

ME-464

**Introduction to nuclear engineering**

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Cursus	Sem.	Type
Energy Science and Technology	MA2, MA4	Opt.
Energy minor	E	Obl.
Mechanical engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	2
Session	Summer
Semester	Spring
Exam	Oral
Workload	60h
Weeks	14
<b>Hours</b>	<b>2 weekly</b>
Courses	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 diffusion equation
- Formulate approximations to solving the diffusion equation for simple systems
- Describe various nuclear reactors concepts
- Explain nuclear safety principles

**Assessment methods**

Oral (100%)– 25 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)

### **Ressources en bibliothèque**

- [Introduction au génie nucléaire / Ligou](#)