EE 6327, AE 5336 and ME 5336. Credit will be granted only once. Prerequisite: Prior introductory systems or identification course is desirable.

AE 5337. INTRODUCTION TO ROBOTICS. 3 Hours.
An overview of industrial robots and their application to traditional and emerging applications. Coordinate systems and homogeneous transformations, kinematics of manipulators; motion characteristics and trajectories; dynamics and control of manipulators; actuation and design issues. Programming of industrial robotic manipulators in the laboratory. Offered as AE 5337 and ME 5337. Credit will be granted only once.

AE 5338. ANALYTICAL & COMPUTATIONAL DYNAMICS. 3 Hours.
The course focuses on developing the equations of motion for dynamic systems composed of multiple, connected and unconnected, rigid bodies using Kane's method and the Lagrangian approach. The resulting model is used to simulate and visualize the predicted motion. Topics include kinematics, Euler parameters, kinematic constraints, virtual work, the calculus of variations, energy, momentum, contact, impact, and checking functions. Offered as AE 5338 and ME 5338. Credit will be granted only once.

AE 5339. STRUCTURAL ASPECTS OF DESIGN. 3 Hours.
This fundamental mechanics course covers the concepts of deriving stress formulas from deformation and the stress-strain relationship, stress and failure analysis, 2D elasticity, energy methods, and elastic stability. Offered as AE 5339 and ME 5339. Credit will be granted only once.

AE 5341. CONTROL SYSTEM COMPONENTS. 3 Hours.
The components and hardware used in electronic, hydraulic, and pneumatic control systems; techniques of amplification, computation, compensation, actuation, and sensing; modeling of multiport systems as well as servo systems analysis. Pulse modulated systems. Offered as AE 5341 and ME 5341. Credit will be granted only once. Prerequisite: Undergraduate introductory control course in Mechanical Engineering or equivalent or ME 5303 or equivalent.

AE 5342. GAS DYNAMICS. 3 Hours.
Review of fundamental compressible flow theory, method of characteristics for perfect gases, the Rankine-Hugoniot conditions, linearized flow theory. Offered as AE 5342 and ME 5342. Credit will be granted only once.

AE 5345. NUMERICAL HEAT TRANSFER AND FLUID FLOW. 3 Hours.
Introduction to numerical solutions for problems in heat transfer and fluid flow by the finite-volume method. The focus will be on numerical aspects pertaining to incompressible fluids. It provides the background training towards the use of commercial software. Offered as AE 5345 and ME 5345. Credit will be granted only once.

AE 5347. ROCKET PROPULSION. 3 Hours.
Thrust and efficiency relations, trajectory analysis, introduction to design and performance analysis of chemical (liquid and solid), electrical and nuclear rocket systems, combined cycle propulsion systems, and pulse detonation rockets.

AE 5348. HYPERSONIC PROPULSION. 3 Hours.
Design and performance analysis of propulsion systems for sustained flight at hypersonic speeds, airframe/propulsion system integration, supersonic combustion, finite-rate chemistry effects, radiative cooling.

AE 5350. CLASSICAL AERODYNAMICS. 3 Hours.
To present a classical treatment of incompressible and compressible aerodynamics. Kinematics of fluid flow. Potential flow theory applied to non-lifting and lifting wings and bodies. Subsonic and supersonic wings and bodies. Familiarity with advanced engineering mathematics is recommended.

AE 5362. GUIDANCE, NAVIGATION, AND CONTROL OF AEROSPACE VEHICLES. 3 Hours.
Basics of flight dynamics and control. Autopilot structures for aerospace vehicles (aircraft, missiles, launch vehicles). Equilibrium glide trajectories for atmospheric flight. Discussion of the various guidance algorithms used in aircraft/missiles/launch vehicles. Basics of Kalman filtering, sensor and data fusion. Selection and trade-off between various navigation components such as the IMU, GPS and other navigation components. Integration of the guidance, navigation and control components in aerospace vehicles.

AE 5363. INTRODUCTION TO ROTORCRAFT ANALYSIS. 3 Hours.
History of rotorcraft. Behavior of the rotor blade in hover and forward flight. Rotor configurations, dynamic coupling with the fuselage, elastic and aeroelastic effects. Offered as AE 5363 and ME 5363. Credit will be granted only once.

AE 5364. INTRODUCTION TO AERODYNAMICS OF ROTORCRAFT. 3 Hours.
Practical aerodynamics of rotors and other components of rotorcraft. Introduction to performance, handling qualities, and general flight mechanics related to rotorcraft design, test, and certification requirements. Emphasis is on real rotorcraft mission capabilities as defined by the customer. Offered as AE 5364 and ME 5364. Credit will be granted only once.

AE 5365. INTRODUCTION TO HELICOPTER AND TILTROTOR SIMULATION. 3 Hours.
Dynamic and aerodynamic modeling of rotorcraft elements using vector mechanics, linear algebra, calculus and numerical methods. Special emphasis on rotors, aerodynamic interference, proper axis system representation, model assembly methods and trimming. Offered as AE 5365 and ME 5365. Credit will be granted only once.

