

ME-464

Introduction to nuclear engineering

Hursin Mathieu

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 - 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 diffusion equation
- Formulate approximations to solving the diffusion equation for simple systems
- Describe various nuclear reactors concepts
- Explain nuclear safety principles
- 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

Bibliography

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

Moodle Link

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