

# AEROSPACE ENGINEERING SCIENCES - BACHELOR OF SCIENCE (BSAE)

The undergraduate curriculum in aerospace engineering sciences is designed to prepare students to advance to a distinguished professional career in the aerospace industry or for graduate school, consistent with our stated program educational objectives. In particular, this involves providing students with an interdisciplinary systems perspective of aerospace engineering. The curriculum accomplishes these goals by:

- providing a strong basis in mathematics, science and engineering fundamentals;
- extending these fundamentals to advanced topics in aerospace engineering;
- complementing the engineering education with sufficient exposure to the humanities and social sciences; and
- beginning and ending in major design experiences that stress an interdisciplinary systems perspective.

AES students are also encouraged to consider a technical minor or double major in electrical engineering, computer science, applied math, engineering physics, astrophysical and planetary sciences or atmospheric and oceanic sciences. In most cases, the junior- and senior-level courses required for the above-mentioned minors can be applied to the technical elective requirements.

For students having sufficient ability and interest, planning for graduate study should begin by the start of the junior year. Such a plan should consider the foreign language requirements of appropriate graduate schools and an advanced mathematics program. Students who wish to combine the business and aerospace engineering sciences curricula are advised to consider obtaining the BS degree in aerospace and a master's degree in business rather than a combined BS degree.

For more information, visit the department's Prospective Students (<https://www.colorado.edu/aerospace/prospective-students/undergraduates/>) webpage.

## Requirements

The Bachelor of Science curriculum in Aerospace Engineering Sciences is revised annually to keep up with advances in technology, to make use of new educational methodologies and to satisfy current program accreditation criteria. A minimum of 128 credit hours is required. For up-to-date program requirements, visit the Bachelor of Science in Aerospace Engineering Sciences web page (<https://www.colorado.edu/aerospace/current-students/undergraduates/curriculum/>).

Note: This major cannot be combined with a BS in Integrated Design Engineering with an aerospace engineering emphasis.

In addition, students must meet the general undergraduate degree requirements of the College of Engineering and Applied Science. (<https://www.colorado.edu/engineering-advising/get-your-degree/graduation-requirements/>)

## Required Courses and Credits

Code	Title	Credit Hours
<b>Required Courses</b>		
ASEN 1030	Introduction to Computing for Aerospace Engineering	3
or CSCI 1300	Computer Science 1: Starting Computing	
or CHEN 1310	Introduction to Engineering Computing	
or ECEN 1310	Introduction to C Programming	
ASEN 1400/ ASTR 2500	Gateway to Space	3
or ASEN 1403	Introduction to Rocket Engineering	
or GEEN 1400	Engineering Projects	
or ECEN 1400	Introduction to Digital and Analog Electronics	
ASEN 2401	Statics	3
or CVEN 2121	Analytical Mechanics 1	
or GEEN 2851	Statics for Engineers	
or MCEN 2023	Statics and Structures	
ASEN 2402	Thermodynamics	3
or AREN 2110	Thermodynamics	
or EVEN 3012	Thermodynamics for Environmental Science and Engineering	
or GEEN 3852	Thermodynamics for Engineers	
or MCEN 3012	Thermodynamics	
ASEN 2403	Dynamics	3
or CVEN 3111	Analytical Mechanics 2	
or MCEN 2043	Dynamics	
ASEN 2501	Introduction to Astronautics	3
ASEN 2502	Introduction to Aeronautics	3
ASEN 3401	Aerospace Structures	3
ASEN 3402	Aerospace Heat Transfer	3
ASEN 3403	Aerodynamics	3
ASEN 3404	Aerospace Dynamics and Control	3
ASEN 3501	Aerospace Experimental Methods	3
ASEN 3502	Aerospace Computational Methods	3
ASEN 3503	Aerospace Electronics	3
ASEN 4013	Foundations of Propulsion	3
ASEN 4018	Senior Projects 1: Design Synthesis	4
ASEN 4028	Senior Projects 2: Design Practicum	4
<i>Astronautics Focus:</i> <sup>1</sup>		6
ASEN 3405	Astrodynamics	
ASEN 4401	Aerospace Communication Systems	
<i>Aeronautics Focus:</i> <sup>1</sup>		6
ASEN 3406	Aircraft Dynamics	
ASEN 4402	Aerospace Materials and Structural Analysis	
<b>Basic Engineering Electives</b>		
<i>Required Math</i>		
APPM 1350	Calculus 1 for Engineers	4
or APPM 1345	Calculus 1 with Algebra, Part B	
or MATH 1300	Calculus 1	
APPM 1360	Calculus 2 for Engineers	4
or MATH 2300	Calculus 2	

APPM 2350 or MATH 2400	Calculus 3 for Engineers Calculus 3	4
APPM 2360 or MATH 2130 & MATH 3430	Introduction to Differential Equations with Linear Algebra Introduction to Linear Algebra for Non-Mathematics Majors and Ordinary Differential Equations	4
or MATH 2135 & MATH 3430	Introduction to Linear Algebra for Mathematics Majors and Ordinary Differential Equations	

