

Aerospace Engineering

In the College of Engineering

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The undergraduate degree in Aerospace Engineering is accredited by the Engineering Accreditation Commission (EAC) of ABET, <http://www.abet.org>.

Faculty

Emeritus: Conly, Dharmarajan, Nosseir, Pierucci, Shutts, Wang
Chair: Lu
Professors: Jacobs, Katz, Narang, Plotkin, Venkataraman
Associate Professor: Demasi
Assistant Professor: Liu

Offered by the Department

Doctor of Philosophy degree in engineering sciences:
(bioengineering), (electrical and computer engineering),
(mechanical and aerospace engineering), (structural engineering).
Master of Engineering.
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 Engineering Accreditation Commission (EAC) of ABET, 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 12 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 of Learning and Explorations of Human Experience), nor more than 10 units from one department in Sections II, III, and IV combined (Foundations of Learning, American Institutions, and Explorations of Human Experience).

I. Communication and Critical Thinking: 9 units

You may **not** use Credit/No Credit grades in this section. A grade of C- (1.7) or better is required.

1. Oral Communication (3 units)
2. Composition (3 units)
3. Intermediate Composition and Critical Thinking (3 units)

II. Foundations of Learning: 29 units

- A. Natural Sciences and Quantitative Reasoning (17 units):
 1. Physical Sciences (11 units)
Engineering students will take Chemistry 202 (4 units) or Chemistry 200 (5 units).
Physics 195 (3 units)
Physics 195L (1 unit)
Physics 196 (3 units)
 2. Life Sciences (3 units)
Engineering students will take Biology 100 or 101.
 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. A grade of C- (1.7) or better is required. (NOTE: preparation for the major requires a grade of C (2.0) or better.)

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 to satisfy this section, excluding courses numbered 500 and above.

IV. Explorations of Human Experience: 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 of Learning.

B. Upper division Social and Behavioral Sciences (3 units).

C. Upper division Social and Behavioral Sciences (Engineering majors may satisfy this area with an additional American Institutions course (excluding 500-level) to complete the American Institutions requirement if this requirement was not completely satisfied with lower division coursework) (3 units).

The Major

The objectives of the aerospace engineering program are to produce Bachelor of Science graduates who will (1) be successfully employed in government laboratories, industry, organizations, or small businesses and contribute to the advancement of aerospace engineering and related fields; (2) continue to advance in their careers on the merits of their skills in communication and teamwork, ethical behavior, leadership abilities, and technical problem solving; (3) continue their professional development by pursuing graduate degrees or utilizing educational and career building opportunities provided through their employer or professional societies.

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.

Retention Policy

The engineering program expects all majors will make reasonable academic progress toward the degree. Engineering premajors who have either (1) completed major preparatory courses, earned 60 units, but have less than a 2.7 cumulative GPA; or (2) earned 60 units but have not completed major preparatory courses and/or have less than a 2.7 cumulative GPA may be removed from the premajor and placed in undeclared.

Impacted Program

The aerospace engineering major is an impacted program. To be admitted to the aerospace engineering major, students must meet the following criteria:

- a. Complete with a grade of C (2.0) or better: Aerospace Engineering 200 [or Mechanical Engineering 200]; Chemistry 202 (or 200); Mathematics 150, 151; Physics 195, 196. These courses cannot be taken for credit/no credit (Cr/NC);
- b. Have an overall cumulative GPA of 2.7.

To complete the major, students must fulfill the degree requirements for the major described in the catalog in effect at the time they are accepted into the premajor at SDSU (assuming continuous enrollment).

Major Academic Plans (MAPs)

Visit <http://www.sdsu.edu/mymap> for the recommended courses needed to fulfill your major requirements. The MAPs website 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.

Aerospace Engineering Major

With the B.S. Degree

(Major Code: 09021) (SIMS Code: 441001)

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, structural analysis, aerodynamics, and propulsion.

The program below describes 137 units required for the degree. Each course specifically listed in the program is required.

Preparation for the Major. Aerospace Engineering 123, 280; Aerospace Engineering 200 [or Mechanical Engineering 200]; Aerospace Engineering 220 [or Mechanical Engineering 220]; Biology 100 or 101; Chemistry 202 (or 200); Electrical Engineering 204; Mathematics 150, 151, 252; Mechanical Engineering 101, 202, 240; Physics 195, 195L, 196, 197. (50 units)

Aerospace Engineering 200 [or Mechanical Engineering 200]; Chemistry 202 (or 200); Mathematics 150, 151; Physics 195, 196 must be completed with a grade of C (2.0) or better. These courses cannot be taken for credit/no credit (Cr/NC).

General Education. Engineering students must follow the specific General Education program outlined in this section of the catalog. Other general education requirements and limitations, as well as listings of specific General Education course electives are presented in the General Education section of Graduation Requirements for the Bachelor's Degree.

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

Major. A minimum of 51 upper division units to include Aerospace Engineering 301, 302, 303, 310, 320, 340, 341, 403, 410, 430, 440, 460A, 460B, 515; Civil Engineering 301 (or Mechanical Engineering 304), 302; Mechanical Engineering 350; and six units selected from Aerospace Engineering 510, 520, 530, 535 [or Mechanical Engineering 535], 540, 550.

