Aerospace Engineering and Engineering Mechanics

In the College of Engineering

OFFICE: Engineering 308
TELEPHONE: 619-594-6074
E-MAIL: ae@engineering.sdsu.edu

The undergraduate degree in Aerospace Engineering is accredited by the American Board for Engineering and Technology.

Faculty

Emeritus: Conly, Dharmarajan, Faulkner, Pierucci, Shutts, Wang
Chair: Katz
Professors: Katz, Narang, Nosseir, Plotkin
Assistant Professor: Venkataraman

Offered by the Department

Doctor of Philosophy degree in engineering sciences/applied mechanics.
Master of Engineering in manufacturing and design.
Master of Science degree in aerospace engineering.
Major in aerospace engineering with the B.S. degree.

Transfer Credit

No credit will be given for upper division engineering coursework taken at an institution having an engineering program which has not been accredited by the American Board for Engineering and Technology, unless the student successfully completes the first 12 units of engineering work attempted at this university. At that time, and upon recommendation of the department, credit will be given for the unaccredited work.

General Education

Students will complete a minimum of 50 units in General Education, to include a minimum of nine upper division units taken after attaining junior class standing. No more than twelve units may be used for General Education credit from any one department or academic unit. No more than 7 units from one department can be used in Sections II and IV combined (Foundations and Explorations), nor more than 10 units from one department in Sections II, III, and IV combined (Foundations, American Institutions, and Explorations).

I. Communication and Critical Thinking: 9 units
You may ***not*** use Credit/No Credit grades in this section.
1. Oral Communication (3 units)
2. Composition (3 units)
3. Intermediate Composition and Critical Thinking (3 units)

II. Foundations: 29 units
A. Natural Sciences and Quantitative Reasoning (17 units):
1. Physical Sciences (11 units)
Engineering students will take Chemistry 202 (4 units).
Physics 195 (3 units)
Physics 195L (1 unit)
Physics 196 (3 units)
2. Life Sciences (3 units)
3. Laboratory (satisfied under A.1. above)
4. Mathematics/Quantitative Reasoning
Engineering students will take Mathematics 150, 3 units applicable to General Education. You may ***not*** use Credit/No Credit grades.

B. Social and Behavioral Sciences (3 units)
C. Humanities (9 units)
Complete three courses in three different areas. One of these courses and the one under IV.A. below must be taken in the same department.

III. American Institutions: Three units of the six units of coursework which meet the American Institutions graduation requirement may be used in General Education, excluding courses numbered 500 and above.

IV. Explorations: Courses in this area must not be taken sooner than the semester in which you achieve upper division standing (60 units passed). Upper division courses in the major department may not be used to satisfy General Education. Total 9 units; must include one course of cultural diversity.
A. Upper division Humanities (3 units)
Three units must be taken from the same department as one of the Humanities courses selected in Foundations.
B. Upper division Humanities (3 units from a department not selected in A above.)
C. Upper division Social and Behavioral Sciences (3 units)

The Major

The educational objectives of the aerospace engineering program are (1) To provide students with a comprehensive education in aerospace engineering with coverage of all major sub-disciplines. All students will receive an appropriate background in mathematics, science, and engineering fundamentals, and further studies in aerodynamics, structures, flight mechanics, stability and control, propulsion and aerospace design. (2) To provide students with preparation for careers in aerospace engineering or related fields by emphasizing analysis and problem solving skills and fostering the following attributes: individual initiative, ability to work in teams, good communication skills, and ethical professional behavior. (3) To cultivate in students an appreciation for lifelong learning including graduate study and career paths in research and development.

The aerospace industry, the second largest industry in our country, is one of the largest employers of engineers. Opportunities for employment in entry level positions in large aircraft companies, general aviation manufacturers, or government aerospace-related laboratories are good. Graduates of the program are also qualified to continue their formal education at the graduate level or to accept entry level positions in several nonaerospace fields.

Major Academic Plans (MAPs)

Visit http://www.sdsu.edu/mymap for the recommended courses needed to fulfill your major requirements. The MAPs Web site was created to help students navigate the course requirements for their majors and to identify which General Education course will also fulfill a major preparation course requirement.

The following is a recommended sequence of courses for the major in aerospace engineering.
See General Education in this section for specific GE requirements.

