

COURSES FOR AEROSPACE ENGINEERING AND MECHANICS

Aerospace Engineering and Mechanics Courses

AEM121 Intr. to Aerospace Eng.

Hours 1

To survey aerospace history, discuss pertinent topics and introduce basic concepts that promote an understanding of aerospace engineering and the profession.

Prerequisite(s) with concurrency: MATH 125 or MATH 145

AEM201 Statics

Hours 3

The study of forces, couples and resultants of force systems; free-body diagrams; two- and three-dimensional equilibrium, and problems involving friction; and centroids, center of gravity, and distributed forces.

Prerequisite(s): [(MATH 125 or MATH 145) and (PH 105 or PH 125) and (ENGR 103 or ENGR 123)] or [(MATH 126 or MATH 146) and (PH 105 or PH 125)]

AEM249 Algorithm Devl Implementation

Hours 3

Syntax and data structures, algorithm development, and data plotting using currently relevant technical computing programming language(s). Prior knowledge of programming is not required, but the course is appropriate for students with prior programming experience.

Prerequisite(s) with concurrency: MATH 125 or MATH 145

AEM250 Mechanics Of Materials I

Hours 3

Concepts of stress and strain; analysis of stresses and deformation in bodies loaded by axial, torsional, and bending loads; combined loads analysis; statically indeterminate members; thermal stresses; columns; and thin-walled pressure vessels.

Prerequisite(s): MATH 126 or MATH 146 and AEM 201

AEM251 Mechanics Of Materials I Lab

Hours 1

Mechanical tests of metallic and nonmetallic materials in the elastic and inelastic ranges; use of materials testing for acceptance tests, for the determination of properties of materials, and for illustration of the validity of assumptions made in mechanics of materials.

Prerequisite(s) with concurrency: AEM 250

AEM264 Dynamics

Hours 3

Kinematics of particles and rigid bodies, Newton's laws of motion, and principles of work-energy and impulse-momentum for particles and rigid bodies.

Prerequisite(s): MATH 126 or MATH 146; and AEM 201

AEM311 Fluid Mechanics

Hours 3

Fluid statics, application of conservation laws to simple systems, dimensional analysis and similitude, and flow in open and closed conduits.

Prerequisite(s): MATH 227 or MATH 247; and AEM 201

AEM313 Aerodynamics

Hours 3

Introduction to subsonic aerodynamics, including properties of the atmosphere; aerodynamic characteristics of airfoils, wings, and other components; lift and drag phenomena; and topics of current interest.

Prerequisite(s): AEM 311 and AEM 264

Prerequisite(s) with concurrency: MATH 238

AEM341 Aerospace Structures

Hours 3

Methods of analyzing stressed skin structures of the types that are typically found in aircraft, missiles and space vehicles. Unsymmetrical bending and bending and twisting of multiple cell structures are also covered.

Prerequisite(s): MATH 237 and AEM 249 or CS 100 or CS 110 or (RRS 101 and RRS 102), and AEM 250

AEM349 Applied Numerical Methods

C

Hours 3

Elements of analytical and numerical analysis with engineering applications including, but not limited to, differential equations, linear algebra, root-finding, Gaussian elimination, and Runge-Kutta integration.

Prerequisite(s): MATH 237 and MATH 238 and (AEM 249 or CS 100 or CS 110 or (RRS 101 and RRS 102))

Computer Science

AEM351 Aerospace Structures Laboratory

Hours 1

Strain gage mounting and bridge circuits analysis; strain measurement in axial, bending, and torsional members resembling aerospace structures using axial and rosette strain gages; stress measurements in wing structural subcomponents (skin, stiffener, spar, rib, stringer) under bending loads using strain data; design, fabrication, and testing of a stiffened panel.

Prerequisite(s): AEM 251

Prerequisite(s) with concurrency: AEM 341

AEM360 Astronautics

Hours 3

Survey of topics and basic concepts in astronautics: orbital mechanics, space environment, attitude determination & control, telecommunications, space structures, rocket propulsion, and spacecraft systems.