*Required Science*

MCEN 1024 or CHEM 1113 or CHEM 1400 or CHEN 1201 or CHEN 1211	Chemistry for Energy and Materials Science General Chemistry 1 Foundations of Chemistry General Chemistry for Engineers 1 Accelerated Chemistry for Engineers	3
PHYS 1110 or PHYS 1115	General Physics 1 General Physics 1 for Majors	4
PHYS 1120 or PHYS 1125	General Physics 2 General Physics 2 for Majors	4

**Required Humanities, Social Sciences and Writing**

College-approved humanities & social sciences courses. At least 6 credits must be upper-division (3000 level or higher). <sup>2</sup>	15
College-approved writing course. <sup>2</sup>	3

**Electives**

Aerospace Engineering Elective <sup>3</sup>	3
Math and Science Elective <sup>4</sup>	3
Free Electives	6
Technical Electives <sup>5</sup>	12

<sup>1</sup> Students select from either the Aeronautics Focus Area or the Astronautics Focus Area and complete 6 credit hours of required coursework in that area.

<sup>2</sup> Courses from approved Humanities, Social Sciences and Writing Requirements (<https://www.colorado.edu/engineering-advising/get-your-degree/degree-requirements/humanities-social-sciences-and-writing-requirements/>).

<sup>3</sup> Any ASEN course at the 4000-level or above that is not a required course can be used to satisfy the Aerospace Engineering Elective requirement. Additionally, for Astronautics Focus students, either ASEN 3406 or ASEN 4402 can be used to satisfy the Aerospace Engineering Elective requirement, while for Aeronautics Focus students, either ASEN 3405 or ASEN 4401 can be used to satisfy the Aerospace Engineering Elective requirement.

<sup>4</sup> A full listing of approved math and science elective courses can be found in the degree audit.

<sup>5</sup> A technical elective is generally a course in math, engineering, or science at the 3000 level or above. Any ASEN course at the 4000 level or above that is not a required course can be used as a technical elective if it is not used to satisfy the Aerospace Engineering Elective requirement. Additionally, for Astronautics Focus students, either ASEN 3406 or ASEN 4402 can be used as a technical elective if it is not used to satisfy the Aerospace Engineering Elective requirement, while for Aeronautics Focus students, either ASEN 3405 or ASEN 4401 can be used as a technical elective if it is not used to satisfy the Aerospace Engineering Elective requirement. A full listing of approved technical elective courses can be found in the degree audit.

**Prerequisites and Passing Grades**

The minimum passing grade for a course that is a prerequisite for another required course is C-. If a grade of D+ or lower is earned in a course which is a prerequisite to another, the student may not register for the subsequent course until the first grade has been raised to a C- or higher.

The minimum passing grade for a course that is not specifically a prerequisite for another required course is D-.

The Ann and HJ Smead Department of Aerospace Engineering Sciences (AES) reserves the right to drop students enrolled in ASEN courses who have not met the minimum prerequisite grade requirements. It is the student's responsibility to communicate with the department if summer coursework and/or transfer credit will be used to meet the prerequisite requirement.

**Recommended Four-Year Plan of Study****Year One**

Fall Semester		Credit Hours
APPM 1350 or MATH 1300	Calculus 1 for Engineers or Calculus 1	4
GEEN 1400 or ASEN 1403	Engineering Projects or Introduction to Rocket Engineering	3
PHYS 1110	General Physics 1	4
COEN 1500	CEAS First Year Seminar <sup>2</sup>	1
Humanities/Social Science Elective <sup>1</sup>		3
<b>Credit Hours</b>		<b>15</b>

**Spring Semester**

APPM 1360 or MATH 2300	Calculus 2 for Engineers or Calculus 2	4
ASEN 1030	Introduction to Computing for Aerospace Engineering	3
MCEN 1024	Chemistry for Energy and Materials Science	3
Humanities/Social Science Elective <sup>1</sup>		6
<b>Credit Hours</b>		<b>16</b>

**Year Two****Fall Semester**

APPM 2360 or MATH 2130 <b>and</b> MATH 3430	Introduction to Differential Equations with Linear Algebra or Introduction to Linear Algebra for Non-Mathematics Majors <b>and</b> Ordinary Differential Equations	4
ASEN 2401	Statics	3
ASEN 2402	Thermodynamics	3

