



American Institute of Aeronautics and Astronautics

CAREERS IN AEROSPACE

WITHIN YOUR LIFETIME



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A CAREER IN AEROSPACE

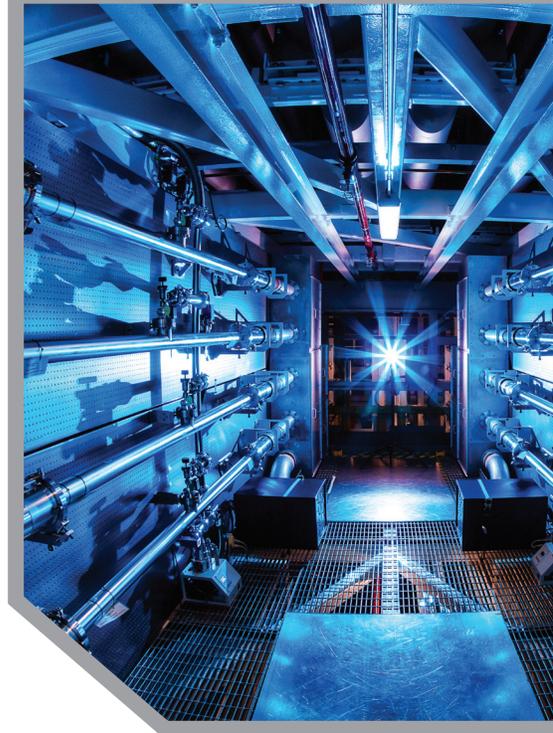
It is rocket science... and much more!

When today's aerospace professionals were students, they may have dreamed about becoming astronauts, designing the next great airplane, managing a spacecraft from mission control, or colonizing Mars.

We have come a long way since that windy day at Kitty Hawk when the Wright Brothers flew for the first time. The technology to develop successful powered aircraft barely existed. Now, aircraft fly many times faster than the speed of sound, and spacecraft travel to other planets within our solar system.

Today's aerospace professionals design, develop, test, and supervise the manufacture of aircraft, spacecraft, satellites, and missiles. They develop new technologies for use in aviation, defense systems, and space exploration, often specializing in areas such as aerodynamics; structural design; guidance, navigation, and control; thermal dynamics; propulsion; information systems; production methods; etc. They use computer-aided design software, robotics, lasers, and advanced electronics.

Aerospace professionals often specialize in a particular type of aerospace product such as commercial aircraft, military aircraft, helicopters, spacecraft, missiles, and rockets. Those working specifically with aircraft are called aeronautical engineers, and those working specifically with spacecraft are astronautical engineers.



But they're not all rocket scientists!

Some aerospace professionals use their knowledge to study how the wind will affect a new building in a large urban area, to design an energy-conserving skyscraper, or to research materials and fluid flow for an artificial heart. Aerospace technology has expanded to include the design and development of new Earthbound vehicles, such as performance automobiles, hydrofoil ships, deep-diving vessels for oceanographic research, and high-speed rail systems.

The future of aerospace is exciting and challenging. In their lifetimes, aspiring aerospace professionals are likely to see space colonization, space-based solar power stations, an active search for extraterrestrial life, and the ability to travel to any point on Earth in a matter of hours. As an aerospace professional, you could be a major factor in this development.



Christina Gallegos Deoja

NASA Johnson Space Center

Job Title: Electrical Engineer and Test Director

College: The University of Texas at Dallas

Hometown: Lewisville, TX

Hobbies: Traveling, home improvement DIY projects, outdoor activities (sailing, hiking, camping), tinkering with electronics

As an electrical engineer I work on the design, development, buildup, testing, and integration of electrical power systems for space vehicles (Orion and International Space Station) and other advanced engineering projects (Morpheus). As a test director I'm responsible for all aspects of power/battery test programs. This includes leading a team during test planning, hardware development, hazardous test operations, and data reporting of the test. My job is fun to me because it involves problem solving, working on a team, and is very hands-on type of work.



