

## DEPARTMENT OF AERONAUTICS AND ASTRONAUTICS

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### Graduate Study

Graduate study in the Department of Aeronautics and Astronautics includes graduate-level subjects in Course 16 and others at MIT, and research work culminating in a thesis. Degrees are awarded at the master's and doctoral levels. The range of subject matter is described under Sectors of Instruction (p. 3). Departmental research centers' websites offer information on research interests. Detailed information may be obtained from the Department Academic Programs Office or from individual faculty members.

### Admission Requirements

In addition to the general requirements for admission to the Graduate School, applicants to the Department of Aeronautics and Astronautics should have a strong undergraduate background in the fundamentals of engineering and mathematics as described in the Undergraduate Study section.

International students whose language of instruction has not been English in their primary and secondary schooling must pass the Test of English as a Foreign Language (TOEFL) with a minimum score of 100 out of 120, or the International English Language Testing System (IELTS) with a minimum score of 7 out of 9 to be considered for admission to this department. TOEFL waivers are not accepted. No other exams fulfill this requirement.

New graduate students are normally admitted as candidates for the degree of Master of Science. Admission to the doctoral program is offered through a two-step process to students who have been accepted for graduate study: 1) passing performance on a course-based field evaluation (FE); 2) a faculty review consisting of an examination of the student's achievements, including an assessment of the quality of past research work and evaluation of the student's academic record in light of the performance on the FE.

The Department of Aeronautics and Astronautics requires that all entering graduate students demonstrate satisfactory English writing ability by taking the Graduate Writing Examination offered by the Comparative Media Studies/Writing Program. The examination is usually administered in July, and all entering candidates must take the examination electronically at that time. Students with deficient skills must complete remedial training specifically designed to fulfill their individual needs. The remedial training prescribed by the CMS/Writing Program must be completed by the end of the first Independent Activities Period following initial registration in the graduate program or, in some cases, in the spring term of the first year of the program.

All incoming graduate students whose native language is not English are required to take the Department of Humanities English

Evaluation Test (EET) offered at the start of each regular term. This test is a proficiency examination designed to indicate areas where deficiencies may still exist and recommend specific language subjects available at MIT.

### Degree Requirements

All entering students are provided with additional information concerning degree requirements, including lists of recommended subjects, thesis advising, research and teaching assistantships, and course and thesis registration.

### Degrees Offered

#### Master of Science in Aeronautics and Astronautics

The Master of Science (SM) degree is a one- to two-year graduate program with a beginning research or design experience represented by the SM thesis. This degree prepares the graduate for an advanced position in the aerospace field, and provides a solid foundation for future doctoral study.

The general requirements for the Master of Science degree (<http://catalog.mit.edu/mit/graduate-education/general-degree-requirements>) are cited in the section on General Degree Requirements for graduate students. The specific departmental requirements include at least 66 graduate subject units, typically in subjects relevant to the candidate's area of technical interest. Of the 66 units, at least 21 units must be in departmental subjects. To be credited toward the degree, graduate subjects must carry a grade of B or better. In addition, a 24-unit thesis is required beyond the 66 units of coursework. Full-time students normally must be in residence one full academic year. Special students admitted to the SM program in this department must enroll in and satisfactorily complete at least two graduate subjects while in residence (i.e., after being admitted as a degree candidate) regardless of the number of subjects completed before admission to the program. Students holding research assistantships typically require a longer period of residence.

In addition, the department's SM program requires one graduate-level mathematics subject. The requirement is satisfied only by graduate-level subjects on the list approved by the department graduate committee. The specific choice of math subjects is arranged individually by each student in consultation with their faculty advisor.

#### Doctor of Philosophy and Doctor of Science in Aeronautics and Astronautics Fields

AeroAstro offers the doctor of philosophy and doctor of science (PhD and ScD) degrees in aeronautics and astronautics and in other fields of specialization (<http://catalog.mit.edu/schools/engineering/#degreesandprogramstext>). The doctoral program emphasizes in-depth study, with a significant research project in a focused area. The admission process for the department's doctoral program is described previously in this section under Admission Requirements.