AEROSPACE ENGINEERING MAJOR

FRESHMAN YEAR

Fall Semester	*Units*	*Spring Semester*	*Units*
GE Composition	3	GE Intermediate Composition	3
GE Math / Math 150, Calculus I	4	GE Oral Communication	3
GE Social Science	3	GE Humanities	3
Chemistry 202, General Chemistry	4	Physics 195, Principles of Physics	3
M E 101, Solid Modeling I	2	Physics 195L, Principles of Physics Lab.	1
A E 123, The Aerospace Engineer	1	Mathematics 151, Calculus II	4
	17		17

SOPHOMORE YEAR

Fall Semester	*Units*	*Spring Semester*	*Units*
GE Life Science	3	*Take the Writing Proficiency Assessment Examination*	
GE Humanities	3	Physics 197, Principles of Physics	3
Mathematics 252, Calculus III	4	E E 204, Principles of Elec. Engr.	3
E M 200, Statics	3	E M 220, Dynamics	3
Physics 196, Principles of Physics	3	ENGR 280, Methods of Analysis	3
M E 203, Computer Prog. & Appl.	2	M E 240, Intro. to Engineering Materials	3
		GE Humanities	3
	18		18

JUNIOR YEAR *

Fall Semester	*Units*	*Spring Semester*	*Units*
M E 352, Thermodynamics and Heat Transfer	3	ENGR 510, Methods of Analysis	3
A E 301, Low Speed Aerodynamics	3	A E 302, High Speed Aerodynamics	3
CIV E 301, Intro. to Solid Mechanics	3	A E 303, Experimental Aerodynamics	2
CIV E 302, Solid Mechanics Lab.	1	A E 310, Aerospace Struc. Anal.	3
E M 340, Fluid Mechanics	3	A E 320, Aerospace Flight Mech.	3
E M 341, Fluid Mechanics Lab.	1	American Institutions	3
American Institutions	3		
	17		17

SENIOR YEAR

Fall Semester–*All Specializations*

	Units
A E 403, Aerosp. Engr. Senior Project	3
A E 410, Aerospace Struc. Dynamics	3
A E 430, Aircraft Propulsion Systems	3
A E 440, Aircraft Stab. and Control I	3
A E 460A, Aerosp. Engr. Applications	3
GE Explorations	3
	18

Spring Semester–*According to Specialization*

Aerodynamics	*Units*
A E 460B, Aerosp. Engr. Applications	2
GE Explorations	3
GE Explorations	3
Choose any two courses:	
A E 530, Rocket & Space Propulsion	3
A E 550, Viscous Flow	3
E M 510, Fin. Elem. Meth. Aero. Struc.	3
	14

Aerospace Structures	*Units*
A E 460B, Aerosp. Engr. Applications	2
GE Explorations	3
GE Explorations	3
Choose any two courses:	
A E 540, Arcrft. Stability & Control II	3
E M 510, Fin. Ele. Meth. Aero. Struc.	3
E M 530, Composite Struc. Analysis	3
	14

Propulsion & Flight Mechanics	*Units*
A E 460B, Aerosp. Engr. Applications	2
GE Explorations	3
GE Explorations	3
Choose any two courses:	
A E 520, Int. Aerospace Flight Mech.	3
A E 530, Rocket & Space Propulsion	3
A E 540, Arcrft. Stability & Control II	3
	14

TOTAL **136**

* A master plan must be filed during first semester of junior year.

Other electives may be substituted with permission of the adviser and department chair.

Aerospace Engineering Major

With the B.S. Degree (Major Code: 09021)

Students majoring in aerospace engineering must include in their program a sequence of fundamental courses. In addition, the students have the opportunity to satisfy their particular areas of interest by selecting a pattern of study indicated in the sequence below. This pattern includes typical aerospace engineering topics, such as aerospace vehicle design, performance, structural analysis, aerodynamics, and propulsion.

Graduation Writing Assessment Requirement. Passing the Writing Proficiency Assessment with a score of 10 or above or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See page 81 in "Graduation Requirements" section for a complete listing of requirements.

Master Plan. A master plan of elective courses and area of specialization must be approved by the undergraduate adviser and filed with the Office of Advising and Evaluations during the first semester of the junior year.

NOTE: See previous page for recommended sequence of courses for the major in aerospace engineering.

Courses

Refer to Courses and Curricula and University Policies sections of this catalog for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.

LOWER DIVISION COURSE IN AEROSPACE ENGINEERING (A E)

A E 123. The Aerospace Engineer (1)
Introduction to professional aerospace engineering. Emphasis on aeronautics and astronautics.

