

AERONAUTICS AND ASTRONAUTICS UNDERGRADUATE MAJOR

COVID-19-Related Degree Requirement Changes

For information on how Aeronautics and Astronautics degree requirements have been affected by the pandemic, see the "COVID-19 Policies" tab (<http://exploreddegrees.stanford.edu/schoolofengineering/aeronauticsandastronautics/#covid19policiestext>) in the "Aeronautics and Astronautics" of this bulletin. For University-wide policy changes related to the pandemic, see the "COVID-19 and Academic Continuity (<http://exploreddegrees.stanford.edu/covid-19-policy-changes/>)" section of this bulletin.

See the "Department of Aeronautics and Astronautics (<http://exploreddegrees.stanford.edu/schoolofengineering/aeronauticsandastronautics/>)" section of this bulletin for additional information on the department, and its programs and faculty.

The department offers a B.S. as well as a minor in Aeronautics and Astronautics.

Aeronautics and Astronautics (AA) Mission of the Undergraduate Program in Aeronautics and Astronautics

The mission of the undergraduate program in Aeronautics and Astronautics Engineering is to provide students with the fundamental principles and techniques necessary for success and leadership in the conception, design, implementation, and operation of aerospace and related engineering systems. Courses in the major introduce students to engineering principles. Students learn to apply this fundamental knowledge to conduct laboratory experiments, and aerospace system design problems. Courses in the major include engineering fundamentals, mathematics, and the sciences, as well as in-depth courses in aeronautics and astronautics, dynamics, mechanics of materials, autonomous systems, computational engineering, embedded programming, fluids engineering, and heat transfer. The major prepares students for careers in aircraft and spacecraft engineering, autonomy, robotics, unmanned aerial vehicles, drones, space exploration, air and space-based telecommunication industries, computational engineering, teaching, research, military service, and other related technology-intensive fields.

Completion of the undergraduate program in Aeronautics and Astronautics leads to the conferral of the Bachelor of Science in Aeronautics and Astronautics.

Requirements

	Units
Mathematics	
24 units minimum	
MATH 19	Calculus (required) ¹ 3
MATH 20	Calculus (required) ¹ 3
MATH 21	Calculus (required) ¹ 4
CME 100/ENGR 154	Vector Calculus for Engineers (required) ² 5
or MATH 51	Linear Algebra, Multivariable Calculus, and Modern Applications
CME 102/ENGR 155A	Ordinary Differential Equations for Engineers (required) ² 5

or MATH 53	Ordinary Differential Equations with Linear Algebra	
CME 106/ENGR 155C	Introduction to Probability and Statistics for Engineers (required)	4-5
or STATS 110	Statistical Methods in Engineering and the Physical Sciences	
or STATS 116	Theory of Probability	
or CS 109	Introduction to Probability for Computer Scientists	
CME 104	Linear Algebra and Partial Differential Equations for Engineers (recommended) ²	5
or MATH 52	Integral Calculus of Several Variables	
CME 108	Introduction to Scientific Computing (recommended)	3

Science

20 units minimum		
PHYSICS 41	Mechanics (required) ³	4
or PHYSICS 41E	Mechanics, Concepts, Calculations, and Context	
PHYSICS 43	Electricity and Magnetism (required) ³	4
PHYSICS 45	Light and Heat (required)	4
CHEM 31M	Chemical Principles: From Molecules to Solids (or CHEM 31A and CHEM 31B, or AP Chemistry) (required)	5
ENGR 80	Introduction to Bioengineering (Engineering Living Matter) (recommended)	4

School of Engineering approved Science Electives: See Undergraduate Handbook, Figure 4-2

Technology in Society (one course required)

School of Engineering approved Technology in Society courses: See Undergraduate Handbook, Figure 4-3. The course must be on the School of Engineering approved list the year you take it.

AA 252	Techniques of Failure Analysis (recommended)	3
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Engineering Fundamentals (three courses required)

11 units minimum		
ENGR 21	Engineering of Systems (required)	3
CS 106A	Programming Methodology	3-5
ENGR 10	Introduction to Engineering Analysis (recommended)	4
ENGR 40M	An Intro to Making: What is EE (recommended)	3-5

Fundamentals Elective; see list of Approved Courses in Undergraduate Engineering Handbook website at ughb.stanford.edu, Figure 4-4

Aero/Astro Depth Requirements

35 units minimum		
ENGR 14	Intro to Solid Mechanics (required)	3
ENGR 15	Dynamics (required)	3
ENGR 105	Feedback Control Design (required)	3
ME 30	Engineering Thermodynamics (required)	3
ME 70	Introductory Fluids Engineering (required)	3
AA 100	Introduction to Aeronautics and Astronautics (required)	3
AA 131	Space Flight (required)	3
AA 141	Atmospheric Flight (required)	3
AA 151	Lightweight Structures (required)	3
AA 174A	Principles of Robot Autonomy I (required)	5
AA 190	Directed Research and Writing in Aero/Astro (required) satisfies the Writing in the Major requirement, (WIM)	3-5

