The breadth and depth of options is ideal for undergraduates still considering what their futures might bring.

—Ashley Finan G

I was attracted to the department of Nuclear Science and Engineering because of the opportunities provided by this multidisciplinary field and ease of working directly with NSE faculty.

—Vladimir Sobes '11

If you are the type of person who loves adventures and challenges, I believe nuclear engineering will be a good fit for you.

—Bao Truong G

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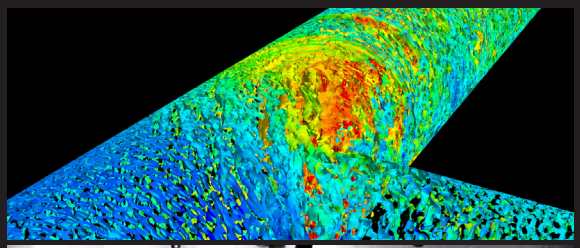
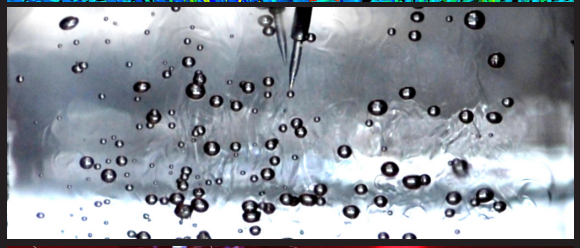
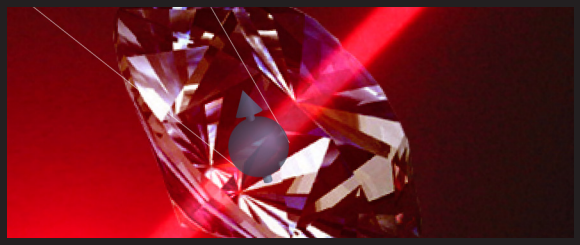
Photos | Justin Knight

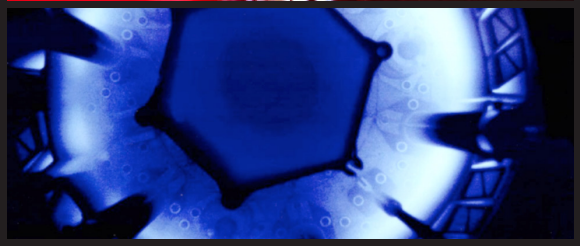
NSE
Nuclear Science and Engineering

science : systems : society









Massachusetts Institute of Technology

course XXII

Interested in Course 22?

One of our most frequently asked questions is: How much breadth and depth can I expect from an NSE degree?

Nuclear engineering is the ultimate integrated engineering discipline. This is because nuclear systems – whether fission reactors, fusion reactors, ultrasensitive detectors, or medical imagers – have many different components, all of which need to be understood in an interconnected way. As a nuclear engineer, you need to be both an expert in your field and know enough about other fields (thermodynamics, materials science, mechanical engineering, physics, electronics, computer science) that you can hold your own in any scientific setting. For example, the fundamentals of materials science, central to issues of corrosion, fuel performance, and safety in nuclear reactors, involve the same principles and tools you would apply in solving problems of preventing corrosion in oil pipelines, building robust space vehicles, or optimizing manufacturing systems to minimize human error and maximize efficiency.

Recent NSE graduates have taken positions at universities, nuclear vendors, reactor designers, safety regulators, national laboratories, and nuclear power plants. But it may surprise you to know that some have also started their own companies, worked as hedge fund managers, created interactive science and arts displays in Paris, improved aircraft components, attended medical school and crafted energy policy in many countries.

One of the best things about declaring Course 22 is that the classes, UROPs, and internships have given me a wide range of experiences and have opened doors to an equally wide range of choices in future career paths.

—Sara Ferry G

Photo | Working on a circuit in 22.071J lab during a lesson about op-amps. All course 22 undergraduates take this class.

