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 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 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; 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): 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 aircraft performance and static flight mechanics. Aircraft performance, including the straight and level flight, climb and glide, range and endurance, takeoff and landing, turning, performance testing, is introduced for propeller-driven and jet-engine aircraft. Flight mechanics deals with the trim and static stability of aircraft for steady flight conditions, based on the aerodynamic coefficients and stability derivatives derived from the aerodynamic build-up of complete aircraft.

Prerequisite(s): MATH 237 and MATH 238 and AEM 264 and AEM 311 and (AEM 249 or CS 100 or CS 110 or (RRS 101 and RRS 102))

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 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

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.

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

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 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/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.

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 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. 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

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.

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

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

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

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.

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

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 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

AEM500 Intermediate Fluid Mechanics
Hours 3

Development and use of the integral and differential forms of the equations of continuity, momentum, and energy with ideal fluids, viscous fluids and compressible fluids. Advanced topics in fluid mechanics, including potential flow, viscous flow and compressible flow.

AEM508 Propulsion Systems
Hours 3

Basic propulsion dynamics, thermodynamics of fluid flow, combustion kinetics, air-breathing engines, rockets, design criteria, performance, and advanced propulsion systems.

AEM513 Compressible Flow
Hours 3

Fundamentals of high-speed aerodynamics theory discussed. Topics covered include: normal and oblique shock waves, heat addition and friction effects in one-dimensional flow, expansion waves in two-dimensional flow, quasi 1-D nozzle flow, unsteady compressible flow calculations using method of characteristics, shock tube relations.

AEM514 Experimental Aerodynamics
Hours 3

The 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.

AEM515 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.

AEM516 Helicopter Theory
Hours 3

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

AEM517 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.

AEM520 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.

Computer Science

AEM525 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.

AEM528 Space Propulsion
Hours 3

Students are introduced to different types of space propulsion systems in this class. Different rockets, such as: monopropellant, bi-propellant, solid, liquid, nuclear and electric rockets are discussed in detail. Working principles of these rockets, their intended use and their design are discussed. Power limited and energy limited rocket working principles are given. Several rocket design projects are assigned throughout the class.

AEM530 Continuum Mechanics
Hours 3

Introduction to tensor analysis. Analysis of stress and strain at a point. Development of the equations representing conservation laws for a continuum. Study of constitutive relationships for fluids and solids. Application of field equations to simple boundary value problems in solid mechanics and fluid mechanics.

AEM535 Applied Finite Element Analysis
Hours 3

Applications of the finite element method to static stress analysis, heat transfer, natural frequency and Eigen-mode determination, for linear, hyper-elastic, and elastic-plastic materials. The course includes a basic background on finite element theory as well as usage of current finite element software.

AEM546 Intermediate Solid Mechanics
Hours 3

Two-dimensional theory of elasticity; exact and approximate solutions of bending, torsion, and buckling for bars; open sections and curved beams; stresses in axisymmetric members; and finite-element and energy methods.

AEM548 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.

AEM552 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.

AEM553 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, including atomistic-to-continuum coupling, continuum-to-continuum coupling, and temporal bridging.

AEM555 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.

AEM562 Intermediate Dynamics
Hours 3

Dynamics of systems in moving coordinate frames; Lagrangian formulation and Hamilton's principle; stability and perturbation concepts for rigid body motion; motion of systems of rigid bodies in three dimensions.

AEM569 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.

AEM570 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.

AEM574 Structural Dynamics
Hours 3

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

AEM575 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.

AEM582 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.

AEM584 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.

AEM588 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.

AEM591 Special Problems
Hours 1-6

Independent investigations of special problems. Credit is based on the amount of work undertaken.

AEM592 Special Problems
Hours 1-6

Independent investigations of special problems. Credit is based on the amount of work undertaken.

AEM594 Special Projects
Hours 1-6

Planning, executing, and presenting results of an individual project involving a research design, analysis, or similar undertaking.

AEM598 Non-Thesis Research
Hours 1-3

Research not related to thesis.

AEM599 Thesis Research
Hours 1-12

This independent research course partially fulfills required master's-level research thesis hours toward the master's degree Aerospace Engineering and Mechanics. The course is conducted under the guidance of the thesis advisor. Material covered or studied will be of an advanced nature aimed at providing master's students with an understanding of the latest research and current developments within the field. Discussion and advisor guidance will be directed towards readings of research articles and development of research methodology, with the aim of producing an original research contribution that represents a novel development in the field, or a novel perspective on a pre-existing topic in the field.

AEM606 Physical Gas Dynamics
Hours 3

Introduction to the behavior of gases. Gases are treated as interacting particles and the collective behavior is studied as an ensemble of semi-random events. The evolution of gas properties from the molecular viewpoint to the continuum viewpoint will be examined. Applications of interest include chemical reactions important to hypersonic aircraft, scramjet engines, current and future high pressure ratio gas turbine engines as well as rocket propulsion.

AEM614 Airfoil And Wing Theory
Hours 3

Compressible and incompressible airfoil and wing theory.

