AEROSPACE ENGINEERING (AERO ENG)

AERO ENG 2001 Special Topics (LAB 1.0 and LEC 1.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

AERO ENG 2360 Dynamics (LEC 3.0)
The principles of mechanics are used to model engineering systems. Kinematics of particle motion, kinematics of plane- and three-dimensional motions of rigid bodies. Kinetics of particles and of rigid bodies. Energy and momentum methods. Prerequisite: Grade of "C" or better in each of Civ Eng 2200, Math 2222. (Co-listed with Mech Eng 2360).

AERO ENG 2780 Introduction to Aerospace Design (LAB 1.0 and LEC 1.0)
Introduction to methodology of aerospace vehicle design and principles of layout to meet a given specification, mission objective, component sizing, design iteration and building & performance testing of models. Prerequisite: A grade of "C" or better in Aero Eng 2861.

AERO ENG 2861 Aerospace Vehicle Performance (LEC 3.0)
Nature and theory of lift, drag, performance, and stability and control of aerospace vehicles. Prerequisite: "C" or better grade in both Math 1215 and Physics 1135.

AERO ENG 3000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

AERO ENG 3001 Special Topics (IND 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

AERO ENG 3002 Cooperative Engineering Training (IND 0.0-6.0)
On-the-job experience gained through cooperative education with industry with credit arranged through departmental co-op adviser. Grade received depends on quality of reports submitted and work supervisor’s evaluation.

AERO ENG 3010 Seminar in Aerospace Engineering (RSD 1.0)
Discussion of current topics.

AERO ENG 3131 Aerodynamics I (LEC 3.0)
A study of the fundamental concepts of fluid mechanics as applied to aerodynamic applications with both differential and control volume analysis. Theory and application of viscous and inviscid incompressible flow including boundary layer theory and two dimensional airfoil theory. Prerequisites: A grade of "C" or better in each of Aero Eng 2861, Math 1214, 1215, 2222, Physics 1135, and Mech Eng 2519.

AERO ENG 3171 Aerodynamics II (LEC 3.0)
Three dimensional incompressible wing theory. Compressible one dimensional flow with normal and oblique shock waves, heat addition, and friction. Compressible transonic, and supersonic linearized flow theory. Supersonic wings and wing/fuselage configurations. Prerequisite: "C" or better in Aero Eng 3131 and Mech Eng 2519.

AERO ENG 3251 Aerospace Structures I (LEC 3.0)
An introduction to various loads on aerospace vehicles. Basic theory and analysis of typical aerospace and related vehicle structures subjected to steady loading. An overview of various failure theories including yielding, buckling, fracture and fatigue. Design of thin walled structures. Introduction to advanced composite materials. Prerequisites: "C" or better in Math 1214 (or 1208), 1215 (or 1221), 2222, Physics 1135 and Civ Eng 2210.

AERO ENG 3361 Flight Dynamics and Control (LEC 3.0)
Static stability and control of conventional aircraft and implications in aircraft design. Six degrees of freedom time dependent equations of motion and their linearized solutions. Consideration of stability vs maneuverability, and the dynamic modes of motion of the aircraft. Prerequisites: Aero Eng 3613, Aero Eng 3131, and accompanied or preceded by Aero Eng 2780.

AERO ENG 3613 Aerospace Mechanics I (LEC 3.0)
Introduction to celestial mechanics and an analytical study of spacecraft flight. Emphasis is placed on satellite orbits and general theory of gyrodynamics. Prerequisites: Math 3304; a grade of "C" or better in each of Aero Eng 2360 (or Mech Eng 2360), Math 1214 (or 1208), 1215 (or 1221), 2222, and Physics 1135.

AERO ENG 3877 Principles of Engineering Materials (LEC 3.0)
Introduction to various loads on aerospace vehicles. Basic theory and analysis of typical aerospace and related vehicle structures subjected to steady loading. An overview of various failure theories including yielding, buckling, fracture and fatigue. Design of thin walled structures. Introduction to advanced composite materials. Prerequisites: "C" or better in Aero Eng 2861.

AERO ENG 4000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

AERO ENG 4001 Special Topics (LAB 0.0 and LEC 0.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

AERO ENG 4099 Undergraduate Research (IND 0.0-6.0)
Designed for the undergraduate student who wishes to engage in research. Not for graduate credit. Not more than six (6) credit hours allowed for graduation credit. Subject and credit to be arranged with the instructor.