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

Master Plan. The master plan provides an advising record for aerospace engineering majors and should be initiated by the student with their faculty adviser during the second semester of the freshman year. All students must have a master plan on file in the department prior to enrollment in Aerospace Engineering 301 or 310. The master plan must be reviewed each semester with the faculty adviser before registration. All course substitutions must be approved by the department chair.

COURSES (A E)

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 COURSES

A E 123. The Aerospace Engineer (1)

Introduction to professional aerospace engineering. Emphasis on aeronautics and astronautics.

A E 200. Statics (3)

(Same course as Mechanical Engineering 200)

Prerequisites: Physics 195 and credit or concurrent registration in Mathematics 151. **Proof of completion of prerequisites required:** Copy of transcript or registration confirmation.

Force systems, equilibrium, structures, distributed forces, friction, virtual work, moments of inertia, vector algebra. (Formerly numbered Engineering Mechanics 200.)

A E 220. Dynamics (3)

(Same course as Mechanical Engineering 220)

Prerequisite: Aerospace Engineering 200 [or Mechanical Engineering 200] with a grade of C (2.0) 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. (Formerly numbered Engineering Mechanics 220.)

A E 280. Methods of Analysis (3)

Prerequisite: Mathematics 151 with minimum grade of C. Recommended: Mathematics 252.

Selected topics from ordinary differential equations, the Laplace transform, Fourier series, and linear algebra, with engineering applications. (Formerly numbered Engineering 280.)

A E 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 (Intended for Undergraduates)

A E 301. Low Speed Aerodynamics (3)

Prerequisite: Credit or concurrent registration in Aerospace Engineering 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 350.

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: Aerospace Engineering 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)

Prerequisites: Mechanical Engineering 240; and Civil Engineering 301 (or Mechanical Engineering 304).

Methods of static structural analysis of problems encountered in flight of aerospace vehicles.

A E 320. Aerospace Flight Mechanics (3)

Prerequisites: Aerospace Engineering 220 [or Mechanical Engineering 220] and Aerospace Engineering 280.

Two-body orbital mechanics including geocentric orbits and interplanetary transfers.

A E 340. Fluid Mechanics (3)

Prerequisites: Aerospace Engineering 220 [or Mechanical Engineering 220]; and credit or concurrent registration in Aerospace 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. (Formerly numbered Engineering Mechanics 340.)

A E 341. Fluid Mechanics Laboratory (1)

Three hours of laboratory.

Prerequisite: Credit or concurrent registration in Aerospace Engineering 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. (Formerly numbered Engineering Mechanics 341.)

A E 403. Aerospace Engineering Senior Project (3)

One lecture and six hours of laboratory.

Prerequisites: Aerospace Engineering 302, 303, 340.

Design and build an aerospace project, conduct experimental measurements, perform analyses of measured data.

A E 410. Aerospace Structural Dynamics (3)

Prerequisite: 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)

One lecture and five hours of design activity.

Prerequisites: Aerospace Engineering 302, 303, 310.

Student projects in aerospace design.

A E 460B. Aerospace Engineering Applications (2)

Six hours of laboratory.

Prerequisite: Aerospace Engineering 460A.

Student projects in aerospace design.

A E 496. Advanced Aerospace Engineering Topics (1-3)

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, 499, and 596.

A E 499. Special Study (1-3)

Prerequisite: Consent of instructor.

Individual study. Maximum credit six units for any combination of Aerospace Engineering 496, 499, and 596.

UPPER DIVISION COURSES (Also Acceptable for Advanced Degrees)

A E 510. Finite Element Methods in Aerospace Structures (3)

Prerequisite: Aerospace Engineering 410.

Static and dynamic analysis of aerospace structures utilizing finite element methods. (Formerly numbered Engineering Mechanics 510.)

A E 515. Methods of Analysis (3)

Prerequisite: Aerospace Engineering 280 with minimum grade of C.

Selected topics from vector calculus, partial differential equations, and complex analysis, with engineering applications. (Formerly numbered Engineering 510.)

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 535. Mechanics of Composite Structures (3)

(Same course as Mechanical Engineering 535)

Prerequisites: Aerospace Engineering 280 and Aerospace Engineering 310 or Mechanical Engineering 314.

Micro- and macro-mechanics of composite materials, classical lamination theory, initial failure prediction and progressive failure analysis of laminates, analysis of beam and plate structures, stiffness and strength based design of composites. Not open to students with credit in Mechanical Engineering 540. (Formerly numbered Engineering Mechanics 530.)

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: Aerospace Engineering 340 and credit or concurrent registration in Aerospace Engineering 515.

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. May be repeated with new content. See *Class Schedule* for specific content. Maximum credit of six units for any combination of Aerospace Engineering 496, 499, and 596 applicable to a bachelor's degree. Credit for 596 and 696 applicable to a master's degree with approval of the graduate adviser.

GRADUATE COURSES Refer to the Graduate Bulletin.