Prerequisite(s): MATH 238 and AEM 311

AEM368 Flight Mechanics

Hours 3

This course is a combination of spacecraft and aircraft performance and flight mechanics. Spacecraft performance and flight mechanics includes rocket propulsion, rocket dynamics, spacecraft attitude, orbits, trajectories, maneuvers, and re-entry. Aircraft performance and flight mechanics includes propeller and turbine propulsion, cruise, climb, glide, range, endurance, takeoff, landing, turning, and static longitudinal stability.

Prerequisite(s): MATH 238 and AEM 264 and (AEM 249 or CS 100 or CS 110 or (RRS 101 and RRS 102))

Prerequisite(s) with concurrency: AEM 313

AEM395 Professional Development in Aerospace Engineering

Hours 3

This course covers topics in technical communication, writing proficiency, engineering ethics, and project planning & management to help prepare aerospace engineering students for senior-level courses, career development, and life-long learning. Visiting lecturers may be invited to speak on these topics and other relevant, contemporary issues in the aerospace industry. Writing proficiency within the discipline is required for a passing grade in this course.

Prerequisite(s) with concurrency: AEM 313 or AEM 341

AEM402 Integrated Aerospace Design I

W

Hours 3

Project planning and preliminary design techniques for an aerospace system. Writing proficiency is required for a passing grade in this course. A student who does not write with the skill normally required of an upper-division student will not earn a passing grade, no matter how well the student performs in other areas of the course.

Prerequisite(s): AEM 313 and AEM 341 and AEM 360 and AEM 368 and AEM 413 or AEM 513

Prerequisite(s) with concurrency: AEM 408 or AEM 508

Writing

AEM404 Integrated Aerospace Design II

Hours 3

Detailed design of aircraft or space vehicles, including weight and balance, power plant selection, exterior layout, performance, stability, and control. Involves group efforts on selected projects.

Prerequisite(s): AEM 402

AEM408 Propulsion Systems

Hours 3

Principles of air-breathing jet engines (turboshaft, turboprop, turbojet, ramjet, scramjet) and their applications, aircraft engine matching, introduction to rocket propulsion principles.

Prerequisite(s): AEM 413

AEM413 Compressible Flow

Hours 3

Dynamics of compressible fluids: shock waves, one-dimensional flow, expansion waves in two-dimensional flow and compressible flow over aerodynamic bodies.

Prerequisite(s): AEM 311 and ME 215

AEM414 Experimental Aerodynamics

Hours 3

This course provides a laboratory counterpart to concepts discussed in aerodynamics and fluid mechanics. Course topics include statistical and uncertainty analysis techniques, design of experiments, computer-based data-acquisition, sensors for fluid mechanic measurements, and aerodynamic measurement techniques and facilities.

Prerequisite(s): AEM 313

AEM416 Helicopter Theory

Hours 3

Critical examination of the propulsive airscrew, including induced velocity relations, flow patterns, and similarity. Practical applications are approached through existing theory and practice.

Prerequisite(s): MATH 238 and AEM 264 and AEM 311

AEM417 Aircraft Systems

Hours 3

The principal objective of this course is to establish, develop, and refine capability in the integrated analysis and interdependency of aircraft systems.

Prerequisite(s): AEM 468 or ECE 475 or ME 475

AEM418 Uncrewed Aircraft Systems

Hours 3

The objectives of this course are to teach the design and operation of uncrewed aircraft systems. General design criteria will be developed for radiocommunication, propulsion, avionics, airframe, and integration. Regulatory and operational procedures will be given for communication, and command & control with an emphasis on safety.

Prerequisite(s): AEM 368

AEM420 Computational Fluid Dynamics

C

Hours 3

Introduction to basic mathematical concepts and engineering problems associated with numerical modeling of fluid systems. Application of the state-of-the-art numerical models to engineering problems. Fundamentals of Finite Difference and Finite Volume Methods and their applications in fluid dynamics and heat transfer problems will be covered. Computing proficiency is required for a passing grade in this course.

Prerequisite(s): AEM 311 and (ME 349 or AEM 349), and MATH 238

Computer Science

AEM425 Spacecraft Dynamics and Control

Hours 3

Formulate, understand, and apply rigid body dynamics to a spacecraft. Determine the orientation of the spacecraft. Demonstrate the ability stabilize a spacecraft (gravity gradient, momentum-bias, spin stabilization). Perform analytic and numerical analysis to understand its behavior.