The PhD or ScD degree is awarded after completion of an individual course of study, submission and defense of a thesis proposal, and submission and defense of a thesis embodying an original research contribution.

All doctoral students must fulfill MIT's General Degree Requirements (<http://catalog.mit.edu/mit/graduate-education/general-degree-requirements>). The general program requirements for the PhD and ScD degrees in aeronautics and astronautics (<http://catalog.mit.edu/degree-charts/phd-aeronautics-astronautics>) are outlined in this degree chart. Additional information ([http://mit.edu/aeroastro/academics/grad/forms/New\\_Doctoral\\_Booklet.pdf](http://mit.edu/aeroastro/academics/grad/forms/New_Doctoral_Booklet.pdf)) is available on the department website. After successful admission to the doctoral program, the doctoral candidate selects a field of study and research in consultation with the thesis supervisor and forms a doctoral thesis committee, which assists in the formulation of the candidate's research and study programs and monitors their progress. Demonstrated competence for original research at the forefront of aerospace engineering is the final and main criterion for granting the doctoral degree. The candidate's thesis serves in part to demonstrate such competence and, upon completion, is defended orally in a presentation to the faculty of the department, who may then recommend that the degree be awarded.

### **Interdisciplinary Programs**

The department participates in several interdisciplinary fields at the graduate level, which are of special importance for aeronautics and astronautics in both research and the curriculum.

### **Aeronautics, Astronautics, and Statistics**

The Interdisciplinary Doctoral Program in Statistics provides training in statistics, including classical statistics and probability as well as computation and data analysis, to students who wish to integrate these valuable skills into their primary academic program. The program is administered jointly by the departments of Aeronautics and Astronautics, Economics, Mathematics, Mechanical Engineering, Physics, and Political Science, and the Statistics and Data Science Center within the Institute for Data, Systems, and Society. It is open to current doctoral students in participating departments. For more information, including department-specific requirements, see the full program description (<http://catalog.mit.edu/interdisciplinary/graduate-programs/phd-statistics>) under Interdisciplinary Graduate Programs.

### **Air Transportation**

For students interested in a career in flight transportation, a program is available that incorporates a broader graduate education in disciplines such as economics, management, and operations research than is normally pursued by candidates for degrees in engineering. Graduate research emphasizes one of the four areas of flight transportation: airport planning and design, air traffic control, air transportation systems analysis, and airline economics and management, with subjects selected appropriately from those available in the departments of Aeronautics and

Astronautics, Civil and Environmental Engineering, Economics, and the interdepartmental Master of Science in Transportation (MST) program. Doctoral students may pursue a PhD with specialization in air transportation in the Department of Aeronautics and Astronautics or in the interdepartmental PhD program in transportation or in the PhD program of the Operations Research Center (see the section on Graduate Programs in Operations Research under Research and Study).

### **Biomedical Engineering**

The department offers opportunities for students interested in biomedical instrumentation and physiological control systems where the disciplines involved in aeronautics and astronautics are applied to biology and medicine. Graduate study combining aerospace engineering with biomedical engineering may be pursued through the Bioastronautics program offered as part of the Medical Engineering and Medical Physics PhD program in the Institute for Medical Engineering and Science (IMES) via the Harvard-MIT Program in Health Sciences and Technology (HST).

Students wishing to pursue a degree through HST must apply to that graduate program. At the master's degree level, students in the department may specialize in biomedical engineering research, emphasizing space life sciences and life support, instrumentation and control, or in human factors engineering and in instrumentation and statistics. Most biomedical engineering research in the Department of Aeronautics and Astronautics is conducted in the Man Vehicle Laboratory.

### **Computational Science and Engineering**

The Master of Science in Computational Science and Engineering (CSE SM) (<https://cse.mit.edu/programs/sm>) is an interdisciplinary program for students interested in the development, analysis, and application of computational approaches to science and engineering. The curriculum is designed with a common core serving all science and engineering disciplines and an elective component focusing on specific disciplinary topics. Students may pursue the CSE SM as a standalone degree or as leading to the CSE PhD program described below.