Education & Research in NSE

Fission

Our fission program has a long and distinguished history of contributions to the worldwide development of the current light water reactor fleet. Current research initiatives include the development of new kinds of reactors and fuel cycle strategies, high fidelity modeling and simulation, and lifetime extension of current reactors.

Fusion

Developing fusion energy requires deep understanding of the extremely high-temperature plasma state of matter. NSE's fusion program specializes in plasma confinement theory and computation, fusion engineering, alternative confinement research, inertial confinement, plasma radiation generation, and basic plasma physics.

Materials

Fundamental studies of materials contribute to every aspect of engineering. Nuclear materials require special attention, because of their harsh environment, intense radiation, and high safety & reliability requirements. NSE's nuclear materials students work on stopping corrosion and deposition in nuclear reactor coolants, developing radiation-resistant structural materials and materials for safely disposing of nuclear waste. Fundamental scientific and engineering studies conducted at the nanoscale are also leading to advances in battery, fuel cell and solar energy systems.

Quantum Control

New technologies at scales approaching the quantum regime are driving new theoretical and experimental research on control in quantum systems. An ideal application is quantum information, which promises to radically improve the acquisition, transmission, and processing of information. NSE research focuses on improving both experimental techniques and control theory of quantum bits, as well as on gaining a deeper knowledge of decoherence.

Accelerators, Detectors & Nuclear Security

The development and worldwide use of nuclear energy requires the parallel development of measures to prevent the spread of nuclear weapons. Current NSE research focuses on transformational changes in detection methods, as well as new technical strategies and policies for proliferation-resistant fuel cycles and for verifying disarmament commitments.

Undergraduate Research Opportunities

Challenging research opportunities exist for undergraduates at all levels in Course 22 through MIT's Undergraduate Research Opportunities Program (UROP), especially for freshmen! Join our faculty, students, and staff on pioneering research projects for either academic credit or pay and get hands-on experience of the cutting edge research underway in NSE. No previous experience is required!

NSE Affiliated Labs & Centers

MIT Nuclear Reactor Laboratory

The MIT Nuclear Reactor Laboratory (NRL) is an interdepartmental center that operates a 6-MW research reactor. It provides the MIT community with a state-of-the-art reactor facility for research in advanced fuels and materials, nuclear medicine, and other areas of nuclear science. The reactor also serves an educational role in course 22's laboratory class, and provides opportunities for students to become licensed nuclear reactor operators.

Plasma Science Fusion Center

The Plasma Science and Fusion Center (PSFC) provides opportunities to expand the scientific understanding of the physics of plasmas and to use that knowledge to develop useful applications. PSFC is home to world-renowned experimental facilities, investigating topics ranging from plasma confinement to plasma-surface interactions and the use of plasmas to clean automobile emissions.

find a
Nuclear UROP

Sample course roadmap

Sophomore year

22.01 Introduction to ionizing radiation
22.02 Introduction to Applied Nuclear Physics
8.03 Physics III*
2.005 Thermal-Fluids Engineering I*
18.03/18.034 Differential Equations
**Course 22 recitation instructor*

Junior year

22.05 Neutron Science and Reactor Physics
22.09 Principles of Nuclear Radiation Measurement and Protection
22.071 Electronics, Signals, and Measurement
18.085 Computational Science and Engineering I
6.00/12.010 Computational Requirement
Major elective (1)

Senior year

22.033 Nuclear Systems Design Project
22.ThT Undergraduate Thesis Tutorial
22.ThU Undergraduate Thesis
Major elective (2)

Major electives

22.055 Radiation Biophysics
22.058 Principles of Tomographic Imaging
22.06 Engineering of Nuclear Systems
22.070 Materials for Nuclear Applications
Graduate courses are also available with academic advisor permission

IAP Courses

SEMINAR Introduction to Nuclear Power
22.921 Nuclear Power Plant Dynamics and Control

Other roadmaps are available for students with a particular interest in fission energy, plasmas and fusion, medical applications and pre-med, quantum engineering, nuclear security and policy, and nuclear materials.

web.mit.edu/nse