UPPER DIVISION COURSES IN AEROSPACE ENGINEERING (Intended for Undergraduates)

A E 301. Low Speed Aerodynamics (3)
Prerequisite: Credit or concurrent registration in Engineering Mechanics 340.
Subsonic flow, airfoil and wing theory, experimental characteristics of wing sections, high lift devices.

A E 302. High Speed Aerodynamics (3)
Prerequisites: Aerospace Engineering 301 and Mechanical Engineering 352.
Supersonic flow, two- and three-dimensional compressible flow, wings in compressible flow, two- and three-dimensional method of characteristics, transonic flow.

A E 303. Experimental Aerodynamics (2)
One lecture and three hours of laboratory.
Prerequisites: Engineering Mechanics 341 and credit or concurrent registration in Aerospace Engineering 301.
Operating characteristics of subsonic and supersonic wind tunnels. Aerodynamic characteristics of wings and bodies. Flow visualization techniques. Force, moment and pressure distribution measurement. Use of hot-wire anemometer and schlieren equipment.

A E 310. Aerospace Structural Analysis (3)
Prerequisite: Civil Engineering 301.
Methods of static structural analysis of problems encountered in flight of aerospace vehicles.

A E 320. Aerospace Flight Mechanics (3)
Prerequisites: Engineering Mechanics 220 and Engineering 280.
Two-body orbital mechanics including geocentric orbits and interplanetary transfers.

A E 403. Aerospace Engineering Senior Project (3)
One lecture and six hours of laboratory.
Prerequisites: Aerospace Engineering 302, 303, Engineering Mechanics 340.
Design and build an aerospace project, conduct experimental measurements, perform analyses of measured data.

A E 410. Aerospace Structural Dynamics (3)
Prerequisites: Credit or concurrent registration in Aerospace Engineering 310.
Methods of structural dynamic analysis of problems encountered in aerospace vehicles.

A E 430. Aircraft Propulsion Systems (3)
Prerequisite: Aerospace Engineering 302 or Mechanical Engineering 351.
Theory and performance characteristics of aircraft propulsion systems including reciprocating engines, turbojets, ramjets, etc.

A E 440. Aircraft Stability and Control I (3)
Prerequisite: Aerospace Engineering 303.
Static stability and control, general equations of unsteady motion, stability derivatives, stability of uncontrolled motion, response of aircraft to actuation of controls.

A E 460A. Aerospace Engineering Applications (3) I
One lecture and five hours of design activity.
Prerequisites: Aerospace Engineering 302, 303 and 310.
Student projects in aerospace design.

A E 460B. Aerospace Engineering Applications (2) II
Six hours of laboratory.
Prerequisite: Aerospace Engineering 460A.
Student projects in aerospace design.

A E 496. Advanced Aerospace Engineering Topics (1-3) I, II
Prerequisite: Consent of instructor.
Modern developments in engineering. See *Class Schedule* for specific content. Maximum credit six units for any combination of Aerospace Engineering 496 and 499.

A E 499. Special Study (1-3) I, II
Prerequisite: Consent of instructor.
Individual study. Maximum credit six units for any combination of Aerospace Engineering 496 and 499.

UPPER DIVISION COURSES IN AEROSPACE ENGINEERING (Also Acceptable for Advanced Degrees)

A E 520. Intermediate Aerospace Flight Mechanics (3)
Prerequisite: Aerospace Engineering 320.
Rigid-body dynamics with applications in spacecraft attitude dynamics.

A E 530. Rocket and Space Propulsion (3)
Prerequisite: Aerospace Engineering 430.
Equilibrium combustion thermodynamics. Performance of rocket propelled vehicles. Rocket propulsion fundamentals. Topics in chemical (solid and liquid) and electrical propulsion systems.

A E 540. Aircraft Stability and Control II (3)
Prerequisite: Aerospace Engineering 440.
Dynamic stability and control of rigid aircraft; general equations of unsteady motion, stability derivatives, perturbed state thrust forces and moment, special problems in dynamic stability and response.

A E 550. Viscous Flow (3)
Prerequisites: Credit or concurrent registration in Engineering Mechanics 340, and Engineering 510.
Kinematics of fluid motion. Conservation of mass, momentum, and energy. Navier-Stokes equations; exact solutions. Boundary layer approximations, turbulent flow.