Planning for **Your Aerospace Education**

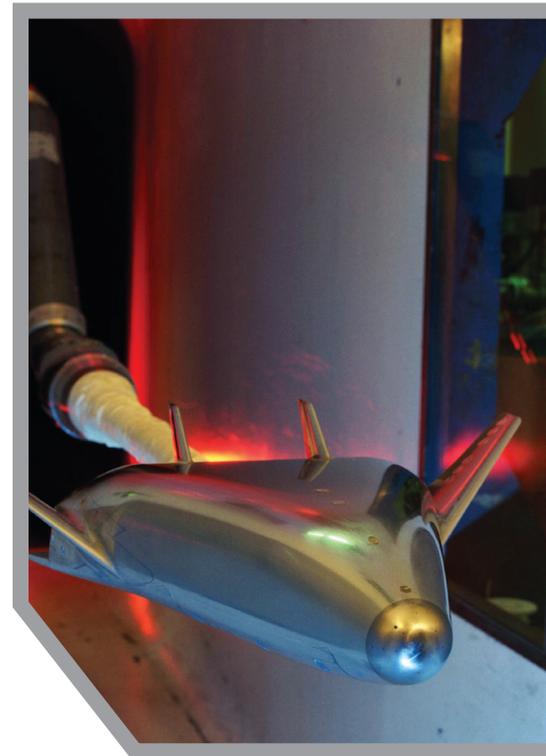
As an aerospace engineering student, your classes will introduce you to propulsion, thermodynamics, fluid dynamics, aerodynamics, structures, flight and space mechanics, and so on. As you continue, you might want to concentrate on a particular area of your studies, such as structures or thermodynamics. From these classes, you will discover the areas that interest you the most and that will lead you to a professional career.

Upon graduation, it will be time to enter the workforce through a job you will enjoy and look forward to every day.

This booklet can help you make your plan for your aerospace education and career success. Although the booklet can only provide a representation of available jobs, you will gain insight into a career in aerospace:

- › **Common disciplines** within the field of aerospace engineering
- › **Aerospace engineering and other degrees** that are applicable to the various jobs and field specialties of aerospace professionals
- › **A list of courses** usually required in a four-year college engineering curriculum, along with high school and college-entry requirements
- › **Guidance for finding the college** with the engineering program that is right for you
- › **Information** about student membership in AIAA

No matter which degree or field specialty you plan to pursue, a career in aerospace is waiting for you!





Lauren Smith

Northrop Grumman Corporation

Job Title: **Program Manager**

College: **Case Western Reserve University**

Hometown: **Pittsburgh, PA**

Hobbies: **Going to the art museum. “Engineering requires incredible creativity; I love to take time away from numbers to revisit my favorite paintings and find new perspective and inspiration.”**

I am an entrepreneur within a large company. My job utilizes not only my engineering background but also strategy, people leadership, and a whole lot of resourcefulness to grow new technologies and programs that will shape the future of aerospace.



Nathan Wasserman

The Boeing Company

Job Title: **Product Review Engineer**

College: **University of Maryland**

Hometown: **Silver Spring, MD**

Hobbies: **Running, hiking, sports**

Every day is a new challenge, a new puzzle. I get to spend my time on the actual airplane helping solve the problems. For me, the ability to leave my desk and see/touch the airplane means so much. I am excited to learn about every system the airplane has to offer in order to solve even the most complicated of issues.



Your Aerospace Career

The aerospace profession offers many different and interesting kinds of jobs. Many of the people working in the aerospace industry are engineers. Engineers design aircraft, spacecraft, and unmanned vehicles as solutions to complex problems for a variety of missions. These missions may include defense, global transportation of people or goods, or international endeavors like the exploration of space or harnessing our airspace. There are also commercial applications like race car, golf ball, or speedboat design.

Engineers usually work as part of a team. They design methods to build, test, and operate aircraft or spacecraft. Scientists research unknown areas of aerospace. Business people market new products to meet the needs of their customers. Engineers or business people manage engineering development projects. Technicians, logisticians, and mechanics manufacture, build, and maintain the aircraft or spacecraft.

Some typical careers in the aerospace profession are described below.

