

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.

Language of teaching	English
Credits	2
Session	Summer
Semester	Spring
Exam	Written
Workload	60h
Weeks	14
Hours	2 weekly
Courses	2 weekly
Number of positions	

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 - Nuclear reactions - Cross sections - Fission reaction main characteristics - Chain reaction

Reactor physics

- Neutron balance equation - Reactor dynamics: prompt and delayed transients - Reactivity variations and control - Basic reactor thermo-dynamics and design

Nuclear safety principles

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

Nuclear Reactor Technology

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

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 basics of nuclear physics, radioactivity, nuclear reactions, cross-sections
- Formulate radioactive decay, reaction rates, basics of nuclear reactor neutronics and thermal behavior
- Explain nuclear safety principles
- Elaborate on neutron life cycle in a reactor, reactor kinetics, reactor thermal-hydraulics, physics of fission reaction
- Describe various nuclear reactors concepts
- Explain design basis accidents, severe accidents, safety systems, radiation protection

Assessment methods

Written exam during exam session (100%)

Resources**Bibliography**

Elements of Nuclear Engineering, J. Ligou, Chs. 1, 3, (4), 5, (6) – English translation of “Introduction au génie nucléaire” (PPUR, 1997)

Ressources en bibliothèque

- [Elements of Nuclear Engineering / Ligou](#)

Moodle Link

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