Aero/Astro Focus Electives

12 units minimum

AA 102	Introduction to Applied Aerodynamics (recommended)	3
AA 103	Air and Space Propulsion	3
AA 113	Aerospace Computational Science	3
AA 135	Introduction to Space Policy	3
AA 156	Mechanics of Composite Materials	3
AA 173	Flight Mechanics & Controls	3
CS 237B	Principles of Robot Autonomy II (AA 174B)	3-4
AA 199	Independent Study in Aero/Astro	1-5
AA 261	Building an Aerospace Startup from the Ground Up	3
AA 272	Global Positioning Systems	3
AA 279A	Space Mechanics	3
MS&E 178	The Spirit of Entrepreneurship	2
Aero/Astro Suggested Courses (not required)		
AA 149	Operation of Aerospace Systems	1
Aero/Astro Capstone Requirement		
7 units minimum. Select either the Spacecraft or Aircraft course sequence		
AA 136A	Spacecraft Design	3-5
AA 136B	Spacecraft Design Laboratory	3-5
AA 146A	Aircraft Design	4
AA 146B	Aircraft Design Laboratory	3

For additional information and sample programs see the Handbook for Undergraduate Engineering (<http://ughb.stanford.edu>) and the Aeronautics and Astronautics Undergraduate Program Sheet (<https://ughb.stanford.edu/program-sheets/>).

All courses taken for the major must be taken for a letter grade if that option is offered by the instructor.

Minimum Combined GPA for all courses in Engineering Topics (Engineering Fundamentals and Depth courses) is 2.0.

Transfer and AP credits in Math, Science, Fundamentals, and the Technology in Society course must be approved by the School of Engineering Dean's office.

¹ A score of 4 on the Calculus BC test or 5 on the AB test only gives students 8 units, not 10 units, so is equal to MATH 19 + MATH 20, but not MATH 21. The Math Placement Exam determines what math course the student starts with.

² It is recommended that the CME series (100, 102, 104) be taken rather than the MATH series (51, 52, 53). It is recommended that students taking the MATH series also take CME 192 Introduction to MATLAB.

³ A score of 5 on the AP Physics C Mechanics test places the student out of PHYSICS 41. Similarly, a score of 5 on the AP Physics Electricity and Magnetism test places the student out of PHYSICS 43.

Honors Program

The Department of Aeronautics and Astronautics honors program has been designed to allow undergraduates with strong records and enthusiasm for independent research to engage in a significant project leading to a degree with departmental honors.

Students who meet the eligibility criteria and wish to be considered for the honors program should apply to the program by the end of the junior year. All applications are subject to the review and final approval by the Aero/Astro Undergraduate Curriculum Committee.

Application Requirements:

- One-page written statement describing the research topic and signed adviser form
- GPA of 3.5 or higher in the major
- Unofficial Stanford transcript (from Axess)
- Signature of thesis adviser

Honors criteria:

- Maintain the 3.5 GPA required for admissions to the honors program.
- Arrangement with an Aero/Astro faculty member who agrees to serve as the thesis adviser. The adviser must be a member of the Academic Council.
- Under the direction of the thesis adviser, complete at least two quarters of research with a minimum of 9 units of independent research; 3 of these units may be used towards a student's Aero/Astro Focus Elective requirement.
- Submit an honors thesis (20-30 pages). Thesis is due by April 30th of senior year in order to be eligible for University prizes.
- Attend Research Experience for Undergraduates Poster Session or present in another suitable forum approved by the faculty adviser.

Aeronautics and Astronautics (AA) Minor

The Aero/Astro minor introduces undergraduates to the key elements of modern aerospace systems. Within the minor, students may focus on aircraft, spacecraft, or disciplines relevant to both. The course requirements for the minor are described in detail below. If any core classes (aside from ENGR 21; see footnote) are part of student's major or other degree program, the Aero/Astro adviser can help select substitute courses to fulfill the Aero/Astro minor requirements; no double counting allowed. All courses taken for the minor must be taken for a letter grade if that option is offered by the instructor. Minimum GPA for all minor courses combined is 2.0.

The following core courses fulfill the minor requirements:

AA Core

12 Core Units, 24 Total Program Units		
ENGR 21	Engineering of Systems ¹	3
AA 100	Introduction to Aeronautics and Astronautics	3
AA 131	Space Flight	3
AA 141	Atmospheric Flight	3

AA Electives

Choose 4 courses		
ENGR 105	Feedback Control Design	3
ME 70	Introductory Fluids Engineering	3
AA 102	Introduction to Applied Aerodynamics	3
AA 103	Air and Space Propulsion	3
AA 113	Aerospace Computational Science	3
AA 135	Introduction to Space Policy	3
AA 151	Lightweight Structures	3
AA 156	Mechanics of Composite Materials	3
AA 173	Flight Mechanics & Controls	3
AA 174A	Principles of Robot Autonomy I	5
AA 261	Building an Aerospace Startup from the Ground Up	3
AA 272	Global Positioning Systems	3
AA 279A	Space Mechanics	3

¹ ENGR 21 is waived as minor requirement if already taken as part of the major program.