AEROSPACE ENGINEERING

The aerospace engineering program is offered in the department of mechanical and aerospace engineering. In aerospace engineering, you will apply the laws of physics and mathematics to problems of aircraft flight and space vehicles in planetary atmospheres and adjoining regions of space. Maybe you will design space shuttles, rockets, or missiles. Possibly you might design military, transport, and general aviation aircraft, a V/TOL (vertical/ take-off and landing) aircraft, or a UAV (unmanned aerial vehicle). You could design a spacecraft to travel to Mars or to a more distant planet.

You'll be able to tackle problems in the environmental pollution of air and water, or work on wind effects on buildings and structures, or wind energy harnessing. Designing all types of transportation systems, including high speed vehicles, urban rapid transit systems, and undersea craft might be some of the challenges you will undertake.

Your professional training in aerospace engineering will be directed generally toward the analysis and design of aerospace vehicles, including aircraft, missiles, and spacecraft with special emphasis on the fundamental treatment of aerospace science.

You will accomplish your goals through your basic training in aerodynamics, dynamics, stability and control, structures, and propulsion including cross-linkage among these areas. You will use this knowledge to design, build, and flight test aerospace systems.

Your studies at Missouri S&T will include both basic science and engineering science, mathematics, and liberal arts courses as well as advanced aerospace engineering courses. Within aerospace engineering, you can choose nine hours of technical electives in a special interest area such as aerodynamics, structures, composites, flight dynamics, controls, propulsion, and aeroelasticity.

Your design courses will be integrated with Missouri S&T's computer graphics system to unify the graphical capabilities of the computer into your design experience. Undergraduate research opportunities are also available through the NASA Space Grant Consortium and the OURE program.

Classes and laboratories are held in Toomey Hall. Laboratory facilities include a Mach 1.5 to 4 supersonic blow down wind tunnel with a five-inch diameter jet with instrumentation for Schlieren photography, pressure, temperature, and turbulence measurements. A large subsonic wind tunnel, capable of speeds up to 300 miles per hour, has a test section 48 inches wide, 32 inches high, and 11 feet long. Other facilities include a flight simulation laboratory, space systems engineering laboratory, aerospace structural test equipment, propulsion component analysis systems, and shock tubes.

Mission Statement

We will provide a rigorous, productive, and relevant academic learning environment for students, faculty, and staff in the mechanical and aerospace engineering department by continually focusing on our core missions of teaching, research, and service.

We will ensure that graduating students are well-educated and sufficiently prepared in the fundamentals of mechanical and aerospace engineering practice and science, such that they have the ability to solve open-ended problems in these disciplines and the capabilities required in order to become competent, productive, and well-rounded professionals.

We will emphasize scholarship, graduate education, and the development of new knowledge and skills in the traditional areas associated with mechanical and aerospace engineering. Additionally, we will develop cross-cutting multi-disciplinary efforts such that we are widely recognized by local, national, and international research and business communities as respected leaders in research, innovation, and discovery.

We will render meritorious service to our profession through active participation and engagement in service activities in our professional communities at all levels (local, national, and international), as well as in fulfilling campus and departmental governance, outreach, and service activities.

Missouri S&T Aerospace Engineering Program Objectives

The overall educational objective of the aerospace engineering program is to prepare graduates for careers in the aerospace engineering profession and related disciplines, and/or receive an advanced graduate degree within three to five years from their graduation. Specifically, the expected professional accomplishments of the program graduates within five years from their graduation are that:

- They are employed by industry, a government agency, or in academia, or are in private practice.
- They have demonstrated competence and are successfully contributing to the aerospace science, technology, or engineering workforce.
- They have found that their education at Missouri S&T was valuable preparation for their careers.

Aerospace Program Outcomes:

Students graduating from the Missouri S&T aerospace engineering program should have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Bachelor of Science Aerospace Engineering

The aerospace engineering program at Missouri S&T is characterized by its focus on the scientific basics of engineering and its innovative application. Indeed, the underlying theme of this educational program is the application of the scientific basics to engineering practice through attention to problems and needs of the public. The necessary interrelations among the various topics, the engineering disciplines, and the other professions as they naturally come together in the solution of real world problems are emphasized as research, analysis, synthesis, and design are presented and discussed through classroom and laboratory instruction.