AERO ENG 4133 Introduction to Aerothermochemistry (LEC 3.0)
Principles of thermochemistry in reacting flow including an introduction to fundamentals of quantum mechanics, statistical mechanics and statistical thermodynamics. Applications in flow through nozzles and shock waves, combustion, aerodynamic heating, ablation and propulsion. Prerequisites: Aero Eng 3131, Aero Eng 3171.

AERO ENG 4253 Aerospace Structures II (LEC 3.0)

AERO ENG 4355 Aircraft and Space Vehicle Propulsion (LEC 3.0)
Analysis of aircraft and missile propulsion systems; fundamentals of jet propulsion including air breathing and rocket engines. Introduction to advanced propulsion systems for space flights such as nuclear, thermonuclear, and plasma jets. Prerequisite: Mech Eng 3131, or Aero Eng 3171.
AER 5131 Aerospace Systems Design I (LEC 2.0)
Consideration of the creative design process with emphasis on aeronautical-aerospace systems. Short design problems to illustrate the process. Selection of design projects for Aero Eng 4781. Information gathering for the design projects which will be completed in Aerosp Systems Design II. Fall semester. Prerequisites: Aero Eng 3251, 3361, 3171.

AER 5131 Aerospace Systems Design II (LAB 3.0)
Preliminary design of aerospace systems. Project to integrate the knowledge of different aerospace engineering areas through synthesis and analysis. The creative design will include a consideration of such factors as performance reliability, cost, human factors, energy and ecology. Spring semester. Prerequisite: Aero Eng 4780.

AER 5139 Computational Fluid Dynamics (LEC 3.0)
Introduction to the numerical solution of the Navier-Stokes equations, by finite difference methods, in both stream function-vorticity and primitive variable formulations. Course format emphasizes student development of complete computer programs utilizing a variety of solution methods. Prerequisites: Comp Sci 1570 or 1970 or 1971; one course in fluid mechanics. (Co-listed with Mech Eng 5139).

AER 5169 Introduction to Hypersonic Flow (LEC 3.0)
A study of the basic principles of hypersonic flow. Inviscid and viscous hypersonic flow. Application of numerical methods. High temperature flow. Consideration of real gas and rarefied flow. Applications in aerodynamic heating and atmospheric entry. Prerequisite: Aero Eng 3171 or Mech Eng 5131 or Aero Eng 5131.

AER 5171 V/STOL Aerodynamics (LEC 3.0)

AER 5212 Introduction to Finite Element Analysis (LEC 3.0)
Variational formulation of the governing equations. Finite element model, interpolation functions, numerical integration, assembly of elements and solution procedures. Applications to solid mechanics, fluid mechanics and heat transfer problems. Two-dimensional problems. Computer implementation and use of commercial finite element codes. Prerequisite: Mech Eng 3708 or Aero Eng 4253 or consent of instructor for majors that do not require either of these courses, or graduate standing. (Co-listed with Mech Eng 5212).

AER 5220 Advanced Mechanics of Materials (LEC 3.0)
Comprehensive insight into mechanics of materials. Topics to include: theories of failure, torsion of noncircular sections, shear flow and shear center, unsymmetric bending, bending of curved members, beams on elastic foundation and pressurization of thick walled cylinders. Prerequisites: Civ Eng 2210, Math 3304. (Co-listed with Mech Eng 5220).

AER 5222 Introduction to Solid Mechanics (LEC 3.0)
Review of basic concepts in continuum mechanics. Finite elasticity: some universal solutions for isotropic materials, application of special mechanical models. Linear elasticity: compatibility, stress functions, superposition, special examples such as extension, torsion, bending, and plane problems. Elements of plasticity. Prerequisite: Eng Mech 5211. (Co-listed with Mech Eng 5222).

AER 5229 Smart Materials and Sensors (LAB 1.0 and LEC 2.0)
Smart structures with fiber reinforced polymer (FRP) composites and advanced sensors. Multi-disciplinary topics include characterization, performance, and fabrication of composite structures; fiber optic, resistance, and piezoelectric systems for strain sensing; and applications of smart composite structures. Laboratory and team activities involve manufacturing, measurement systems, instrumented structures, and performance tests on a large-scale smart composite bridge. Prerequisites: Senior standing and Math 3304. (Co-listed with Mech Eng 5229, Elec Eng 5270 and Civ Eng 5118).