AE 5367. HIGH-SPEED AIRCRAFT AND SPACE ACCESS VEHICLE DESIGN. 3 Hours.
An introductory course on high-speed aircraft and space access vehicle design. The course concentrates on reusable flight vehicles. Topics covered are historical case studies, design disciplines, design space visualization and proof of design convergence. Prerequisite: consent of the instructor.

AE 5368. FLIGHT VEHICLE SYNTHESIS AND SYSTEMS ENGINEERING. 3 Hours.
An introductory course on multi-disciplinary design decision-making applied to flight vehicle design. The course introduces decision-making techniques leading to efficient aerospace product design. The following main topics are covered: a) management domain, b) operational domain, c) engineering domain. Prerequisite: MAE 4350, MAE 4351 or equivalent.

AE 5372. PARAMETRIC SIZING OF HIGH-SPEED AIRCRAFT. 3 Hours.
An introductory course on high-speed aircraft design. Aimed to develop insight into basic concepts underlying the analysis and design of supersonic and hypersonic aircraft. Topics covered are historical case studies, design disciplines, and design methodologies. Prerequisite: MAE 4350, MAE 4351 or equivalent.

AE 5374. NONLINEAR SYSTEMS ANALYSIS AND CONTROLS. 3 Hours.
Nonlinear systems; phase plane analysis; Poincare-Bendixon theorems; nonlinear system stability; limit cycles and oscillations; center manifold theorem, Lyapunov methods in control; variable structure control; feedback linearization; backstepping techniques. Offered as AE 5374 and ME 5374. Credit will be granted only once.

AE 5378. INTRODUCTION TO UNMANNED VEHICLE SYSTEMS. 3 Hours.
Introduction to UVS (Unmanned Vehicle Systems) such as UAS (Unmanned Aircraft Systems), UGS (Unmanned Ground System) and UMS (Unmanned Maritime System), their history, missions, capabilities, types, configurations, subsystems, and the disciplines needed for UVS development and operation. UVS missions could include student competitions sponsored by various technical organizations. This course is team-taught by engineering faculty. Offered as AE 5378 and ME 5378. Credit will be granted only once.

AE 5379. UNMANNED VEHICLE SYSTEM DEVELOPMENT. 3 Hours.
Introduction to the technologies needed to create an UVS (Unmanned Vehicle System). Integration of these technologies (embodied as a set of sensors, actuators, computing and mobility platform sub-systems) into a functioning UVS through team work. UVS could be designed to compete in a student competition sponsored by various technical organizations or to support a specific mission or function defined by the instructors. This course is team-taught by engineering faculty. Offered as AE 5379 and ME 5379. Credit will be granted only once. Prerequisite: B or better in MAE 4378 or AE 5378 or ME 5378 and admission to the UVS certificate program.

AE 5380. DESIGN OF DIGITAL CONTROL SYSTEMS. 3 Hours.
Difference equations, Z- and w-transforms, discrete TF (Transfer Function). Discrete equivalence (DE) to continuous TF. Aliasing & Nyquist sampling theorem. Design by DE, root locus in z-plane & Youla parameterization. Discrete state-space model, minimality after sampling, pole placement, Moore-Kimura method, linear quadratic regulator, asymptotic observer. Computer simulation and/or lab implementation. Offered as EE 5324, AE 5380 and ME 5380. Credit will be granted only once. Prerequisite: MAE 4310 or equivalent.

AE 5381. BOUNDARY LAYERS. 3 Hours.
An introductory course on boundary layers. The coverage emphasizes the physical understanding and the mathematical foundations of boundary layers, including applications. Topics covered include laminar and turbulent incompressible and compressible layers, and an introduction to boundary layer transition. Offered as AE 5381 and ME 5381. Credit will be granted only once.

AE 5382. ADVANCED ASTRONAUTICS. 3 Hours.
Topics include orbital mechanics, orbital maneuvering, relative motion, orbit determination and estimation, three body problem, perturbations and numerical techniques.

AE 5383. HYPERSONIC FLOW. 3 Hours.
A study of the basic principles of hypersonic flows. Inviscid and viscous hypersonic flows. The course focuses on the effects of high temperature on the gas properties and associated effects on canonical gas dynamics processes. Applications in aerodynamic heating and atmospheric entry. Application of numerical methods.

AE 5385. HIGH TEMPERATURE GASDYNAMICS. 3 Hours.
Surveys kinetic theory, statistical mechanics, and chemical reaction rate theory. Application to the prediction of thermodynamic properties of gasses and the analysis of problems in high-temperature gasdynamics.

AE 5386. WIND & OCEAN CURRENT ENERGY HARVESTING FUNDAMENTALS. 3 Hours.
A broad senior/graduate first course in wind/wave/ocean current energy harvesting systems, focused on fundamentals, and serving as the basis for subsequent MAE specialized follow-on graduate course offerings focused on structures (conventional and composite), aero/hydro-mechanical response and control, and tailoring and smart material actuation, respectively, as well as for non-MAE, specialized graduate courses.