Prerequisite(s): MATH 237 and AEM 264 and AEM 360 and (AEM 349 or ME 349)

AEM428 Space Propulsion

Hours 3

This course introduces the student to analyses of space and launch-vehicle propulsion and design. Topics covered include mono-propellant, bi-propellant solid and liquid rockets, nuclear rocket, and cold-gas thruster designs. Other advanced schemes such as solar and laser propulsion are also introduced.

Prerequisite(s): AEM 408

AEM446 Intermediate Solid Mechanics

Hours 3

Introduction to plane elasticity, failure theories, energy methods, thick walled cylinders and spinning disks, shear center and of unsymmetrical bending of beams, curved beams, beams on elastic foundations, torsion of non-circular cross-sections, thick-walled pressure vessels and other topics.

Prerequisite(s): AEM 250

AEM448 Stochastic Mechanics

Hours 3

This course develops, analyzes and discusses the application of uncertainty quantification in engineering systems and design methodologies to include uncertainties in the systems. Topics include: classification of uncertainties and methods of quantification, perturbation approaches, polynomial chaos, sampling techniques, random processes and Bayesian analysis.

Prerequisite(s): MATH 238

AEM451 Aircraft Structural Design

Hours 3

Design of tension, compression bending, torsion, and stiffened panel members. Analytical investigation involving aircraft structural components.

Prerequisite(s): AEM 341

AEM452 Composite Materials

Hours 3

First exposure to composite materials. Focus on how heterogeneity/anisotropy in composites influence thermomechanical behavior. The behavior of both continuous and short fiber reinforced composites will be emphasized. Stress analysis for design, manufacturing processes and test methods of composite materials will be covered.

Prerequisite(s): AEM 250 and AEM 341 or CE 331 or ME 350

AEM453 Multiscale Analysis of Advanced Composites

Hours 3

Concepts of multiscale analysis, nano-mechanics, micromechanics - principles of Analysis of heterogeneous systems, information transfer between multiple spatial and temporal scales, included atomistic-to-continuum coupling, continuum-to-continuum coupling, and temporal bridging.

Prerequisite(s): AEM 250

AEM455 Nondestructive Evaluation

Hours 3

Fundamental theories, limitations and instrumentation of nondestructive test methods used for metal, polymer and composites materials. The ultrasonic, acoustic emission, vibration, thermography, eddy current, penetrant, and radiography methods are emphasized.

Prerequisite(s): MATH 238, and PH 105 or PH 125

AEM461 Computation Method Aero Struct

C

Hours 3

Development of the fundamentals of the finite-element method from matrix and energy methods. Use of the finite-element method for detailed design of aerospace structures. Modeling techniques for static and dynamic analyses. Computing proficiency is required for a passing grade in this course.

Prerequisite(s): MATH 227 or MATH 247, AEM 341 and (AEM 349 or ME 349)

Computer Science

AEM468 Flight Dynamics & Control

Hours 3

The objectives of this course are to present linear, time-invariant dynamical systems and control theory and apply it to aerospace vehicles. Stability analysis is performed for linearized airplane straight-and-level flight dynamics and satellite gravity-gradient attitude dynamics. Design of attitude determination and control systems for airplanes and satellites is introduced.

Prerequisite(s): AEM 249 or CS 100 or CS 110 or (RRS 101 and RRS 102), ME 349, MATH 237 and AEM 368

AEM469 Orbital Mechanics

Hours 3

Introduction to engineering application of celestial mechanics; to formulate, understand, and apply fundamentals in orbital mechanics to trajectory design process. Perform analytic and numerical analysis to understand its behavior. Kepler's laws, coordinate transformations, and related studies.

Prerequisite(s): MATH 237 and MATH 238 and AEM 264 and (AEM 349 or ME 349) and AEM 360

AEM470 Mechanical Vibrations

Hours 3

Free and forced vibrations, both undamped and damped. Systems with many degrees of freedom are formulated and analyzed by matrix methods. Experimental techniques of vibration measurement are introduced.

Prerequisite(s): AEM 264 and MATH 238 and AEM 250

AEM474 Structural Dynamics

Hours 3

Study of dynamic behaviors of elastic structures (interaction of elastic and inertial forces) with emphasis on aeronautical applications. Introduction of concepts and tools used in structural dynamics, including the Newtonian and variational methods. Basic numerical integration schemes to solve time-domain responses of elastic structures.