AER 5234 Stability of Engineering Structures (LEC 3.0)
Solution of stability problems with applications to columns, plates and shell structures. Torsional and lateral buckling of columns. Buckling under high temperatures. Effect of imperfections introduced by a technological process on stability. Design issues related to stability requirements. Prerequisites: Civ Eng 2210, Math 3304; and Mech Eng 2350 or Mech Eng 2360 or Aero Eng 2360. (Co-listed with Mech Eng 5234).
**AERO ENG 5236 Fracture Mechanics (LEC 3.0)**
Linear elastic and plastic mathematical models for stresses around cracks; concept of stress intensity; strain energy release rates; correlation of models with experiment; determination of plane stress and plane strain parameters; application to design. Prerequisite: Civ Eng 2210. (Co-listed with Mech Eng 5236).

**AERO ENG 5238 Fatigue Analysis (LEC 3.0)**
The mechanism of fatigue, fatigue strength of metals, fracture mechanics, influence of stress conditions on fatigue strength, stress concentrations, surface treatment effects, corrosion fatigue and fretting corrosion, fatigue of joints components and structures, design to prevent fatigue. Prerequisite: Civ Eng 2210. (Co-listed with Mech Eng 5238).

**AERO ENG 5282 Introduction to Composite Materials & Structures (LEC 3.0)**
Introduction to fiber-reinforced composite materials and structures with emphasis on analysis and design. Composite micromechanics, lamination theory and failure criteria. Design procedures for structures made of composite materials. An overview of fabrication and experimental characterization. Prerequisite: Civ Eng 2210. (Co-listed with Mech Eng 5282).

**AERO ENG 5307 Vibrations I (LEC 3.0)**
Equations of motion, free and forced vibration of single degree of freedom systems. Natural frequencies, resonance, modes of vibration and energy dissipation are studied. The vibration of continuous systems is introduced. Prerequisites: Mech Eng 3411 and 3313, or Aero Eng 3613 and Math 3304. (Co-listed with Mech Eng 5307).

**AERO ENG 5309 Engineering Acoustics I (LEC 3.0)**
Introduction to acoustical theory and measurement with emphasis on mechanical and aerospace engineering applications. Plane and spherical wave propagation, resonators and filters, absorption, room acoustics, human response to noise, noise legislation, noise control. Use of common instrumentation in several projects. Prerequisites: Mech Eng 3411 & 3313, or Aero Eng 3613 & Math 3304. (Co-listed with Mech Eng 5309).

**AERO ENG 5313 Intermediate Dynamics of Mechanical and Aerospace Systems (LEC 3.0)**
Principles of dynamics are applied to problems in the design of mechanical and aerospace systems; basic concepts in kinematics and dynamics; dynamics of systems of particles; dynamics of rigid bodies, three-dimensional effects in machine elements; dynamic stability, theory and applications; methods of analytical dynamics. Prerequisite: Mech Eng 3313 or Aero Eng 3613. (Co-listed with Mech Eng 5313).

**AERO ENG 5352 Aerelasticity**
Study of phenomena involving interactions among inertial, aerodynamic, and elastic forces and the influence of these interactions on aircraft and space vehicle design. Some aerelastic phenomena are: divergence, control effectiveness, control reversal, flutter, buffeting, dynamic response to rapidly applied loads, aerelastic effects on load distribution, and static and dynamic stability. Prerequisites: Aero Eng 3251 and 3171.

**AERO ENG 5361 Flight Dynamics-Stability And Control (LEC 3.0)**
Review of static stability, dynamic equations of motion, linearized solutions, classical control design and analysis techniques, introduction to modern control. Prerequisite: Aero Eng 3361.

**AERO ENG 5449 Robotic Manipulators & Mechanisms (LAB 1.0 and LEC 2.0)**
Overview of industrial applications, manipulator systems and geometry. Manipulator kinematics; hand location, velocity and acceleration. Basic formulation of manipulator dynamics and control. Introduction to machine vision. Projects include robot programming, vision-aided inspection and guidance, and system integration. Prerequisites: Comp Sci 1970, Aero Eng 3613. (Co-listed with Mech Eng 5449).

**AERO ENG 5478 Mechatronics (LAB 1.0 and LEC 2.0)**
This course will introduce students to the basics of mechatronics (i.e., the integration of mechanical, electrical, computer, and control systems). Students will learn the fundamentals of sensors and actuators for mechanical systems, computer interfacing, microcontrollers, real-time software, and control. Prerequisite: Mech Eng 4479 or equivalent. (Co-listed with Mech Eng 5478, Elec Eng 5870 and Comp Eng 5820).

