

AEROSPACE ENGINEERING

Undergraduate Study

For undergraduate curriculum in aerospace engineering leading to the degree bachelor of science. The Aerospace Engineering program is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org/>.

The aerospace engineer is primarily concerned with the design, analysis, testing, and overall operation of vehicles which operate in air and space. The curriculum is designed to provide the student with an education in the fundamental principles of aerodynamics, flight dynamics, propulsion, structural mechanics, flight controls, design, testing, and space technologies. A wide variety of opportunities awaits the aerospace engineering graduate in research, development, design, production, sales, and management in the aerospace industry, and in many related industries in which fluid flow, control, structural, and transportation challenges play major roles.

Make To Innovate (M:2:I) is an exciting new program in the Aerospace Engineering Department that engages students in hands-on projects to augment their understanding of engineering fundamentals.

A cooperative education program in aerospace engineering is available in cooperation with government agencies and industry. The usual four-year curriculum is extended for students who participate in alternating industrial experience periods and academic periods. This arrangement offers valuable practical experience and financial assistance during the college years.

Undergraduate Mission and Educational Objectives

The Department of Aerospace Engineering maintains an internationally recognized academic program in aerospace engineering via ongoing consultation with students, faculty, industry, and aerospace professionals. Results of these consultations are used in a process of continuous academic improvement to provide the best possible education for our students.

Mission statement:

The mission of the aerospace engineering program is to prepare the aerospace engineering student for a career with wide-ranging opportunities in research, development, design, production, sales, and management in the aerospace industry and in the many related industries which are involved with the solution of multi-disciplinary, advanced technology problems.

Program Educational Objectives:

The objectives of the Aerospace Engineering program at ISU are to produce graduates:

- who actively contribute to the field of aerospace, related fields or other disciplines;
- are critical thinkers and lifelong learners; and
- are aware of the societal, economic and environmental impact of their work.

Student Learning Outcomes

Upon graduation, students should have:

- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- 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
- an ability to communicate effectively with a range of audiences
- 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
- 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
- an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

CURRICULUM IN AEROSPACE ENGINEERING

Leading to the degree bachelor of science.

TOTAL CREDITS REQUIRED: 129.0.

Any transfer credit courses applied to the degree program require a grade of C or better (but will not be calculated into the ISU cumulative GPA, Basic Program GPA or Core GPA). See also Basic Program and Special Programs. Note: Department does not allow Pass/Not Pass credits to be used to meet graduation requirements for either required or elective courses.

INTERNATIONAL PERSPECTIVES ¹: 3 CR.

U.S. DIVERSITY ¹: 3 CR.

COMMUNICATION PROFICIENCY/LIBRARY REQUIREMENT:

ENGL 150	Critical Thinking and Communication (Must have a C or better in this course)	3
ENGL 250	Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)	3

LIB 160	Introduction to College Level Research	1
One of the following:		3
ENGL 314	Technical Communication (C or better in this course)	
ENGL 309	Proposal and Report Writing (C or better in this course)	

GENERAL EDUCATION ELECTIVES: 12.0 CR. ²

Complete 12 cr. General Education Electives are requirements for graduation so may not be taken on a P-NP basis.

BASIC PROGRAM: 24 CR.

A minimum GPA of 2.00 required for this set of courses (please note that transfer course grades will not be calculated into the Basic Program GPA). See Requirement for Entry into Professional Program in College of Engineering Overview section.

CHEM 167	General Chemistry for Engineering Students	4
or CHEM 177	General Chemistry I	
ENGL 150	Critical Thinking and Communication (Must have a C or better in this course)	3
ENGR 101	Engineering Orientation	R
AER E 160	Aerospace Engineering Problems With Computer Applications Laboratory ³	3
LIB 160	Introduction to College Level Research	1
MATH 165	Calculus I	4
MATH 166	Calculus II	4
PHYS 231	Introduction to Classical Physics I	4
PHYS 231L	Introduction to Classical Physics I Laboratory	1
Total Credits		24

MATH AND PHYSICAL SCIENCE: 13 CR.

