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

—Ahsley 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.

—Valdimir 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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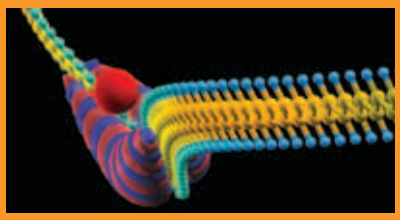
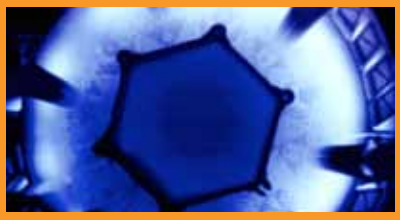
Photos | Justin Knight

NSE
Nuclear Science and Engineering

science : systems : society





course XXII

Massachusetts Institute of Technology

Interested in Course 22?

One of the most frequently asked questions about Nuclear Science and Engineering 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 nuclear fission reactors, fusion reactors, ultrasensitive detectors, or medical imaging systems – have many different components, all of which need to be understood along with the relationships between them. As a nuclear engineer, you need to be both an expert in your field, plus know enough about other fields (thermodynamics, materials science, mechanical engineering, physics, electronics, computer science) that you can hold your own in a variety of other disciplines. For example, the fundamentals of materials science, central to issues of corrosion, fuel performance, and safety in nuclear reactors are the same tools you would apply in solving problems such as the corrosion of oil pipelines, materials compatibility on space vehicles, or optimizing manufacturing processes to minimize human errors and maximize efficiency.

Recent graduates have taken positions at universities, nuclear vendors and designers, regulators, national laboratories and nuclear power plants. But it may surprise you to know that some of our recent grads have also been starting their own companies, working as hedge fund managers at large investment firms, creating interactive science and arts displays in Paris, designing new reactors at startup companies, improving aircraft components, attending medical school and crafting 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 '11

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 had a long and distinguished history of contributions to worldwide development of the current light water reactor fleet. Research initiatives include conceptualization of advanced reactor concepts and fuel cycle strategies, high fidelity modeling and simulation, and lifetime extension of current reactors.

Fusion

Developing fusion energy requires the understanding of the extreme high-temperature plasma state of matter. NSE leads the world in experimental research on reactor-prototypical magnetically confined plasmas with additional activities 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 applications require special attention because of their harsh environment and the extreme safety and reliability requirements. Students can work on significant problems relevant to industry and society by integrating new experimental techniques with advanced theory, modeling and simulation.

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. Our 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 a similar development in non-proliferation and arms control measures to prevent the spread of nuclear weapons. Current work focuses on transformational changes in accelerator technology as well as to advance the state of the art in new concepts for radiation detection.

Undergraduate Research Opportunities

Challenging research opportunities exist for undergraduates of all levels in Course 22 through MIT's Undergraduate Research Opportunities Program (UROP). Join our elite faculty, students, and staff on relevant research projects for either academic credit or pay and get hands-on experience of the cutting edge research that the NSE department hasto offer.

NSE Affiliated Labs & Centers

MIT Nuclear Reactor Laboratory

The MIT Nuclear Reactor Laboratory (NRL) is an interdepartmental center that operates a 5-MW research reactor in support of MIT's educational and research initiatives and goals. It provides the MIT community with a state-of-the-art reactor facility for research in advanced fuel and materials, nuclear medicine and other related nuclear science areas. The reactor also serves an educational role in course 22's laboratory class and provides the possibility for students to become licensed operators.

Plasma Science Fusion Center

The Plasma Science and Fusion Center (PSFC) seeks to provide research and educational opportunities for expanding the scientific understanding of the physics of plasmas and to use that knowledge to develop useful applications. PSFC is home to the Alcator C-Mod tokamak reactor that performs at levels rivaling the largest fusion experiments, as well as many other experimental facilities.

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

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