A E 596. Advanced Aerospace Engineering Topics (3)
Prerequisite: Consent of instructor.
Modern developments in aerospace engineering. See *Class Schedule* for specific content. Maximum credit of six units for any combination of Aerospace Engineering or Engineering Mechanics 496, 499, and 596 applicable to a bachelor's degree. Maximum combined credit of six units of Aerospace Engineering or Engineering Mechanics 596 and 696 applicable to a 30-unit master's degree.

LOWER DIVISION COURSES IN ENGINEERING MECHANICS (E M)

E M 200. Statics (3) I, II
Prerequisites: Physics 195 and credit or concurrent registration in Mathematics 151. **Proof of completion of prerequisites required:** Copy of transcript or enrollment confirmation.
Force systems, equilibrium, structures, distributed forces, friction, virtual work, moments of inertia, vector algebra.

E M 202. Mechanics for Engineers (3) I, II
Prerequisites: Physics 195 and credit or concurrent registration in Mathematics 151.
Essentials of mechanics of particles and rigid bodies for engineering applications. Emphasis on particle dynamics. Intended for electrical engineering and environmental engineering majors. Not open to students with credit in Engineering Mechanics 200 or 220.

E M 220. Dynamics (3) I, II
Prerequisite: Engineering Mechanics 200 with a grade of C or better. **Proof of completion of prerequisite required:** Copy of transcript.
Kinetics of a particle; central force motion; systems of particles; work and energy; impulse and momentum; moments and products of inertia; Euler's equations of motion; vibration and time response; engineering applications.

E M 296. Experimental Topics (1-4)
Selected topics. May be repeated with new content. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

UPPER DIVISION COURSES IN ENGINEERING MECHANICS (Intended for Undergraduates)

E M 340. Fluid Mechanics (3) I, II
Prerequisites: Engineering Mechanics 220 or 202; and credit or concurrent registration in Engineering 280.
Fluid statics. Laminar and turbulent flow of liquids and gases in pipes, nozzles, and channels. Dimensional analysis and modeling. Drag forces on moving or immersed objects.

E M 341. Fluid Mechanics Laboratory (1) I, II
Three hours of laboratory.
Prerequisite: Credit or concurrent registration in Engineering Mechanics 340.
Flow measuring devices. Experimental applications of continuity, Bernoulli and momentum equations. Model studies. Pipe and channel flows. Flow visualization techniques. Operating characteristics of wind tunnel and water table.

E M 496. Advanced Engineering Mechanics Topics (1-3) I, II
Prerequisite: Consent of instructor.
Modern developments in engineering mechanics. See *Class Schedule* for specific content. Maximum credit six units for any combination of Engineering Mechanics 496, 499, and 596.

E M 499. Special Study (1-3) I, II
Prerequisite: Consent of instructor.
Individual study. Maximum credit six units for any combination of Engineering Mechanics 496, 499, and 596.

UPPER DIVISION COURSES IN ENGINEERING MECHANICS (Also Acceptable for Advanced Degrees)

E M 510. Finite Element Methods in Aerospace Structures (3)
Prerequisite: Aerospace Engineering 410.
Static and dynamic analysis of aerospace structures utilizing finite element methods.

E M 530. Composite Structural Analysis (3)
Prerequisites: Engineering 280 and Civil Engineering 301.
Strength of composite materials; lamination theory; strength analysis of laminates; bending, buckling, and vibration of composite plates.

E M 585. Fundamentals of Micro-Electro-Mechanical Systems (MEMS) (3)
One lecture and four hours of laboratory.
Prerequisites for aerospace engineering majors: E E 204, E M 220, and M E 240.
Prerequisites for electrical engineering majors: E E 330, E M 202, and M E 240.
Prerequisites for mechanical engineering majors: E E 303, E M 220, and M E 240.
Microfabrication techniques, microsensors and microactuators, and scaling laws. A design project of a micro-device including schematic creation, test of performance, layout generation, and layout versus schematic comparison.

E M 596. Advanced Engineering Mechanics Topics (1-3)
Prerequisite: Consent of instructor.
Modern developments in engineering mechanics. See *Class Schedule* for specific content. Maximum credit of six units for any combination of Engineering Mechanics 496, 499, and 596 applicable to a bachelor's degree. Maximum combined credit of six units of Engineering Mechanics 596 and 696 applicable to a 30-unit master's degree.

GRADUATE COURSES IN AEROSPACE ENGINEERING AND ENGINEERING MECHANICS
Refer to the *Graduate Bulletin.*