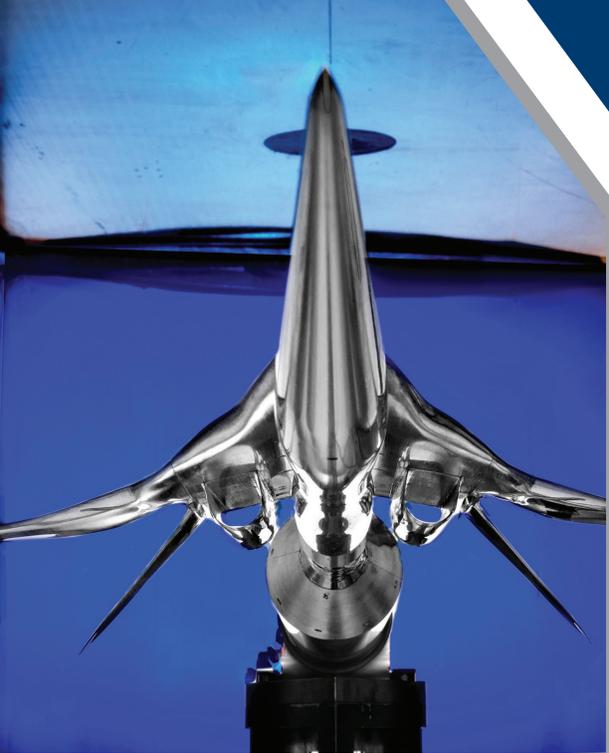
Aerodynamics, Structures, and Controls

There are many specialty areas in engineering where experts in narrow areas are needed. Some examples are structural engineering, aerodynamics and computational fluid dynamics, wind tunnel testing, stability and control, trajectory analysis and guidance law development, and human factors. In all these areas, engineers use math and basic engineering knowledge to develop their designs, build physical or virtual prototypes for evaluation, and then look at data from research to assess their suitability. An example of a specialty area is computational fluid dynamics (CFD). In this field, high-speed computers solve mathematical equations that will show how a fluid, like air, will flow around an object, like an airplane. The computers produce a model of what will happen in certain flight conditions. This saves time and money, and is a much lower risk than building the airplane and then having a pilot try to fly it.



Design

Design is the process of taking a creative idea or a need and turning it into the blueprint for a new or improved product, such as landing gear for an aircraft. Design engineers have to consider the structure, arrangement, and function of the object, whether it is an individual part or just one piece of a larger object. In the aerospace industry, designs have to conform to the rules of aerodynamics or astrodynamics; they have to be able to work under certain stresses and conditions. For example, an engineer designing a new spacecraft would have to study the possible effects of radiation in the space environment. The design also has to consider other engineers involved, such as the structural or production engineers who will eventually build the object. Further, the design also has to meet the needs of the people who will ultimately buy and use the product. To create their designs, engineers use computer-aided design/computer-aided manufacturing (CAD/CAM) tools.



Test and Evaluation

In a flight test, a new or modified aircraft or space vehicle goes through specific maneuvers and flight conditions to see how well it meets the design demands. Propulsion, aerodynamics, acoustics, thermal conditions, structures, stability and control, performance, and vehicle systems—the test monitors and records information about all of these factors. Often, test engineers need to design special facilities to conduct the testing, like wind tunnels or test chambers, or complex software models. They ensure that the results mirror the real world. Qualified and experienced pilots usually fly the aircraft, but test engineers design the test plan and conduct the test program. The test results are carefully noted, and the test engineer uses theories, concepts, and equations to analyze the data and prepare flight reports.

Field Service

Training, maintenance, and service support is almost always required after a product is developed and delivered to the customer. Manufacturers want to make sure the customer gets the most from their product. Field service representatives work with the manufacturers and the design engineers to fix any problems that might develop after the product has been built. Field service duties require technical know-how, expertise with the product, and the ability to work well with people.

Systems Engineering

Systems engineers are methodical and organized, and they are involved in all phases of engineering projects. They must be aware of many ways to address complex problems, potential ways to solve them, and the risks associated with each. Systems engineers analyze the mission; develop requirements for hardware, software, operations, and testing; and break down the mission and system requirements into subsystem and component requirements. As these elements are developed and integrated, systems engineers ensure that the original requirements are being met.



