DEPARTMENT OF NUCLEAR SCIENCE AND ENGINEERING

Graduate Study

The nuclear science and engineering field is broad and many undergraduate disciplines provide suitable preparation for graduate study.

An undergraduate degree in physics, engineering physics, chemistry, mathematics, materials science, or chemical, civil, electrical, mechanical, or nuclear science and engineering can provide a good foundation for graduate study in the department. Optimal undergraduate preparation would include the following:

- **Physics:** At least three introductory subjects covering classical mechanics, electricity and magnetism, and wave phenomena. An introduction to quantum mechanics is quite helpful, and an advanced subject in electricity and magnetism (including a description of time-dependent fields via Maxwell's equations) is recommended for those wishing to specialize in fusion.
- **Mathematics:** It is essential that incoming students have a solid understanding of mathematics, including the study and application of ordinary differential equations. It is also highly recommended that students will have studied partial differential equations and linear algebra.
- **Chemistry:** At least one term of general, inorganic, and physical chemistry.
- **Engineering fundamentals:** The graduate curriculum builds on a variety of engineering fundamentals, and incoming students are expected to have had an introduction to thermodynamics, fluid mechanics, heat transfer, electronics and measurement, and computation. A subject covering the mechanics of materials is recommended, particularly for students wishing to specialize in fission.
- **Laboratory experience:** This component is essential. It may have been achieved through an organized subject, and ideally was supplemented with an independent undergraduate research activity or a design project.

Applicants for admission can find information about admission requirements in the Graduate Education Admissions section (*https://catalog.mit.edu/mit/graduate-education/admissions*) and on the Nuclear Science and Engineering at MIT Department website (*http://web.mit.edu/nse/education/grad/admissions.html*).

Master of Science in Nuclear Science and Engineering

The object of the master of science program is to give the student a good general knowledge of nuclear science and engineering and to provide a foundation either for productive work in the nuclear field or for more advanced graduate study. The general requirements for the SM degree are listed under Graduate Education.

Subjects are selected in accordance with the student's particular field of interest. Master of science candidates may specialize in one of several fields: including nuclear fission technology, applied plasma physics, nuclear materials, nuclear security, and nuclear science and technology. Some students pursue a master of science degree in technology and policy in parallel with the Course 22 master of science program.

Students with adequate undergraduate preparation take approximately 18 months to complete the requirements for the master of science. Actual completion time ranges from one to two years. Additional information concerning the requirements for the Master of Science in Nuclear Science and Engineering, including lists of recommended subjects, may be obtained from the department's Academic Office, Room 24-102.

Nuclear Engineer

The program of study leading to the nuclear engineer's degree provides deeper knowledge of nuclear science and engineering than is possible in the master's program and is intended to train students for creative professional careers in engineering application or design.

The general requirements for this degree, as described under Graduate Education, include 162 units of subject credit plus a thesis. Each student must plan an individually selected program of study, approved in advance by the faculty advisor, and must complete, and orally defend, a substantial project of significant value.

The objectives of the program are to provide the candidate with broad knowledge of the profession and to develop competence in engineering applications or design. The emphasis in the program is more applied and less research-oriented than the doctoral program.

The engineering project required of all candidates for the nuclear engineer's degree is generally the subject of an engineer's thesis. A student with full undergraduate preparation normally needs two years to complete the program. Additional information may be obtained from the department.

Doctor of Philosophy and Doctor of Science in Nuclear Science and Engineering

The program of study leading to either the Doctor of Philosophy or the Doctor of Science in Nuclear Science and Engineering (*https://catalog.mit.edu/degree-charts/phd-nuclear-science-engineering*) aims to give comprehensive knowledge of nuclear science and engineering, to develop competence in advanced engineering research, and to develop a sense of perspective in assessing the role of nuclear science and technology in our society.

General Institute requirements for the doctorate are described under Graduate Education (*https://catalog.mit.edu/mit/graduate-education/general-degree-requirements/#doctoraldegreetext*) and in the Office of Graduate Education Policy and Procedures manual (*https://oge.mit.edu/gpp/degrees/doctoral*). The specific

requirements of the Department of Nuclear Science and Engineering are the core requirement, the field of specialization requirement, the oral examination, the advanced subject and minor requirements, and the doctoral thesis. Upon satisfactory completion of the requirements, the student ordinarily receives a PhD in nuclear science and engineering, unless he or she requests an ScD. The requirements for both degrees are the same.