Prerequisite(s): AEM 264 and MATH 237 and MATH 238 and AEM 341

AEM475 Fundamentals of Aeroelasticity

Hours 3

Study of fluid-structure interactions between aerodynamic loads and static and/or dynamic deformations of flexible wings, as well as the influence of the interactions on aircraft performance. Concepts such as divergence, buffeting, and flutter, and rejection of external disturbances (e.g., gust alleviation) are introduced.

Prerequisite(s): AEM 313 and AEM 474

AEM482 Space Systems

Hours 3

Concepts in systems engineering of space systems: systems engineering, space systems, satellites, space transportation systems, space environment, attitude determination and control, telecommunications, space structures, rocket propulsion, and spacecraft systems.

Prerequisite(s): AEM 360

AEM484 Space Environment

Hours 3

This course provides an introduction to the effects of the space environment on spacecraft. The harsh space environment introduces several unique challenges to the spacecraft designer. Focus on the impact of this environment and how best to mitigate these effects through early design choices will give the satellite designer better tools. Topics include: geomagnetic field, gravitational field of the Earth, Earth's magnetosphere, vacuum, solar UV, atmospheric drag, atomic oxygen, free and trapped radiation particles, plasma, spacecraft charging, micrometeoroids.

Prerequisite(s): AEM 360

AEM488 Advanced Space Propulsion and Power

Hours 3

This course will explore concepts, theory, and performance of electrical, nuclear, and exotic space propulsion systems for use in space. This exploration will include fundamental physical processes exploited by these propulsion schemes. The course will also include concept, theory and performance of power generation methods in space. Systems studied will include low and high power systems intended for short term or long term applications. Thermal, solar and nuclear devices and the energy conversion means for converting energy from these sources into useful electrical power will be studied.

Prerequisite(s): AEM 311

AEM489 Space Law

Hours 3

Discussion-based course that provides an examination of legal and ethical issues regarding outer space. Topics discussed include: the historical development of international and domestic space law; international treaties, principles, and resolutions; specific issues relevant to contemporary space law; and US statutes governing space flight and resources.

Prerequisite(s): AEM 360

AEM491 Special Problems

SP

Hours 1-6

Assigned problems are explored on an individual basis. Credit is based on the amount of work undertaken.

Special Topics Course

AEM492 Special Problems

SP

Hours 1-6

Assigned problems are explored on an individual basis. Credit is based on the amount of work undertaken.

Special Topics Course

AEM493 Special Topics

SP

Hours 1-3

Planning, executing, and presenting results of an individual project involving a research design, analysis, or similar undertaking; pass/fail designation.

Special Topics Course

AEM495 Senior Seminar

W

Hours 3

Selected topics from recent developments in the aeronautical and space engineering fields. There are visiting lecturers and extensive student participation. Several nontechnical topics of immediate interest to seniors are explored. Each student must complete a personal resume. Writing proficiency is required for a passing grade in this course. A student who does not write with the skill normally required of an upper-division student will not earn a passing grade, no matter how well the student performs in other areas of the course.

Prerequisite(s) with concurrency: AEM 402

Writing

AEM496 Aerospace Engineering Honors Special Problems - I

SP, UH

Hours 3

This course is designed to allow an AEM student to complete a Capstone project and fulfill the Honors Capstone requirement for University Honors. Prior approval of the Honors College to determine the criteria for earning Honors credit is required. The student will plan and conduct research in an area of current interest to the student and instructor on a topic determined in consultation with the instructor before the student enrolls for class.

Prerequisite(s): AEM 368, at least 15 hours of honors coursework and consent of instructor

Special Topics Course, University Honors

AEM497 Aerospace Engineering Honors Special Problems - II

SP, UH

Hours 3

This course is designed to allow an AEM student to complete a Capstone project and fulfill the Honors Capstone requirement for University Honors. Prior approval of the Honors College to determine the criteria for earning Honors credit is required. The student will plan and conduct research in an area of current interest to the student and instructor on a topic determined in consultation with the instructor before the student enrolls for class.

Prerequisite(s): AEM 368, at least 15 hours of honors coursework and consent of instructor.

Special Topics Course, University Honors