Aerospace Science

Sometimes it DOES take a “Rocket Scientist!” Aerospace scientists extend the knowledge of the basic sciences to the fundamental principles that are behind every aerospace product and activity. Specialty areas include air breathing and rocket propulsion, aeroacoustics, astronautics, lasers, life sciences in space, propellants and combustion, material science, and atmospheric and space environments. The scientist works to “know what hasn’t been known before” so the engineer can “build what hasn’t been built before.” Many aerospace scientists work in government or industry laboratories; many others teach and do research at the undergraduate, graduate, and postgraduate level. Often they will have studied physics, chemistry, or biology before specializing in aerospace. Others will be skilled engineers who have found their calling in expanding the frontiers of knowledge.

Employment Options

Working in the aerospace industry gives you career options within the U.S. government, private industry, and academia. Regardless of where you work, you will be constantly challenged to learn.

Working for the U.S. Government

A job with the U.S. government means that you work for the best interests of the American public. Most federal aerospace jobs are with the Department of Defense (DoD), National Aeronautics and Space Administration (NASA), and the Federal Aviation Administration (FAA).

The U.S. government has the resources to do the research and development work that is either impractical or not profitable for any single company. Typically, federal aerospace jobs offer young people the opportunity to work on interesting projects and provide exposure to a wide variety of people from various companies, other federal agencies and military commands.

Working for Private Industry

Most private industry jobs within aerospace are found primarily within the following segments: civil aviation, general aviation, military aircraft and missiles, military and commercial launch vehicles, communication satellites, etc. Whichever segment you choose, you will be contributing to the development of key next-generation products.

Working in Academia

Working as a university faculty member gives you the opportunity to train the next generation of practicing aerospace engineers. In addition, faculty at research universities are heavily involved with developing new structures and materials, devices and systems, analytical and computational techniques, design concepts, and processes to improve both current and next-generation aerospace products.



Anjaney Kottapalli

Lockheed Martin Corporation

Job Title: **Senior Research Scientist**

College: **Massachusetts Institute of Technology**

Hometown: **San Jose, CA**

Hobbies: **Flying (private pilot license), biking, photography**

I like my job because it's fun and I get to learn something new every day! In one day, I can be on the phone talking about high temperature materials, processing fluid dynamic simulations, learning new topics about machine learning, and drawing up project execution plans. My job requires me to learn new technical areas for each project - already I've learned about optics, infrared radiation, hydrodynamic cavitation, and composite materials, far more than I ever learned in school. My group specializes in modeling and simulation, especially for estimating what can be observed by infrared sensors. It's a fascinating field that involves electromagnetic radiation, fluid dynamics, and material properties.



Irene Chan

Summit Technologies & Solutions, Inc.

Job Title: Flight Planning and Requirements Engineer

College: University of California, San Diego
Embry-Riddle Aeronautical University, Worldwide,
Houston Campus

Hometown: Los Angeles, CA

Hobbies: Traveling, taking massive open online courses – I love learning! Reading biographies, enjoying aerobic dance workout sessions from the 1980s-2000s, visiting museums, homebrewing, developing and facilitating K-12 STEM outreach activities

Primarily, I support the International Space Station Program Office by communicating planned visiting vehicle traffic to different NASA organizations, contractors, and international partners. In this position, I compile launch, dock/berth, and undock/unberth data for Progress, Soyuz, HTV, SpaceX, and future U.S. crewed vehicles into a flight plan. As a web designer and developer, I love presenting these visiting vehicle traffic developments through different graphical and web-based means.

Secondarily, I assess operational and technical requirements, which I then facilitate coordination to obtain necessary agreements for executing the flight plan. When the flight plan or on-orbit activities violate flight requirements, I recommend possible resolutions to ensure successful on-orbit missions. I love how this task fits my personality. I work to encourage integration between diverse stakeholders while pioneering creative solutions. The integration work also appeals to my insatiable desire to learn; working with many organizations exposes me to a variety of approaches, priorities, and philosophies in space operations management.