AEM616 Rotorcraft Aeromechanics
Hours 3

This course presents the fundamentals of rotorcraft aeromechanics, which study equilibrium, motion, and control of elastic rotorcraft under aerodynamic loading. Topics included: blade motion, unsteady rotor aerodynamics, rotor wakes, dynamic stall, noise, and stability and control.

Prerequisite(s): AEM 516

AEM621 Viscous Flow
Hours 3

Development of basic boundary layer equations and concepts. Classical incompressible solutions for laminar boundary layer, approximate solutions, and concepts of turbulence.

AEM622 Turbulent Flows
Hours 3

Introduction to the physics and modeling of turbulent flows. This course will cover the governing equations of multi-species viscous laminar flows, origin and characteristics of turbulence, mathematical methods for obtaining the governing equations of turbulent flows, various modeling techniques for resolving closure problems associated with the governing equations of turbulent flows.

AEM624 Hypersonic Flow
Hours 3

This course develops, analyzes and discusses the application of hypersonic flow theory. Topics include: Hypersonic shock/expansion wave relations, approximate methods to calculate lift and drag on hypersonic vehicles, boundary layer equations for hypersonic flow, hypersonic viscous interactions, and topics of current interest.

AEM625 Advanced Computational Fluid Dynamics
Hours 3

Finite volume methods for numerical analysis of transport problems including fluid dynamics and heat transfer in complex curvilinear boundary fitted domain will be developed and applied.

Prerequisite(s): AEM 420 or AEM 520

AEM626 Unsteady Flow
Hours 3

This course develops, analyzes and discusses unsteady potential flow theory and the calculation of steady and unsteady aerodynamic loads and response on airfoils, wings and bodies as well as corresponding topics of current interest.

Prerequisite(s): BSAE or AEM 500 or instructor's consent

AEM630 Flow Control
Hours 3

Passive, active and reactive flow management strategies to achieve transition delay/advance, separation control, mixing augmentation, drag reduction, lift enhancement, and noise suppression. Unified framework for flow control.

Prerequisite(s): AEM 500 or AEM 621 or equivalent

AEM635 Finite Element Methods
Hours 3

Finite-element formulations in the areas of solid mechanics, fluid mechanics, and heat conduction; isoparametric elements; assembly process; solution of stiffness equations; and convergence of results.

AEM637 Theory Of Elasticity
Hours 3

Equations of linear elasticity, principal stresses and strains, stress and displacement potentials, energy principles, and numerical methods. Boundary value problems of elasticity.

AEM638 Introduction to Experimental Mechanics
Hours 3

Theory and application of electrical resistance strain gauges for stress analysis and for use as transducers. Study of circuits and instruments used for strain measurement. Theory and application of photoelasticity for measurement of stress. Fundamentals of servohydraulic testing.

AEM644 Engineering Fracture Mechanics
Hours 3

Linear elastic and elastic-plastic fracture mechanics. Fracture analysis using Griffith's criterion, stress intensity factors, CTOD methods, and the J-Integral.

AEM648 Theory of Plasticity
Hours 3

Theory of plastic deformation of metals and other materials. Development of yield criteria, application of flow rules, and yield surface based plasticity theories. Application to engineering structures, including computer programming assignments and finite element analysis assignments.

AEM649 Fatigue Analysis
Hours 3

Presentation of the strain life and fracture mechanics approaches to fatigue analysis. Review of damage parameters, mean stress effects, and cycle counting methods for uniaxial and multiaxial loading.

AEM655 Advanced Composite Materials
Hours 3

Advanced topics in composite materials, including theories of linear orthotropic elasticity, micro-mechanics of composites, nano-composites, and sandwich structures.

AEM662 Multibody Dynamics
Hours 3

This course presents the fundamentals of multibody dynamics: kinematics and dynamics of multibody systems, analytical dynamics, constrained dynamical systems, and flexible multibody dynamics.

Prerequisite(s): Instructor's consent.

AEM668 Advanced Dynamics Of Flight
Hours 3

Analysis of the rigid body dynamic motions of an aircraft; response of an airplane to actuation of controls; introduction to automatic control and stability; introduction to vehicle simulation by digital computer.

AEM669 Advanced Astrodynamics
Hours 3

The main objective of this course is to formulate, understand, and apply fundamentals of dynamical systems theory to spacecraft trajectory design process. Understand the behavior of a spacecraft under gravitational and non-gravitational forces and design cost-effective trajectories. Perform analytic and numerical analysis to understand spacecraft behavior beginning with the three-body problem.

Prerequisite(s): AEM 469 or AEM 569

AEM685 Engineering Optimization
Hours 3

This graduate course introduces the techniques of design optimization of engineering systems. Topics include: Basic principles of optimization theory, parameter optimization problems, linear and nonlinear programming. Unconstrained and constrained problems treated by simplex, penalty function, generalized reduced gradient methods, global optimization techniques, and surrogate modeling.

AEM691 Special Problems
Hours 1-3

Independent investigations of special problems. Credit is based on the amount of work undertaken.

AEM694 Special Project
Hours 1-6

Planning, executing, and presenting results of an individual project involving a research design, analysis, or similar undertaking.

AEM698 Non-Dissertation Research
Hours 1-3

Research not related to dissertation.

AEM699 Dissertation Research
Hours 1-12

Research related to dissertation.