**AERO ENG 5481 Mechanical and Aerospace Control Systems (LEC 3.0)**
Synthesis of mechanical and aerospace systems to perform specific control functions. Response and stability are studied. Singular value analysis for stability margins is introduced. Prerequisite: Mech Eng 4479 or Aero Eng 3361. (Co-listed with Mech Eng 5481).

**AERO ENG 5519 Advanced Thermodynamics (LEC 3.0)**
After a short review of classical thermodynamics, the elements of chemical reactions, chemical equilibrium, statistical thermodynamics, and the basic concepts of kinetic theory are presented. Prerequisite: Mech Eng 2519. (Co-listed with Mech Eng 5519).

**AERO ENG 5525 Intermediate Heat Transfer (LEC 3.0)**
Analytical study of conduction; theory of thermal radiation and applications; energy and momentum equations in convective heat transfer and review of empirical relations. Current topics are included. Prerequisite: Mech Eng 3525. (Co-listed with Mech Eng 5525).

**AERO ENG 5527 Combustion Processes (LEC 3.0)**
Application of chemical, thermodynamic, and gas dynamic principles to the combustion of solid, liquid, and gaseous fuels. Includes stoichiometry, thermochemistry, reaction mechanism, reaction velocity, temperature levels, and combustion waves. Prerequisite: Mech Eng 3521. (Co-listed with Mech Eng 5527).

**AERO ENG 5535 Aerospace Propulsion Systems (LEC 3.0)**
Study of atmospheric and space propulsion systems with emphasis on topics of particular current interest. Mission analysis in space as it affects the propulsion system. Power generation in space including direct and indirect energy conversion schemes. Prerequisite: Aero Eng 4535.

**AERO ENG 5570 Plasma Physics I (LEC 3.0)**
Single particle orbits in electric and magnetic fields, moments of Boltzmann equation and introduction to fluid theory. Diffusion of plasma in electric and magnetic fields. Analysis of laboratory plasmas and magnetic confinement devices. Introduction to plasma kinetic theory. Prerequisite: Aero Eng 3131 or Mech Eng 3131 or Physics 3211 or Nuc Eng 3221 or Elec Eng 3600. (Co-listed with Mech Eng 5570, Nuc Eng 4370, Physics 4543).

**AERO ENG 5614 Spaceflight Mechanics (LEC 3.0)**
Further topics in orbital mechanics. Time equations, Lambert’s problem, patched-conic method, orbital maneuvers, orbit determination, orbit design, re-entry problem. Prerequisite: Aero Eng 3613.
AERO ENG 5715 Concurrent Engineering (LEC 3.0)
Students will be introduced to the concurrent engineering approach to product development. They will learn to set up quantitative requirements and then use a quantitative rating process to identify the critical requirements relating to the desired product. The interaction between design, manufacturing, assembly, cost, and supportability will be covered. The students will form teams and practice the concurrent engineering process for simple products. Prerequisites: Mech Eng 3313 or Aero Eng 3131 and Civ Eng 2210 (Co-listed with Mech Eng 5715).

AERO ENG 5758 Integrated Product Development (LAB 1.0 and LEC 2.0)
Students in design teams will simulate the industrial concurrent engineering development process. Areas covered will be design, manufacturing, assembly, cost, and product support. Using a 3-D solid modeling program, students will design, analyze, and send the data base to the automated machine shop where the parts will be manufactured. The parts will then be assembled, tested and analyzed for their performance. Prerequisites: Aero Eng 3251 or Mech Eng 3708 for Design; Mech Eng 3313 for Assembly; Accompanied or preceded by Mech Eng 5653 for Manufacturing; Eng Mgt 5711 or 5714 for Cost/Product Support.

AERO ENG 5760 Probabilistic Engineering Design (LEC 3.0)
The course deals with uncertainties in engineering analysis and design at three levels - uncertainty modeling, uncertainty analysis, and design under uncertainty. It covers physics-based reliability analysis and reliability-based design, robustness assessment and robust design, their integration with design simulations, and their engineering applications. Prerequisite: Mech Eng 3708 or Aero Eng 3361. (Co-listed with Mech Eng 5760).

AERO ENG 5830 Applied Computational Methods (LEC 3.0)
Detailed study of computational methods for efficient solution of selected fluids, structures, thermodynamics, and controls problems in aerospace and mechanical engineering. Besides basic numerical techniques, topics covered include gradient-based optimization and uncertainty quantification. Prerequisite: Comp Sci 1570 or 1970 or 1981; Math 3304. (Co-listed with Mech Eng 5830).