AE 5391. ADVANCED STUDIES IN AEROSPACE ENGINEERING. 3 Hours.
Individual research or design project performed for fulfilling the requirements of the Master of Engineering degree option. Prior approval of the AE Graduate Advisor is required for enrollment. A written and/or oral report is required.

AE 5397. RESEARCH IN AEROSPACE ENGINEERING. 3 Hours.
Research in masters programs.

AE 5398. THESIS. 3 Hours.
Thesis.

AE 5400. PREPARATORY COURSE FOR AEROSPACE ENGINEERING. 4 Hours.
The course may be offered with multiple sections, wherein each section is paired with a corresponding UG course being offered that semester. The purpose of this course is to strengthen academic preparation of students who were found inadequately prepared for a graduate degree in Aerospace Engineering. Students can concurrently enroll in multiple sections and may need to enroll in this course multiple times until their academic preparation is deemed complete. In order to pass this class, the students has to earn at least a B grade in aggregate based all the assignments and exams. The student will earn an R grade if the class aggregate is a C/D and will need to repeat the course until the student passes the class. The student will Fail the class if the aggregate is an F. The course may be repeated as often as required.

AE 5698. THESIS. 6 Hours.
Thesis.

AE 6196. AEROSPACE ENGINEERING INTERNSHIP. 1 Hour.
For students participating in internship programs. Requires prior approval of Graduate Advisor.

AE 6197. RESEARCH IN AEROSPACE ENGINEERING. 1 Hour.
Research in doctoral programs.

AE 6297. RESEARCH IN AEROSPACE ENGINEERING. 2 Hours.
Research in doctoral programs.

AE 6299. DISSERTATION. 2 Hours.
Dissertation Prerequisite: Admission to candidacy for the Doctoral of Philosophy degree.

AE 6310. ADVANCED FINITE ELEMENT METHODS. 3 Hours.
Modeling of large systems, composite and incompressible materials, substructuring, mesh generation, solids applications, nonlinear problems. Also offered as ME 6310.

AE 6311. ADVANCED STRUCTURAL DYNAMICS. 3 Hours.
Normal mode method for undamped and proportionally damped systems, component mode synthesis, generally damped systems, complex modes, effect of design modification on system response. Offered as AE 6311 and ME 6311. Credit will be granted only once. Prerequisite: ME 5311, AE 5311 or equivalent.

AE 6315. ADVANCED COMPOSITES. 3 Hours.
Review of current state-of-the-art applications of composites: composite structural analysis; structural properties, damage characterization and failure mechanism; stiffness loss due to damage, notched sensitivity; delamination;impact; fatigue characteristics; composite material testing; material allowables; characteristics of composite joints. Offered as AE 6315, ME 6315 and MSE 5349. Credit will be granted only once. Prerequisite: ME 5315, AE 5315 or MSE 5348 or equivalent.

AE 6337. ADVANCED ROBOTICS. 3 Hours.
Advanced robotic design concepts considering structural statics, dynamics and control strategies for both rigid and flexible manipulators will be studied using optimization techniques and analytical approaches and introduction to micro- and mobile robotic devices. Study of emerging applications of robotics will be explored. Digital simulation of robotic devices and programming and demonstration of robotic devices in the laboratory. Prerequisites: AE 5337 or ME 5337 or equivalent.

AE 6397. RESEARCH IN AEROSPACE ENGINEERING. 3 Hours.
Research in doctoral programs.

AE 6399. DISSERTATION. 3 Hours.
Dissertation Prerequisite: admission to candidacy for the Doctor of Philosophy degree.

AE 6697. RESEARCH IN AEROSPACE ENGINEERING. 6 Hours.
Research in doctoral programs.

AE 6699. DISSERTATION. 6 Hours.
Dissertation. Prerequisite: Admission to candidacy for the Doctor of Philosophy degree.

AE 6999. DISSERTATION. 9 Hours.
Dissertation. Prerequisite: Admission to candidacy for the Doctor of Philosophy degree.

AE 7399. DOCTORAL DEGREE COMPLETION. 3 Hours.
This course may be taken during the semester in which a student expects to complete all requirements for the doctoral degree and graduate. Enrolling in this course meets minimum enrollment requirements for graduation, for holding fellowships awarded by The Office of Graduate Studies and for full-time GTA or GRA positions. Students should verify that enrollment in this course meets other applicable enrollment requirements. To remain eligible in their final semester of study for grants, loans or other forms of financial aid administered by the Financial Aid Office must enroll in a minimum of 5 hours as required by the Office of Financial Aid. Other funding sources may also require more than 3-hours of enrollment. Additional hours may also be required to meet to requirements set by immigration law or by the policies of the student's degree program. Students should contact the Financial Aid Office, other sources of funding, Office of International Education and/or their graduate advisor to verify enrollment requirements before registering for this course. This course may only be taken once and may not be repeated. Students who do not complete all graduation requirements while enrolled in this course must enroll in a minimum of 6 dissertation hours (6699 or 6999) in their graduation term. Graded P/F/R.