Students must comply with the requirements specified in the current online catalog published by the registrar. For the bachelor of science degree in aerospace engineering a minimum of 128 credit hours is required. These requirements are in addition to credit received for algebra, trigonometry, and basic ROTC courses. An average of at least two grade points per credit hour must be attained. At least two grade points per credit hour must also be attained in all courses taken in aerospace engineering. Each student's program of study must contain a minimum of 24 credit hours of course work in general education and must be chosen to satisfy the following requirements:

1. ENGLISH 1120.
2. HISTORY 1200, HISTORY 1300, HISTORY 1310, or POL SCI 1200
3. ECON 1100 or ECON 1200.
4. ENGLISH 1160 or ENGLISH 3560 or SP&M S 1185
5. A literature elective*
6. An ethics elective*
7. Depth elective. A humanities or social science elective that has a humanities or social science course already taken as a prerequisite*
8. A humanities or social science elective*

*Humanities and social science elective must be at least 3 credit hours of lecture designation, and also meet the requirements as specified under "Engineering Degree Requirements" published in the current undergraduate catalog.

Freshman Year

First Semester	Credits	Second Semester	Credits
FR ENG 1100	1	MECH ENG 1720	3
CHEM 1310 & CHEM 1319 & CHEM 1100[1]	6	MATH 1215[4]	4
ENGLISH 1120	3	PHYSICS 1135[4]	4
MATH 1214 or 1211[4]	4	H/SS Economics elective[3]	3
H/SS History Elective[2]	3		
	17		**14**

Sophomore Year

First Semester	Credits	Second Semester	Credits
COMP SCI 1570 or 1972	2-3	AERO ENG 2780	2
COMP SCI 1580 or 1982	1	AERO ENG 2360[4]	3
CIV ENG 2200[4]	3	MECH ENG 2519[4]	3
MATH 2222[4]	4	MATH 3304[4]	3
PHYSICS 2135[4]	4	CIV ENG 2210[4]	3
AERO ENG 2861[4]	3	AERO ENG 2790	2
	17-18		**16**

Junior Year

First Semester	Credits	Second Semester	Credits
AERO ENG 3613[4]	3	AERO ENG 3251[4]	3
AERO ENG 3131[4]	3	AERO ENG 3361	3
AERO ENG 3877	3	AERO ENG 3171	3
ELEC ENG 2800	3	AERO ENG 4882	2
Electives-Advanced Math/Cmp Sci[5]	3	Elective/Ethics[9]	3
		Elective/Communications[7]	3
	15		**17**

Senior Year

First Semester	Credits	Second Semester	Credits
AERO ENG 4535	3	AERO ENG 4781 or 4791	3
AERO ENG 4253	3	Electives-Technical[6]	3
AERO ENG 4780 or 4790	2	Electives-Technical[6]	3
AERO ENG 4883	2	AERO ENG 4885	1
Electives-Technical[6]	3	Electives-Hum/Soc Sci	3
Depth Elective/Hum/Soc Sci[8]	3	Elective/Literature	3
	16		**16**

Total Credits: 128-129

[1] CHEM 1310, CHEM 1319 and CHEM 1100 or an equivalent training program approved by Missouri S&T.

[2] Must be one of the following: POL SCI 1200, HISTORY 1200, HISTORY 1300, or HISTORY 1310.

[3] Must be one of the following: ECON 1100 or ECON 1200.

[4] A grade of "C" or better in CHEM 1310, MATH 1214 or MATH 1211, MATH 1215, MATH 2222, MATH 3304, PHYSICS 1135, PHYSICS 2135, CIV ENG 2200, CIV ENG 2210, and computer programming elective, AERO ENG 2360, AERO ENG 2861, and MECH ENG 2519, as prerequisite for follow-up courses in the curriculum and for graduation.

[5] Must be one of the following: AERO ENG 5830, COMP SCI 3200, MATH 3108, STAT 3113, STAT 3115, or any 5000-level math or computer science course approved by the student's advisor.

[6] Electives must be approved by the student's advisor. Nine hours of technical electives must be in mechanical and aerospace engineering. Three hours of departmental technical electives must be at the 5000-level. AERO ENG 3877 and the 5000-level Asteroid Mining course co-listed with geological engineering are not to be used for 5000-level technical elective.

[7] This course can be selected from ENGLISH 1160, ENGLISH 3560, SP&M S 1185, or the complete four-course sequence in advanced ROTC (MIL ARMY 3250, MIL ARMY 3500, MIL ARMY 4250, and MIL ARMY 4500; or MIL AIR 3110, MIL AIR 3120, MIL AIR 4110 and MIL AIR 4120).