Students admitted for the master of science or nuclear engineer's degree must apply to the Department of Nuclear Science and Engineering's Admissions Committee for admission to the doctoral program.

Candidates for the doctoral degree must demonstrate competence at the graduate level in the core areas of nuclear science and engineering; the core requirement must be completed by the end of the fourth graduate term. Candidates for the doctoral degree are also required to complete three 12-unit (or greater than 12-unit) graduate subjects in their field of specialization with a grade of B or better. The field-of-specialization subjects should together provide a combination of depth and breadth of knowledge.

Candidates for a doctoral degree are required to demonstrate their readiness to undertake doctoral research by passing an oral examination by the end of their fourth graduate term. Oral exams are held twice a year, at the end of January or beginning of February and at the end of May. Students will generally take the oral exam for the first time in January or February of their second year. Two attempts are allowed at the oral exam. An overall GPA in graduate subjects of 4.0 is required to take the oral.

Candidates for a doctoral degree must also pass a thesis prospectus defense and submit an approved thesis prospectus by the end of the fourth term.

Students will be permitted to embark on doctoral research only if, by the end of their fourth graduate term, they have demonstrated satisfactory performance in the core requirement, the field of specialization, and the oral examination, and have passed the thesis prospectus defense and final thesis prospectus submission by the end of the fifth term.

Candidates for the doctoral degree must satisfactorily complete (with an average grade of B or better) an approved program of two advanced subjects (24 units) that are closely related to the student's doctoral thesis topic. Neither of these subjects may be from the list of three subjects selected to satisfy the field-of-specialization requirement. The advanced subjects should be arranged in consultation with the student's thesis advisor and the student's registration officer, and should have the approval of the registration officer. In addition, students must satisfactorily complete at least 12 units of coursework in an NSE subject outside of their field of specialization to fulfill the breadth requirement, and 12 units of unrestricted electives.

Doctoral research may be undertaken either in the Department of Nuclear Science and Engineering or in a nuclear-related field in another department. Appropriate areas of research are described generally in the introduction to the department, and a detailed list may be obtained from the Department of Nuclear Science and Engineering.

Interdisciplinary Programs

Computational Science and Engineering Doctoral Program
The Doctoral Program in Computational Science and Engineering (CSE PhD) (*https://cse.mit.edu/programs/phd*) allows students to specialize in a computation-related field of their choice through focused coursework and a doctoral thesis through a number of participating host departments. The CSE PhD program is administered jointly by the Center for Computational Science and Engineering (CCSE) and the host departments, with the emphasis of thesis research activities being 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 full program description (*https://catalog.mit.edu/interdisciplinary/graduate-programs/computational-science-engineering*) under Interdisciplinary Graduate Programs.

Leaders for Global Operations
The 24-month Leaders for Global Operations (LGO) (*https://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 eight engineering programs, some of which have optional or required LGO tracks. After graduation, alumni lead strategic initiatives in high-tech, operations, and manufacturing companies.

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 (*https://catalog.mit.edu/*

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

Financial Support

Financial aid for graduate students is available in the form of research and teaching assistantships, department-administered fellowships, and supplemental subsidies from the College Work-Study Program. Assistantships are awarded to students with high quality academic records. The duty of a teaching assistant is to assist a faculty member in the preparation of subject materials and the conduct of classes, while that of a research assistant is to work on a research project under the supervision of one or more faculty members.

Most fellowships are awarded in April for the following academic year. Assistantships are awarded on a semester basis. The assignment of teaching assistants is made before the start of each semester, while research assistants can be assigned at any time. Essentially all students admitted to the doctoral program receive financial aid for the duration of their education.

Application for financial aid should be made to Professor Jacopo Buongiorno, Room 24-206, 617-253-7316.

Inquiries

Additional information on graduate admissions and academic and research programs may be obtained from the department's Academic Office (*cegan@mit.edu*), Room 24-102, 617-253-3814.