Jackelynne Silva-Martinez

NASA Johnson Space Center, Flight Operations Directorate

Job Title: **Aerospace Engineer,
ISS Mission Planning Operations**

College: **Rutgers University,
Embry-Riddle Aeronautical University,
Georgia Institute of Technology**

Hometown: **Cusco, Peru**

Hobbies: **I am an active member of AIAA at the local and national levels. I am also member of the IAF Workforce Development and Young Professionals Committee, and Space Generation Advisory Committee. I like planning events and technical programs, reviewing abstracts and papers, and staying up to date with new research. I also enjoy traveling, hiking, swimming, reading, and learning from new cultures. I am the founder of Centro de Ciencia, Liderazgo y Cultura, an international outreach STEAM program for students and young professionals.**



I am a flight controller supporting the Operations Planning console in the Houston Mission Control Center. I coordinate with various disciplines of the flight control team and the international partners to plan the ISS crew and ground activities, while keeping the crew, vehicle and mission safe. My team and I are conducting an ISS study on crew autonomous scheduling in preparation of deep space missions.

Student Membership in AIAA

The American Institute of Aeronautics and Astronautics (AIAA) is the world's largest society dedicated to the global aerospace profession. Membership in AIAA provides opportunities to meet and talk with a number of engineers

and other distinguished people in the industry, including astronauts, pilots, and business leaders. As a student member, you can meet other students like you who are interested in astronautics and aeronautics.

Student membership costs only \$25 a year and includes:

- › **Online subscription to *Aerospace America***, AIAA's monthly member magazine with special articles about news in the aerospace industry
- › **AIAA Daily Launch**, an email news digest with the latest industry news
- › **Student Branch membership**, the college or university you select may have an AIAA Student Branch, which organizes meetings and activities specifically for students like you who are interested in aerospace
- › **Access** to scholarships
- › **Opportunities to attend conferences** and competitions to present your work
- › **Access to the Career Center** to help you prepare for your first job
- › **Save significant dollars** when you transition from student to professional membership, following your graduation.

For more information about AIAA student membership, please go to aiaa.org/Student



Victoria Chibuogu Nneji

Job Title: **2nd Year Ph.D. Student**

College: **Duke University**

Hometown: **Lagos, Nigeria (born) +
Durham, NC, USA (raised)**

Hobbies: **Appreciating museums, gardens,
islands and live jazz**

As a member of AIAA, I got to fully experience publishing, presenting and participating in the AIAA AVIATION Forum. There I met industry leaders and got live feedback on the progress I am making. I networked with bright students from around the world, learned from their diverse backgrounds, and built connections that will lead to even greater opportunities.

I am a researcher in the Humans & Autonomy Lab within Duke's Robotics program. I study how we can better design machines (e.g., self-driving cars, autopilots, and "internet-of-things") to work well with us humans. As humans, you and I have many skills and experiences to adapt to new environments, but we're not robots so my job is to consider what is necessary to ensure there is good communication and collaboration in safety-critical systems like transportation. As an Intern at General Motors I will work with research engineers to prove new automated safety technologies.



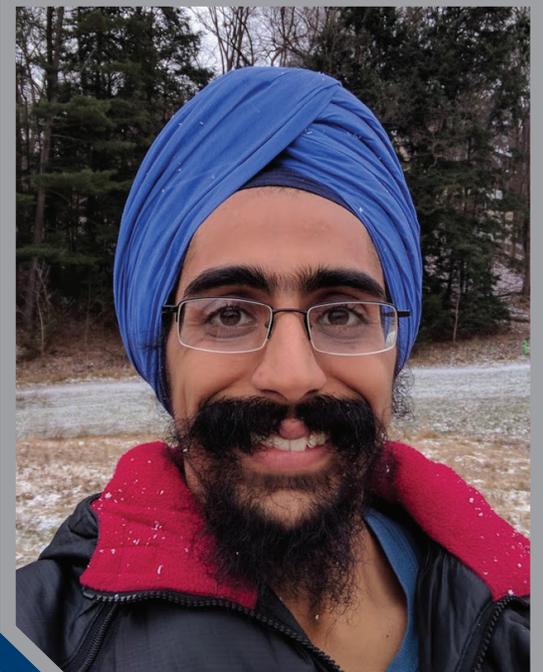
Puneet Singh

Job Title: **Ph.D. Candidate**

College: **University of Michigan**

Hobbies: **I like to read a lot of fiction and popular science books. In my free time, I like to doodle, make origami animals and strum the guitar. I also love building model airplanes.**

I am a Graduate Student Research Assistant. My research focuses on the aeromechanics of rotary wing vehicles, specifically coaxial rotor helicopters. I use mathematical and engineering tools to model the aerodynamics and structural dynamics of the rotor blades. We also estimate the noise and vibrations of a rotor. I enjoy applying equations from math and physics in computer codes. It is very satisfying to see codes give results that match experiments. You can play with parameters and try out things that would not be possible in real life.





