PHYS-443 **Physics of nuclear reactors**

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Cursus	Sem.	Type
Ing.-phys	MA1, MA3	Opt.
Nuclear engineering	MA1	Obl.
Physicien	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

In this course, one acquires an understanding of the basic neutronics interactions occurring in a nuclear fission reactor as well as the conditions for establishing and controlling a nuclear chain reaction.

Content

- **Brief review of nuclear physics**
- Historical: Constitution of the nucleus and discovery of the neutron - Nuclear reactions and radioactivity - Cross sections - Differences between fusion and fission.
- **Nuclear fission**
- Characteristics - Nuclear fuel - Introductory elements of neutronics.
- Fissile and fertile materials - Breeding.
- **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.
- **Multiplying media (reactors)**
- Multiplication factors - Criticality condition in simple cases.
- Thermal reactors - Neutron spectra - Multizone reactors - Multigroup theory and general criticality condition - Heterogeneous reactors.
- **Reactor kinetics**
- Point reactor model: prompt and delayed transients - Practical applications.
- **Reactivity variations and control**
- Short, medium and long term reactivity changes. Different means of control.

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
- Classify nuclear reaction cross sections

Transversal skills

- Access and evaluate appropriate sources of information.

- Collect data.
- Use both general and domain specific IT resources and tools

Teaching methods

Lectures, numerical exercises

Assessment methods

oral exam (100%)