

ME-464

**Introduction to nuclear engineering**

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Cursus	Sem.	Type
Energy minor	E	Opt.
Mechanical engineering minor	E	Opt.
Mechanical engineering	MA2, MA4	Opt.

Contact language	English
Credits	2
Session	Summer
Semester	Spring
Exam	Oral
Workload	60h
Weeks	14
<b>Hours</b>	<b>2 weekly</b>
Lecture	2 weekly
<b>Number of positions</b>	

**Summary**

This course is intended to understand the engineering design of nuclear power plants using the basic principles of reactor physics, fluid flow and heat transfer. This course includes the following: Reactor designs, Thermal analysis of nuclear fuel, Nuclear safety and Reactor dynamics

**Content**

Brief review of nuclear physics

- Nuclear reactions and radioactivity - Cross sections - Introductory elements of neutronics.

Neutron diffusion and slowing down

- Monoenergetic neutrons - Angular and scalar flux - Diffusion theory as simplified case of transport theory - Neutron slowing down through elastic scattering.

Reactor dynamics

- Point reactor model: prompt and delayed transients - Practical applications - Reactivity variations and control

Nuclear safety principles

- Defense in Depth - Radiation protection - Design Basis Accidents - Beyond Design Basis Accidents phenomenology - Fukushima Accident

Nuclear Reactor Technology

- Gen-II/III, active & passive safety systems - Gen-IV - reactor concepts: SFR, LFR, HTR, MSR

Non-power applications of nuclear engineering

- research reactors - isotope production - medical and irradiation applications -

Waste Management

- transport, intermediate storage - waste conditioning - geological disposal and siting - reprocessing - Partitioning & Transmutation

**Learning Outcomes**

By the end of the course, the student must be able to:

- Elaborate on neutron life cycle in a reactor, neutron diffusion equation, reactor kinetics, reactor thermal-hydraulics, physics of fission reaction
- Formulate approximations to solving the diffusion equation for simple systems
- Describe various nuclear reactors concepts
- Explain nuclear safety principles, design basis accidents, severe accidents, safety systems, radiation protection

**Assessment methods**

Oral (100%) - 20 min without preparation. Closed book.

**Resources**

**Moodle Link**

- <https://go.epfl.ch/ME-464>