ASEN 2501	Introduction to Astronautics	3
Free Elective		3
<b>Credit Hours</b>		<b>16</b>
<b>Spring Semester</b>		
APPM 2350 or MATH 2400	Calculus 3 for Engineers or Calculus 3	4
ASEN 2403	Dynamics	3
ASEN 2502	Introduction to Aeronautics	3
PHYS 1120	General Physics 2	4
Free Elective		3
<b>Credit Hours</b>		<b>17</b>
<b>Year Three</b>		
<b>Fall Semester</b>		
ASEN 3401	Aerospace Structures	3
ASEN 3402	Aerospace Heat Transfer	3
ASEN 3404	Aerospace Dynamics and Control	3
ASEN 3501	Aerospace Experimental Methods	3
Math and Science Elective <sup>3</sup>		3
Humanities/Social Science Elective <sup>1</sup>		2
<b>Credit Hours</b>		<b>17</b>
<b>Spring Semester</b>		
ASEN 3403	Aerodynamics	3
ASEN 3405 or ASEN 3406	Astrodynamics or Aircraft Dynamics	3
ASEN 3502	Aerospace Computational Methods	3
ASEN 3503	Aerospace Electronics	3
Technical Elective <sup>5</sup>		3
<b>Credit Hours</b>		<b>15</b>
<b>Year Four</b>		
<b>Fall Semester</b>		
ASEN 4013	Foundations of Propulsion	3
ASEN 4018	Senior Projects 1: Design Synthesis	4
Aerospace Engineering Elective <sup>4</sup>		3
College-Approved Writing Course <sup>1</sup>		3
Technical Elective <sup>5</sup>		3
<b>Credit Hours</b>		<b>16</b>
<b>Spring Semester</b>		
ASEN 4028	Senior Projects 2: Design Practicum	4
ASEN 4401 or ASEN 4402	Aerospace Communication Systems or Aerospace Materials and Structural Analysis	3
Humanities/Social Science Elective <sup>1</sup>		3
Technical Elective <sup>5</sup>		6
<b>Credit Hours</b>		<b>16</b>
<b>Total Credit Hours</b>		<b>128</b>

<sup>1</sup> Courses from approved Humanities, Social Sciences and Writing Requirements (<https://www.colorado.edu/engineering-advising/get-your-degree/degree-requirements/humanities-social-sciences-and-writing-requirements/>).

<sup>2</sup> Students may elect to apply this course towards free elective or Humanities and Social Sciences credits.

<sup>3</sup> A full listing of approved math and science elective courses can be found in the degree audit.

<sup>4</sup> Any ASEN course at the 4000-level or above that is not a required course can be used to satisfy the Aerospace Engineering Elective requirement. Additionally, for Astronautics Focus students, either ASEN 3406 or ASEN 4402 can be used to satisfy the Aerospace Engineering Elective requirement, while for Aeronautics Focus students, either ASEN 3405 or ASEN 4401 can be used to satisfy the Aerospace Engineering Elective requirement.

<sup>5</sup> A technical elective is generally a course in math, engineering, or science at the 3000 level or above. Any ASEN course at the 4000 level or above that is not a required course can be used as a technical elective. Upper-division independent study courses from technical areas (math, science and engineering) are acceptable for up to 6 credit hours of technical elective credit. A full listing of approved technical elective courses can be found in the degree audit.

## Learning Outcomes

By the completion of the program, students will be able to:

- Identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics.
- 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.
- Communicate effectively with a range of audiences.
- 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.
- Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives.
- Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- Acquire and apply new knowledge as needed, using appropriate learning strategies.

## Bachelor's–Accelerated Master's Degree Program(s)

The bachelor's–accelerated master's (BAM) degree program options offer currently enrolled CU Boulder undergraduate students the opportunity to receive a bachelor's and master's degree in a shorter period of time. Students receive the bachelor's degree first but begin taking graduate coursework as undergraduates (typically in their senior year).

Because some courses are allowed to double count for both the bachelor's and the master's degrees, students receive a master's degree in less time and at a lower cost than if they were to enroll in a stand-alone master's degree program after completion of their baccalaureate degree. In addition, staying at CU Boulder to pursue a bachelor's–accelerated master's program enables students to continue working with their established faculty mentors.

## Admission Requirements

### BS and MS in Aerospace Engineering Sciences

In order to gain admission to the BAM program named above, a student must meet the following criteria:

- Have a CU cumulative GPA of 3.50 or higher.
- Have a minimum major GPA (in sophomore level/2000+ coursework and above) of 3.50.
- Have at least junior class standing; enrolled in ASEN 3000-level courses.
- Completion of all MAPS requirements and no deficiencies remaining (students admitted to CU Boulder prior to Summer 2023 only).
- Transfer students must have completed a minimum of 24 credit hours at CU Boulder.

### **BS in Aerospace Engineering Sciences, Professional ME in Engineering Management**

In order to gain admission to the BAM program named above, a student must meet the following criteria:

- Have a CU cumulative GPA of 3.0 or higher.
- Have at least junior class standing.
- Completion of all MAPS requirements and no deficiencies remaining (students admitted to CU Boulder prior to Summer 2023 only).

### **Program Requirements**

For both programs named above, students may take up to and including 12 hours while in the undergraduate program which can later be used toward the master's degree. However, only 6 credits may be double counted toward the bachelor's degree and the master's degree. Students must apply to graduate with the bachelor's degree, and apply to continue with the master's degree, early in the semester in which the undergraduate requirements will be completed.

Please see the Aerospace Engineering Sciences BAM program (<https://www.colorado.edu/aerospace/academics/graduates/bachelors-accelerated-masters/>) webpage for more information on the BS and MS in Aerospace Engineering Sciences BAM program.

Please see the Lockheed Martin Engineering Management Program (<https://www.colorado.edu/emp/graduate-programs/bachelors-accelerated-masters-bam/>) webpage for more information on the BS in Aerospace Engineering Sciences and a Professional ME in Engineering Management BAM program.