MATH 265	Calculus III	4
MATH 267	Elementary Differential Equations and Laplace Transforms	4
PHYS 232	Introduction to Classical Physics II	4
PHYS 232L	Introduction to Classical Physics II Laboratory	1
Total Credits		13

AEROSPACE ENGINEERING CORE: 47 CR.

A minimum GPA of 2.00 required for this set of courses, including any transfer courses (please note that transfer course grades will not be calculated into the Core GPA):

AER E 261	Introduction to Performance and Design	3
AER E 310	Aerodynamics I: Incompressible Flow	3
AER E 311	Aerodynamics II: Compressible Flow	3
AER E 321	Flight Structures Analysis	3

AER E 331	Flight Control Systems I	3
AER E 322	Aerospace Structures Laboratory	2
AER E 344	Aerodynamics and Propulsion Laboratory	3
AER E 351	Astrodynamics I	3
AER E 355	Aircraft Flight Dynamics and Control	3
AER E 411	Aerospace Vehicle Propulsion	3
AER E 415	Rocket Propulsion	3
or AER E 433	Spacecraft Dynamics and Control	
AER E 421	Advanced Flight Structures	3
AER E 461	Modern Design Methodology with Aerospace Applications	3
AER E 462	Design of Aerospace Systems	3
E M 324	Mechanics of Materials	3
M E 231	Engineering Thermodynamics I	3

Total Credits **47**

OTHER REMAINING COURSES: 33 CR.

ENGL 250	Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)	3
C E 274	Engineering Statics	3
M E 345	Engineering Dynamics	3
MAT E 273	Principles of Materials Science and Engineering	3
AER E 161	Numerical, Graphical and Laboratory Techniques for Aerospace Engineering	3
AER E 361	Computational Techniques for Aerospace Design	3
AER E 362	Aerospace Systems Integration	3
3 credits from the following		3
any AER E or EM graduate level (500+ level) course		
AER E 407	Applied Formal Methods	
AER E 412	Spacecraft Electric Propulsion	
AER E 415	Rocket Propulsion	
AER E 417	Experimental Mechanics	
AER E 422	Vibrations and Aeroelasticity	
AER E 423	Composite Flight Structures	
AER E 426	Design of Aerospace Structures	
AER E 432	Flight Control Systems II	
AER E 433	Spacecraft Dynamics and Control	
AER E 442	V/STOL Aerodynamics and Performance	
AER E 446	Computational Fluid Dynamics	
AER E 448	Fluid Dynamics of Turbomachinery	
AER E 451	Astrodynamics II	
AER E 463	Introduction to Multidisciplinary Design Optimization	

AER E 464	Spacecraft Systems	
AER E 468	Large-Scale Complex Engineered Systems (LSCES)	
AER E 481	Advanced Wind Energy: Technology and Design	
AER E 483	Aeroacoustics	
One of the following:		3
ENGL 314	Technical Communication (Must have a C or better in this course)	
ENGL 309	Proposal and Report Writing (Must have a C or better in this course)	
Technical Electives (see below) ²		3
Career Electives (see below) ²		3
Total Credits		33

Technical Electives, 3 cr. and Career Electives, 6 cr. selected from preceding Aer E list or departmental-approved 300-level or above courses relevant to technical and career areas.

Seminar/Co-op/Internships/Flight Experience:

AER E 192	Aerospace Seminar	R
AER E 301	Flight Experience	R

Co-op and internships are optional

1. These university requirements will add to the minimum credits of the program unless the university-approved courses are also allowed by the department to meet other course requirements within the degree program. U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.
2. Choose from department approved list. (http://www.aere.iastate.edu/students/undergraduate_program/)
3. See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

See also: A 4-year plan of study grid showing course template by semester. (<http://catalog.iastate.edu/previouscatalogs/2022-2023/collegeofengineering/aerospaceengineering/#fouryearplantext>)

Aerospace Engineering, B.S.

