

Syllabus

About this course

Welcome to 22.011x Nuclear Engineering: Science, Systems and Society.

This is an introductory, freshman-level course on nuclear science and engineering, based on a freshman seminar series that has been offered for many years at MIT.

This online “freshman seminar” will provide you with an introduction to the basic physics of nuclear energy and radiation, with an emphasis on the unique attributes and challenges of nuclear energy as a low-carbon solution. Peaceful applications of ionizing radiation to help mankind, such as reactors for materials science research, nuclear medicine, and security initiatives, will be introduced. The class will explore fission energy, establishing the scientific, engineering, and economic basis for fission reactors, and will describe the state of the art in nuclear reactor technology. The class will also introduce magnetic fusion energy research, with lectures covering the scientific and engineering basis of tokamaks, the state of the art in world fusion experiments, and the MIT vision for high-magnetic field fusion reactors.

This course comprises three sections, each with video lectures, discussion forums, and automatically graded assessments. Some units also include additional lecture notes and self-study (ungraded) homework problems and exercises, as well as laboratory video tours.

Section 1 introduces the basics of ionizing radiation – what it is, where it comes from, and how it is used to benefit humanity. We specifically focus on the origins and energetics of ionizing radiation, and quantify what radiation dose is, where it comes from, and how much people can safely tolerate with no adverse effects.

Section 2 will articulate attributes and challenges of nuclear energy as a commercial source of electric power. Will focus on potential contribution of nuclear energy to decarbonization of the power sector, including discussion of nuclear power plant economics and safety. A few innovations in nuclear energy systems will be described.

Section 3 will cover the basics of nuclear fusion, including fundamental plasma physics concepts needed to understand the prospects for development of magnetic confinement fusion. Innovation and future directions will be described.

Assessments and Deadlines

There are automatically graded assessments for each unit. It is strongly recommended that learners complete all assessments within a unit before proceeding to the following unit.

The course content, including problems, videos, and text, are made available with sequential releases during the course. The deadline for all assessments is March 26th.

Grading and Certificates

The course has a pass/fail grade range, with a score of 50% as the cutoff. You can attempt each question or problem in the assessments as many times as necessary to answer it correctly. To receive a verified-ID certificate you must correctly answer 50% of the assessments.

The certificates will be released on March 28th, two days after the final deadline. Learners will qualify for a certificate by earning a “pass” grade.

Release Schedule

The course material is released on the basis of the following schedule:

Section	Release date	Time of Release	Assessment Due	Time of Assignment Due
1.1	Tuesday, January 22nd	15:00 UTC	Tuesday, March 26th	23.59 UTC
1.2	Tuesday, January 29th	00:00 UTC	Tuesday, March 26th	23.59 UTC
1.3	Tuesday, February 5th	00:00 UTC	Tuesday, March 26th	23.59 UTC
2.1	Tuesday, February 12th	00:00 UTC	Tuesday, March 26th	23.59 UTC
2.2	Tuesday February 19th	00:00 UTC	Tuesday, March 26th	23.59 UTC
2.3	Tuesday February 19th	00:00 UTC	Tuesday, March 26th	23.59 UTC
3.1	Tuesday, February 26th	00:00 UTC	Tuesday, March 26th	23.59 UTC
3.2	Tuesday, March 5th	00:00 UTC	Tuesday, March 26th	23.59 UTC
3.3	Tuesday, March 12th	00:00 UTC	Tuesday, March 26th	23.59 UTC

Honor Code

As described in the [edX Terms of Service and Honor Code](#) you are expected to:

- Complete all assessments on your own.
- Maintain only one user account and not let anyone else use your username and/or password.
- Not engage in any activity that would dishonestly improve your results, or improve or hurt the results of others.
- Not post answers to problems that are being used to assess student performance.

Textbook and References

No textbook is required for this course. The discussion forums may be used to ask questions about each unit as the course progresses and course staff will answer these questions.

Entrance Survey

We would greatly appreciate if you could please fill in the entrance survey as you begin the course. This will help us improve understand who is using this material, and how it may be improved for future users like you.