[8] To satisfy the depth requirement, this course should have a humanities and social science course already taken as a prerequisite.

[9] Must be a course on engineering ethics, business ethics, bio ethics, social ethics, or any ethics course approved by the student's advisor.

Minor in Aerospace Engineering

A student who receives a bachelor of science degree in an accredited engineering program from Missouri S&T may receive a minor in aerospace engineering by completing the 15 hours of courses listed below. Students must satisfy the prerequisite requirements for each

course. The department granting the bachelor of science degree shall determine whether or not courses taken for the minor may also be used to fulfill the requirements of the B.S. degree.

AERO ENG 2861	Aerospace Vehicle Performance	3
AERO ENG 3613	Aerospace Mechanics I	3
AERO ENG 3131	Aerodynamics I	3
AERO ENG 3251	Aerospace Structures I	3
AERO ENG 3000-level 3-hour lecture course (student choice)		3

Mohammad Abbas, Assistant Teaching Professor
PHD Missouri University of Science and Technology

Yezad Anklesaria, Assistant Teaching Professor
PHD Missouri University of Science and Technology

David Bayless, Professor and Chair
PHD University of Illinois-Urbana

Richard Billo, Director of the Kummer Institute Center for Advanced Manufacturing, Distinguished Professor of Mechanical and Aerospace Engineering
PHD Arizona State University

Victor Birman, Emeritus Professor
PHD Technion, Haifa, Israel

K Chandrashekhara, Curators Distinguished Professor
PHD Virginia Polytechnic Institute

L R Dharani, Curators Distinguished Professor
PHD Clemson University

Xiaosong Du, Assistant Professor
PHD Iowa State University

Daoru Han, Associate Professor
PHD University of Southern California

Serhat Hosder, Professor
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K M Isaac, Professor Emeritus
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Warner Meeks, Associate Teaching Professor
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Henry J Pernicka, Curators' Distinguished Teaching Professor
PHD Purdue University

David W Riggins, Curators Distinguished Teaching Professor Emeritus
PHD Virginia Polytechnic Institute

Jillian Schmidt, Associate Teaching Professor
PHD University of Minnesota

Davide Vigano, Assistant Professor
PHD University of Texas at Arlington

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 2790 Introduction to Spacecraft Design (LAB 1.0 and LEC 1.0)
Intro. to basics of spacecraft design, including design requirements, subsystem definition, and vehicle design synthesis. Lab work includes design and fabrication of a small spacecraft payload that is flight tested on a high altitude balloon to 100,000 feet. Post-flight data reduction and analysis. Field trip will be required for balloon launch/retrieval. Prerequisite: A grade "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: A grade of "C" or better in each of the following: Math 1215; Physics 1135 or Physics 1111.

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 the following: Aero Eng 2861; Math 1214 or Math 1211; Math 1215; Math 2222; Physics 1135 or Physics 1111.

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. Bending, shear, and torsion of open and closed section beams. Design of thin walled structures. Prerequisites: A grade of "C" or better in each of the following: Math 1214 (or 1211); Math 1215; Math 2222; Physics 1135 or Physics 1111; 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 space flight. Emphasis is placed on satellite orbits and general theory of gyrodynamics. Prerequisites: Math 3304; a grade of "C" or better in each of the following: Aero Eng 2360 or Mech Eng 2360; Math 1214 (or 1211); Math 1215; Math 2222; Physics 1135 or Physics 1111.

AERO ENG 3877 Principles of Engineering Materials (LEC 3.0)
Examination of engineering materials with emphasis on selection and application of materials in industry. Particular attention is given to properties and applications of materials in extreme temperature and chemical environments. A discipline specific design project is required. (Not a technical elective for undergraduate metallurgy or ceramic majors) (Co-listed with Chem Eng 5300, Physics 4523, Met Eng 5810, Cer Eng 5810).

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)
Aircraft and spacecraft structure loads and regulations. Advanced methods in structural analysis using virtual work, energy methods, matrix methods, and finite element analysis. Thin plate theory and structural instability. Dynamic analysis of structures and fatigue analysis. Introduction to aeroelasticity. Prerequisite: Aero Eng 3251.

AERO ENG 4535 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.

AERO ENG 4780 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 Aerospace Systems Design II. Fall semester. Prerequisites: Aero Eng 3251, 3361, 3171.

AERO ENG 4781 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.