Freshman

Fall	Credits Spring	Credits
MATH 165	4 MATH 166	4
CHEM 167	4 PHYS 231	4
AER E 160	3 PHYS 231L	1
LIB 160	1 AER E 161	3
ENGL 150	3 General Education Elective	3
ENGR 101	R AER E 192	R
	15	15

Sophomore

Fall	Credits Spring	Credits
MATH 265	4 MATH 267	4
AER E 261	3 M E 345	3
PHYS 232	4 MAT E 273	3
PHYS 232L	1 E M 324	3
C E 274	3 ENGL 314 or 309	3
ENGL 250	3	
	18	16

Junior

Fall	Credits Spring	Credits
AER E 321	3 AER E 421	3
AER E 322	2 AER E 361	3
M E 231	3 AER E 362	3
AER E 310	3 AER E 344	3
AER E 351	3 AER E 311	3
AER E 355	3 AER E 331	3
AER E 301	R	
	17	18

Senior

Fall	Credits Spring	Credits
Technical Elective	3 Technical Elective	3
AER E 461	3 Technical Elective	3
AER E 411	3 AER E 462	3
AER E 415 or 433	3 General Education Elective	3
General Education Elective	3 General Education Elective	3
	15	15

Nondestructive Evaluation (NDE)

The NDE Minor (http://catalog.iastate.edu/previouscatalogs/2022-2023/collegeofengineering/non_destructiveevaluationengineering/) is multidisciplinary and open to undergraduates in the College of Engineering.

BS/MS & BS/ME Degree Programs

The concurrent BS/MS & BS/ME (<https://www.aere.iastate.edu/graduate-students/concurrent-degrees/>) classification offers an opportunity for well-qualified Iowa State juniors and seniors to begin working on a master's degree before completing a bachelor's degree.

Graduate Study

The department offers graduate programs that lead to the degrees master of engineering, master of science, and doctor of philosophy with

major in aerospace engineering and minor work to students taking major work in other departments. For all graduate degrees, it is possible to establish a co-major program with another graduate degree-granting department. Within the aerospace program, students can specialize in one or more of the following areas: aerospace systems design, atmospheric and space flight dynamics, computational fluid dynamics, control systems, wind engineering, fluid mechanics, optimization, structural analysis, and non-destructive evaluation.

Master of Science and Master of Engineering

The Master of Science degree requires a thesis and has strong research emphasis. The Master of Science degree is recommended for students who anticipate entering a doctoral program later. The Master of Engineering degree does not require either research credits or a thesis and is intended for students who do not anticipate pursuing a doctoral degree. The Master of Engineering degree can be completed with coursework only or with a combination of coursework and creative component. Credits for creative component will be obtained by registering for **AER E 599 Creative Component**. A written report and an oral presentation will be given to the student's graduate committee.

At least 30 credits of acceptable graduate work are required for both the Master of Science and the Master of Engineering degrees. For specific course, research, and creative component requirements, see the departmental Graduate Student Handbook (<http://www.aere.iastate.edu/files/2015/04/AerE-Graduate-Handbook-Revised-S15.pdf>).

Bachelor of Science/Master of Science Concurrent Degree Program

The department offers concurrent BS/MS and BS/ME degree programs (<http://www.aere.iastate.edu/students/concurrent-degrees/>) and a concurrent BS/MBA degree program which offer an opportunity for well-qualified Iowa State juniors and seniors to begin working on a master's degree before completing a bachelor's degree. The concurrent degree programs reduce by one year the normal time period for completing both degrees separately.

Preparation for Graduate Work

The normal prerequisite for major graduate work in aerospace engineering is the completion of an undergraduate curriculum substantially equivalent to that required of aerospace engineering students at this university. Due to the diversity of interests of aerospace faculty, students whose prior undergraduate or graduate education has been in allied engineering and/or scientific fields may also qualify. In such cases, it may be necessary for the student to take additional work to provide the requisite aerospace background. A prospective graduate student is urged to specify the degree program and the specific field(s) of interest on the application for admission.

Courses are offered at the times stated in the course description. Where no specific time of offering is stated, the course may be offered during any semester provided there is sufficient demand.

Graduate Minor Work

Minor work for aerospace engineering majors is usually selected from mathematics, physics, electrical engineering, engineering mechanics, mechanical engineering, materials science, meteorology, computer science, and computer engineering.