DEPARTMENT OF NUCLEAR SCIENCE AND ENGINEERING

Undergraduate Study

The department's undergraduate programs offer a strong foundation in science-based engineering, providing the skills and knowledge for a broad range of careers, with an emphasis on hands-on exploration of the subject matter. The programs develop scientific and engineering fundamentals in the production, interactions, measurement, and control of radiation arising from nuclear processes. In addition, the program introduces students to thermal-fluid engineering and computational methods. Building upon these fundamentals, students understand the principles, design, and appropriate application of nuclear-based or nuclear-related systems that have broad societal impacts in energy, human health, and security—for example, reactors, imaging systems, detectors, and plasma confinement. In addition, they develop professional skills in quantitative research, written and oral technical communication, team building, and leadership. The program provides excellent preparation for subsequent employment, graduate education, and/or research in a broad range of fields. In the nuclear field, there is high demand for nuclear engineers around the world as the nuclear energy industry continues to expand. Other nuclear and radiation applications are increasingly important in medicine, industry, and government.

A characteristic of the curriculum is the development of practical skills through hands-on education to reinforce the fundamentals of the nuclear discipline. This is accomplished through various required and elective subjects, such as a laboratory subject on radiation physics, measurement, and protection (22.09 Principles of Nuclear Radiation Measurement and Protection), and through the laboratory components and exercises of the electronics (22.071 Analog Electronics and Analog Instrumentation Design), ionizing radiation, and computational subjects. Even foundational courses in nuclear unit processes (22.01 Introduction to Nuclear Engineering and Ionizing Radiation) and neutronics (22.05 Neutron Science and Reactor Physics) include hands-on activities and analyses of real objects/systems. Examples include measuring the radioactivity of fruits with high potassium content, predicting and measuring the neutron multiplication of a large graphite/uranium pile, and analyzing trace impurities in various foods, minerals, or biological tissues in our nuclear reactor. The concept of experiential learning is continued with a 15-unit design subject focusing on nuclear-centric design and prototyping and/or a 12-unit undergraduate thesis that is normally organized between the student and a faculty member of the department. Thesis subjects can touch on any area of nuclear science and engineering, including nuclear energy applications (fission and fusion) and nuclear science and technology (medical, physical, chemical, security, political science, and materials applications).

Bachelor of Science in Nuclear Science and Engineering (Course 22)

The Bachelor of Science in Nuclear Science and Engineering (Course 22) (*http://catalog.mit.edu/degree-charts/nuclear-science-engineering-course-22*) prepares students for a broad range of careers, from practical engineering work in the energy industry to graduate study in a wide range of technical fields, as well as entrepreneurship, law, medicine, and business. The degree program includes foundational subjects in physics, mathematics, and programming, leading to core subjects in the areas of nuclear energy (fission and fusion), as well as nuclear energy policy, social issues surrounding nuclear energy, quantum engineering, radiation physics, and product design.

The Course 22 degree program is accredited by the Engineering Accreditation Commission of Accreditation Board for Engineering and Technology (ABET) (*http://www.abet.org*).

Bachelor of Science in Engineering (Course 22-ENG)

The 22-ENG degree program (*http://catalog.mit.edu/degree-charts/engineering-nuclear-science-engineering-course-22-eng*) is designed to offer flexibility within the context of nuclear science and engineering applications. This program is designed to enable students to pursue a deeper level of understanding in a specific nuclear application or interdisciplinary field related to the nuclear science and engineering core discipline. The degree requirements include core subjects relevant to a broad array of nuclear and related interdisciplinary areas, a specialization subject in energy systems, and a senior project, as well as a focus area consisting of 72 units of additional coursework.

A significant part of the 22-ENG degree program consists of focus area electives chosen by the student to provide in-depth study in a field of the student's choosing. Focus areas should complement a foundation in nuclear science and engineering and General Institute Requirements. Some examples of potential focus areas include nuclear medicine, energy or nuclear policy, fusion energy or plasma science, clean energy technologies, nuclear materials, modeling and simulation of complex systems, and quantum engineering, or an area of study within one of the departmental focus areas. Focus areas are not limited to these examples. Advising on students' development of focus areas is available from the undergraduate officer or the Academic Office. Students enrolled in the flexible major must submit a proposal to the Academic Office no later than Add Date of the second term in the program, to be reviewed by the Undergraduate Committee.

Combined Bachelor's and Master's Programs

The five-year programs leading to a joint Bachelor of Science in Chemical Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, Nuclear Science and Engineering, or Physics and a Master of Science in Nuclear Science and Engineering are designed for students who decide relatively early in their undergraduate career that they wish to pursue a graduate degree in nuclear science and engineering. Students must submit their application for this program during the second term of their junior year and be judged to satisfy the graduate admission requirements of the department. The normal expectations of MIT undergraduates for admission to the five-year program are an overall MIT grade point average (GPA) of at least 4.3, and a strong mathematics, science, and engineering background with a GPA in these subjects of at least 4.0.

The nuclear science and engineering thesis requirements of the two degrees may be satisfied either by completing both an SB thesis and an SM thesis, or by completing an SM thesis and any 12 units of undergraduate credit.

For further information, interested students should contact either their undergraduate department or the Department of Nuclear Science and Engineering.

Minor in Nuclear Science and Engineering

This minor allows students from any major outside of Course 22 to delve deeper into advanced topics within the department or to support interdisciplinary areas of interest in nuclear science and engineering.

Required subjects		
18.03	Differential Equations	12
22.01	Introduction to Nuclear Engineering and Ionizing Radiation	12
NSE Electives		
Select two of the following:		24
22.02	Introduction to Applied Nuclear Physics	
22.033	Nuclear Systems Design Project	
22.05	Neutron Science and Reactor Physics	
22.06	Engineering of Nuclear Systems	
22.09	Principles of Nuclear Radiation Measurement and Protection	
Foundation and Specialized Subjects		
Select one of the following options:		24
Option 1		
2.005	Thermal-Fluids Engineering I [1]	
or 8.03	Physics III	
12 units of Course 22 coursework [2]		
Option 2		
24 units of Course 22 coursework [2]		
Total Units		**72**

1 *Subject has prerequisites that are outside the program.*

2 *Selected subjects must be letter-graded. Research/UROP subjects cannot be used.*

Inquiries

Further information on undergraduate programs, admissions, and financial aid may be obtained from the department's Academic Office (*cegan@mit.edu*), Room 24-102, 617-258-5682.