High School Preparation for an Engineering Degree

You don't need to wait until high school to begin to think about a college degree and a career. As early as middle school, you can explore ideas about what you would like to do and begin thinking about colleges and universities you might like to attend.

Consult your teachers and counselors for resources. Find engineers and scientists in your community and talk with them about their jobs. Check out the websites of various colleges and universities to see what they offer. We highly recommend that you do this before you select your high school electives; some colleges will reject applicants who have not completed all required courses.

You must have a good scholastic average to qualify for admission. This does not mean that you must be a "straight A" student, but neither can you expect to receive much consideration when you have Cs and Ds to show for your high school work.

Students interested in engineering should consider taking several of the following courses:

- > **Algebra II**
- > **Biology**
- > **Calculus**
- > **Chemistry**
- > **Computer and Information Technology**
- > **Physics**
- > **Trigonometry**



Engineering requires a strong foundation in science and math. While in high school, take as many math and science courses as possible. These subjects provide the foundation for your coursework in college. Calculus is particularly important because many introductory college engineering courses will assume at least some familiarity with calculus. Physics is particularly important for aerospace engineering, but at least one year of chemistry is also suggested.

Engineers must also communicate their design ideas and decisions, so writing and speech classes are also an important part of the studies of a successful aspiring engineer.

Important Qualities

- > **Analytical skills.** Aerospace engineers must be able to identify design elements that may not meet requirements and then must formulate alternatives to improve the performance of those elements.
- > **Business skills.** Much of the work done by aerospace engineers involves meeting federal government standards. Meeting these standards often requires knowledge of standard business practices.
- > **Critical thinking skills.** Aerospace engineers must be able to translate a set of issues into requirements and to figure out why a particular design does not work. They must be able to ask the right question, then find an acceptable answer. Aerospace engineers use the principles of calculus, trigonometry, and other advanced topics in math for analysis, design, and troubleshooting in their work.
- > **Problem-solving skills.** Aerospace engineers use their education and experience to upgrade designs and troubleshoot problems when meeting new demands for aircraft, such as increased fuel efficiency or improved safety.
- > **Writing skills.** Aerospace engineers must be able both to write papers that explain their designs clearly and to create documentation for future reference.



Choosing a College

There is no hard-and-fast rule for selecting a school. You must take into consideration a wide range of variables (distance from home, size of school, majors offered, how you will pay tuition, etc.). Every year, schools and their engineering programs are ranked nationally. While these rankings provide some insight into the relative competitiveness of programs, a school's ranking is insufficient to determine if that school is a good fit for you, your learning style, and your career objectives.

The following curriculum is for a typical four-year aerospace engineering major. Terminology varies among schools: some designate the curriculum as Aeronautics and Astronautics, some as Aeronautical Engineering, some as Aerospace Sciences, etc.

The aerospace engineering program is the result of extensive consultation among university administrators and faculty, key people in the aerospace industry, and ABET, which is the agency that accredits engineering curricula at colleges and universities in the United States. Remember that the following is “typical.” You might not follow it exactly. It is presented to show the flexibility that exists in course structure.

