COURSES FOR AEROSPACE ENGINEERING AND MECHANICS

Aerospace Engineering and Mechanics Courses

AEM120 Aerospace Science For Educators
N

Hours 4

Students develop meaningful understanding and use of engineering and science knowledge and critical-thinking skills and come to appreciate engineering and science as part of the daily life of a scientifically literate professional.

Natural Science

AEM121 Introduction to Aerospace Engineering I
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 and 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 125 or PH 105 and ENGR 151 or ENGR 103

AEM249 Algorithm Devl Implementation
Hours 2

Algorithm development, numerical solution of engineering problems, and structured problem solving in C++.

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; life 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): AEM 249 or CS 100 or RRS 101 or 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 (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 resemble to aerospace structures using axial and rosette strain gages; stress measurements in wing structural subcomponents (skin, stiffener, spar, rib) under bending load using strain data; design, fabrication and testing of stiffened panel.

Prerequisite(s): 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 aircraft performance and basic flight mechanics. It also includes the basics of the aerodynamic build-up of an aircraft to determine aerodynamic coefficients and the so-called stability and control derivatives. Except for takeoff and landing rolls, aircraft performance analyses entail analysis of steady flight conditions. Flight mechanics deals more with the trim and static stability of the aircraft for the steady flight conditions. Steady flight conditions are typically the starting point for small-perturbation dynamics and stability analyses.

Prerequisite(s): MATH 237 and MATH 238 and AEM 264 and AEM 311 and (AEM 249 or CS 100 or (RRS 101 and RRS 102))

AEM402 Integrated Aerospace Design I
W

Hours 3

Preliminary design techniques for an aerospace system. Writing proficiency within the discipline is required for a passing grade in this course.

Prerequisite(s): AEM 313 and AEM 341 and AEM 368 and AEM 413

Prerequisite(s) with concurrency: AEM 408

Writing

AEM404 Integrated Aerospace Design II
Hours 3

Preliminary and 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

AEM415 Micro-Aerial Vehicles (MAVs)
Hours 3

This course surveys topics related to micro air vehicles (MAVs). These are small, flying vehicles generally classified by a maximum length of 15 cm. It is intended to be interdisciplinary in nature, involving seniors and first-year graduate students from different engineering academic departments.

Prerequisite(s): instructor approval

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.

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.

Prerequisite(s): AEM 311 and AEM 349 and MATH 238

Computer Science

AEM428 Space Propulsion
Hours 3

This course introduces the student to descriptions and analyses of space and launch-vehicle propulsion. Topics covered include advanced schemes such as nuclear, solar and laser propulsion; power cycles; and tether systems.

Prerequisite(s): AEM 408

AEM446 Intermediate Solid Mechanics
Hours 3

Introduction to 2-D plane elasticity, thick walled cylinders and spinning disks, bending and shear center of unsymmetric cross-sections, curved beams, beams on elastic foundations, torsion of non-circular cross-sections, thick-walled pressure vessels, and an introduction to the strain-life theory of metal fatigue.

Prerequisite(s): AEM 250 or consent of instructor

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): GES 255

AEM451 Aircraft Structural Design
W

Hours 3

Design of tension, compression bending, torsion, and stiffened panel members; experimental and analytical investigations involving static and dynamic structural behavior. Writing proficiency is required for a passing grade in this course.

Prerequisite(s): AEM 341

Writing

AEM452 Composite Materials
Hours 3

First exposure to composite materials. Focus on how heterogeneity/anisotrophy 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.

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 Computational Methods for Aerospace Structures
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.

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

Computer Science

AEM468 Flight Dynamics & Control
C

Hours 3

Linear equations of motion, dynamic response, state-space methods and fundamentals of classical and modern control theory; flying and handling qualities design criteria; stability augmentation and control augmentation. Computing proficiency is required for a passing grade in this course.

Prerequisite(s): AEM 249 and AEM 368

Computer Science

AEM469 Orbital Mechanics
Hours 3

Introduction to engineering application of celestial mechanics; high-speed, high-altitude aerodynamics; and other fields related to the contemporary problems of space vehicles. Fundamentals of applied dynamics, nomenclature of space flight, space environment and solar system, and two-body orbits. Kepler's laws, coordinate transformations, and related studies.

Prerequisite(s): MATH 238 and AEM 264

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

AEM471 Fundamentals Of Acoustics
Hours 3

Fundamental physical principles underlying wave propagation and resonance in mechanical systems. Introduces applications and provides experience in acoustic and audio measurements and the associated instrumentation.

Prerequisite(s): MATH 238, and PH 106 or PH 126, and ECE 320

AEM474 Structural Dynamics
Hours 3

Theorectical foundations of structural dynamics and application of methods to modeling, analysis, and design.

Prerequisite(s): AEM 250 and AEM 264 and MATH 237 and MATH 238

AEM475 Fundamentals of Aeroelasticity
Hours 3

Aeroelasticity deals with interactions between aerodynamic loads and elastic static and/or dynamic deformations, as well as the influence of the interactions on aircraft performance. The performance of interest may include stability of structures immersed in an airflow (e.g., divergence, buffeting, and flutter), rejection of external disturbances (e.g., gust alleviation), and controllability of flight vehicle trajectory (attitude or motion). Structural mass and stiffness are often tailored to change the aerodynamic load distributions on lifting surfaces. Aeroelasticity is not just fluid mechanics or solid mechanics. Its major emphasis is the fluid-structure interaction. This course focuses on understanding the phenomenology of aerodynamic and structural interactions, instead of the complicated modeling processes. The material is relatively self-contained as we will introduce concepts such as mass and stiffness matrices, shear centers, aerodynamic coefficients, and aerodynamic centers, and then build on these concepts. The students will have access to some simple models, which may become complicated when the fluid-structure interaction is considered. With the study in the class, the students will be able to analyze fundamental aeroelastic phenomena and solve the problem by using a numerical tool. Students should learn the concept of aeroelastic tailoring and structural designs with aeroelastic constraints.

Prerequisite(s): AEM 313 or consent of instructor

AEM481 Complex Engineering Systems
Hours 3

Introduction to the concepts and techniques associated with the analysis of complex systems, dynamic systems, chaos, lumped parameter modeling, feedback, networks, thermal/electrical circuit analogies, entropy.

Prerequisite(s): AEM 349 or ME 349, ME 215, MATH 238

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.

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.

AEM491 Special Problems
Hours 1-6

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

AEM492 Special Problems
Hours 1-6

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

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 within this discipline is required for a passing grade in this course.

Prerequisite(s) with concurrency: AEM 402

Writing