AERO ENG 4790 Spacecraft Design I (LEC 3.0)
Fundamentals of spacecraft design. Systems engineering, subsystem analysis and design. Gantt charts, organizational charts. Oral presentations and technical documentation. Term project to involve design and development of actual flight hardware, continuing into Spacecraft Design II. Prerequisites: Aero Eng 3251, 3361, and 3171 for Aero Eng majors; consent of instructor for non-Aero Eng majors.

AERO ENG 4791 Spacecraft Design II (LAB 3.0)
As a continuation of Aero Eng 4790, detailed spacecraft design is performed, leading to procurement of components. As schedules permit, spacecraft fabrication and test commence. Development of labs to facilitate spacecraft test, operation, and data analysis continues. Prerequisites: Aero Eng 4790 for Aero Eng majors; consent of instructor for non-Aero Eng majors.

AERO ENG 4882 Experimental Methods in Aerospace Engineering I (LAB 2.0)
Introduction to experimental methods in low-speed aerodynamics, flight simulation, and aircraft structures. Measurements of drag, boundary layer flows, and aerodynamic forces and moments. Flight simulations, and structural testing of aircraft components. Statistical methods and probability distributions in data analysis and interpretation. Prerequisites: Aero Eng 3131 and Elec Eng 2800.

AERO ENG 4883 Experimental Methods in Aerospace Engineering II (LAB 2.0)
Laboratory investigations related to aerospace engineering. Investigations include high-speed aerodynamics, flow visualization measurements in turbulent flow, aircraft vibration and flutter, propeller acoustics, flight simulation, propulsion systems, flame measurements, and control experiments. Statistical error analysis. Prerequisites: Aero Eng 3251, 3361, 3171, & 4882.

AERO ENG 4885 Assessment (LEC 1.0)
This course is an overview and assessment of the required aerospace engineering courses that the students took. Prerequisites: Aero Eng 3171, Aero Eng 3361, Aero Eng 4253; preceded or accompanied by Aero Eng 4535.

AERO ENG 5000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

AERO ENG 5001 Special Topics (LEC 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title. (Co-listed with Mech Eng 5001).

AERO ENG 5131 Intermediate Thermofluid Mechanics (LEC 3.0)
Derivation of Navier-Stokes equations, analytical solutions of viscous flows; flow in pipes, flow networks; intermediate treatment of boundary layer theory; micro-fluidics and MEMS; introduction to numerical methods for solving fluid flows; and, preliminary treatise on turbulence. Prerequisite: Mech Eng 3131 or Aero Eng 3131. (Co-listed with Mech Eng 5131).

AERO ENG 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).

AERO ENG 5169 Introduction to Hypersonic Flow (LEC 3.0)
A study of the basic principles of hypersonic flow. Invisvid and viscous hypersonic flow. Application of numerical methods. High temperature flow. Consideration of real gas and rarefied flow. Applications in aero-dynamic heating and atmospheric entry. Prerequisites: Aero Eng 3171.

AERO ENG 5171 V/Stol Aerodynamics (LEC 3.0)
Basic concepts of V/STOL flight. Take-off transition and landing performance, thrust vectoring. Propeller and helicopter aerodynamics. Unblown and blown flaps. Boundary layer control. Lift fans and ducted propellers. Wing-propeller interaction and thrust augmentation. Prerequisite: Aero Eng 3171.

AERO ENG 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. Prerequisites: Math 3304; senior or graduate standing. (Co-listed with Mech Eng 5212).

AERO ENG 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).

AERO ENG 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).

AERO ENG 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).

AERO ENG 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 5353 Aeroelasticity (LEC 3.0)
Study of phenomena involving interactions among inertial, aerodynamic, and elastic forces and the influence of these interactions on aircraft and space vehicle design. Some aeroelastic phenomena are: divergence, control effectiveness, control reversal, flutter, buffeting, dynamic response to rapidly applied loads, aeroelastic 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 and 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: Mech Eng 3313; Comp Sci 1970 or Comp Sci 1971 or Comp Sci 1972 or Comp Sci 1570. (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 5539 Modeling Across Scales in Computational Mechanics (LEC 3.0)
Fundamental principles of continuum and sub-continuum (atomic) models will be learned through lectures and hands-on Matlab coding. Prerequisites: Civ Eng 2210, Mech Eng 2519, or consent of instructor for majors that do not require either of these courses; or graduate standing. (Co-listed with Mech Eng 5539).

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).