The first two years are almost always devoted to the basic physical and engineering sciences, mathematics, and nontechnical subjects. The content of these first years is likely to be as follows:

First Year

- › English
- › Analytic Geometry and Calculus
- › Chemistry (or Physics)
- › Computers

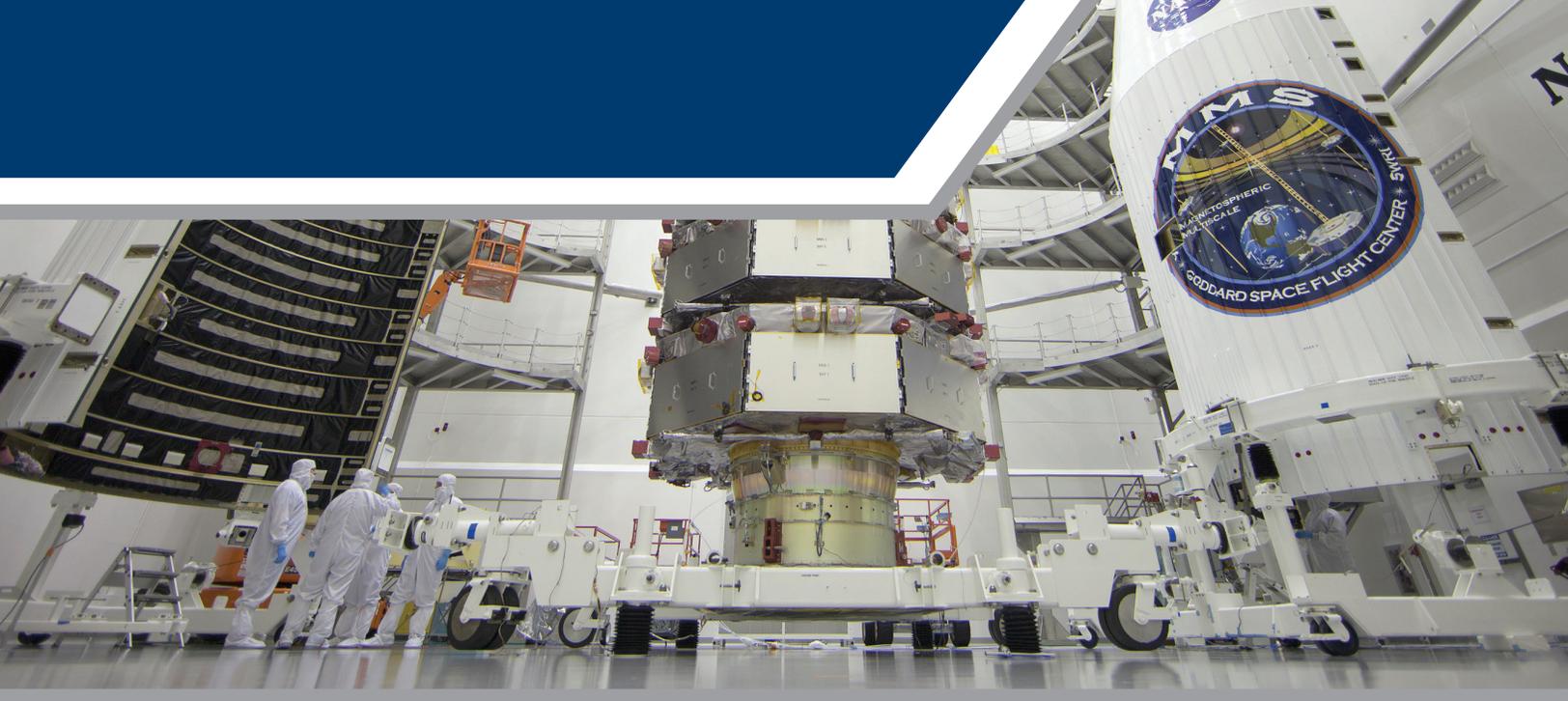
Second Year

- › Humanities and Social Sciences
- › Calculus and Differential Equations
- › Physics (or Chemistry)
- › Engineering Mechanics
- › Statics and Dynamics
- › Thermodynamics

During the junior and senior years, you can choose a program devoted primarily to a field of study—for example, design, or research and development—as well as an aeronautics or astronautics option. Such alternative curricula might be the following:

Third Year

- › Aero/Astro Design Program
- › Applied Aerodynamics/Astrodynamics
- › Elementary Structural Analysis
- › Materials and Metallurgy
- › Analytical Mechanics
- › Electromagnetic Fields
- › Advanced Calculus and Analysis
- › Fluid Mechanics
- › Heat Transfer
- › Electrical Circuits
- › Aeronautical/Astronautical Laboratories
- › Nontechnical Courses