The Interdisciplinary Doctoral Program in Computational Science and Engineering (CSE PhD) (<https://cse.mit.edu/programs/phd>) allows students to specialize at the doctoral level in a computation-related field of their choice through focused coursework and a thesis through one of the participating host departments in the School of Engineering or School of Science. The program is administered jointly by the Center for Computational Science and Engineering (CCSE) and the host departments; the emphasis of thesis research activities is the development of new computational methods and/or the innovative application of computational techniques to important problems in engineering and science.

For more information, see the program descriptions under Interdisciplinary Graduate Programs.

### **Joint Program with the Woods Hole Oceanographic Institution**

The Joint Program with the Woods Hole Oceanographic Institution (WHOI) (<http://mit.who.edu>) is intended for students whose primary career objective is oceanography or oceanographic engineering. Students divide their academic and research efforts between the campuses of MIT and WHOI. Joint Program students are assigned an MIT faculty member as academic advisor; thesis research may be supervised by MIT or WHOI faculty. While in residence at MIT, students follow a program similar to that of other students in their home department. The program is described in more detail (<http://catalog.mit.edu/interdisciplinary/graduate-programs/joint-program-woods-hole-oceanographic-institution>) under Interdisciplinary Graduate Programs.

### **Leaders for Global Operations**

The 24-month Leaders for Global Operations (LGO) (<http://catalog.mit.edu/interdisciplinary/graduate-programs/leaders-global-operations>) program combines graduate degrees in engineering and management for those with previous postgraduate work experience and strong undergraduate degrees in a technical field. During the two-year program, students complete a six-month internship at one of LGO's partner companies, where they conduct research that forms the basis of a dual-degree thesis. Students finish the program with two MIT degrees: an MBA (or SM in management) and an SM from one of seven engineering programs, some of which have optional or required LGO tracks. After graduation, alumni lead strategic initiatives in high-tech, operations, and manufacturing companies.

### **System Design and Management**

The System Design and Management (SDM) (<http://sdm.mit.edu>) program is a partnership among industry, government, and the university for educating technically grounded leaders of 21st-century enterprises. Jointly sponsored by the School of Engineering and the Sloan School of Management, it is MIT's first degree program to be offered with a distance learning option in addition to a full-time in-residence option.

### **Technology and Policy**

The Master of Science in Technology and Policy is an engineering research degree with a strong focus on the role of technology in policy analysis and formulation. The Technology and Policy Program (TPP) (<http://tpp.mit.edu>) curriculum provides a solid grounding in technology and policy by combining advanced subjects in the student's chosen technical field with courses in economics, politics, quantitative methods, and social science. Many students combine TPP's curriculum with complementary subjects to obtain dual degrees in TPP and either a specialized branch of engineering or an applied social science such as political science or urban studies and planning. See the program description (<http://catalog.mit.edu/>

[schools/mit-schwarzman-college-computing/data-systems-society](http://schools/mit-schwarzman-college-computing/data-systems-society)) under the Institute for Data, Systems, and Society.

### **Financial Support**

Financial assistance for graduate study may be in the form of fellowships or research or teaching assistantships. Both fellowship students and research assistants work with a faculty supervisor on a specific research assignment of interest, which generally leads to a thesis. Teaching assistants are appointed to work on specific subjects of instruction.

A special relationship exists between the department and the Charles Stark Draper Laboratory. This relationship affords fellowship opportunities for SM and PhD candidates who perform their research as an integral part of ongoing projects at Draper. Faculty from the department maintain close working relationships with researchers at Draper, and thesis research at Draper performed by Draper fellows can be structured to fulfill MIT residency requirements. Further information on Draper can be found in the section on Research and Study.

### **Inquiries**

For additional information concerning admissions, financial aid and assistantship, and academic, research, and interdisciplinary programs in the department, contact the AeroAstro Student Services Office, Room 33-202, 617-253-0043.