It is safe to say that no two curricula in aerospace engineering offer the same subject matter during the fourth year. There is a good reason for this—the advanced courses are built around the interests and abilities of the faculty members in the department. Because these vary widely from institution to institution, we provide here a list of possible technical electives for the fourth year of study:

Fourth Year

- › **Aero Design Program**
- › **Flight Vehicle Design**
- › **Structural Analysis Astro Design Program**
- › **Spacecraft Design**
- › **Spacecraft Dynamics and Control**
- › **Space Structures Aero Research Program**
- › **Engineering Mechanics**
- › **Vehicle Systems**
- › **Flight Mechanics**
- › **Trajectory Dynamics Astro Research Program**
- › **Orbital Mechanics**
- › **Spacecraft System**
- › **Telecommunications**

- › **Spacecraft Power**
- › **Gas Dynamics**
- › **Electronics**
- › **Modern Physics**
- › **Aerospace Propulsion Systems**
- › **Boundary Layer Theory**
- › **Advanced Mathematical Problems**

Bachelor's degree programs include classroom, laboratory, and field studies in subjects such as general engineering principles, propulsion, stability and control, structures, mechanics, and aerodynamics, which is the study of how air interacts with moving objects.

Some colleges and universities offer cooperative programs in partnership with regional businesses, which give students practical experience while they complete their education. Cooperative programs and internships enable students to gain valuable experience and to finance part of their education.

At some universities, a student can enroll in a 5-year program that leads to both a bachelor's degree and a master's degree upon completion. A graduate degree will allow an engineer to work as an instructor at a university or to do research and development.



Which college is right for me?

As you consider which type of engineering degree to pursue, you need to factor in other important issues, such as programs offered, cost, and distance from home.

Get started by looking at only colleges that offer ABET-accredited engineering programs. ABET is the recognized accreditor for college and university programs in applied science, computing, engineering, and technology. A federation of 28 professional and technical societies represents these fields. AIAA is the recognized society for evaluating aeronautical, aerospace, and similarly named programs, and currently evaluates over 70 programs around the United States.

Why is accreditation important?

ABET accreditation determines whether an engineering program meets quality standards for courses, faculty, and facilities. Accredited programs will adequately prepare you to enter the workforce. Graduation from an ABET-accredited program is often a minimum requirement for some jobs, graduate schools, and state boards of professional licensure.

Where can I find an accredited college that has programs I am interested in?

The ABET website, www.abet.org, is a valuable resource. On the ABET site, you can find an accredited engineering program by specifying a discipline (for example, “aerospace”), a region of the United States (for example, “Mid-Atlantic”), and/or a U.S. state. A list of colleges that meet your criteria is displayed, along with links to their websites and contact information.

Note that ABET does not rank university programs; rather, it ensures that each program has been evaluated by aerospace professionals and other faculty and that it meets the requirements for accreditation.

How do I choose the college that has the right program for me?

Do your homework! Visit the websites of the accredited colleges you found on www.abet.org. Is the school doing things that you are interested in? Some schools are heavily into research. Some are known for their internships and opportunities in the local community. Some have excellent master’s and doctorate programs. These are things that only you will know are right for you.

Engineering students and faculty members also are an excellent resource. The AIAA website aiaa.org/StudentBranches provides access to both. On the website you will find a list of chartered AIAA student branches at U.S. and international colleges and universities, along with contact information for faculty advisors and student branch chairs, and in some cases, URLs to the branch’s home page. You can directly contact the advisor or chair of a student branch for information and recommendations. You also can network with other engineering students by attending a branch meeting at a college near you.

Is there any help to pay for my education?

The AIAA Foundation offers scholarships to college sophomores, juniors, and seniors. In addition, Design Competitions award prizes to individuals and teams of undergraduate and graduate students. Graduate awards provide financial rewards and professional recognition. Student paper competitions are another way to gain financial and recognition benefits. Visit the AIAA website for current scholarship and award information.

Consult the financial aid advisors at your high school or at the colleges you are considering. They can provide information and applications for other sources of financial assistance, such as scholarships, grants, and loans.



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