PHYS-445 **Nuclear fusion and plasma physics**

Fasoli Ambrogio

Cursus	Sem.	Type
Auditeurs en ligne	H	Obl.
Ing.-phys	MA1, MA3	Opt.
Nuclear engineering	MA1	Opt.
Physicien	MA1, MA3	Opt.

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

Summary

The goal of the course is to provide the physics and technology basis for controlled fusion research, from the main elements of plasma physics to the reactor concepts.

Content

1) Basics of thermonuclear fusion
2) The plasma state and its collective effects
3) Charged particle motion and collisional effects
4) Fluid description of a plasma
5) Plasma equilibrium and stability
6) Magnetic confinement: Tokamak and Stellarator
7) Waves in plasma
8) Wave-particle interactions
9) Heating and non inductive current drive by radio frequency waves
10) Heating and non inductive current drive by neutral particle beams
11) Material science and technology: Low and high Temperature superconductor - Properties of material under irradiation
12) Some nuclear aspects of a fusion reactor: Tritium production
13) Licensing a fusion reactor: safety, nuclear waste
14) Inertial confinement

Learning Prerequisites

Recommended courses

Basicknowledge of electricity and magnetism, and of simple concepts of fluids

Learning Outcomes

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

- Design the main elements of a fusion reactor
- Identify the main physics challenges on the way to fusion
- Identify the main technological challenges of fusion

Teaching methods

Ex cathedra and in-class exercises

Assessment methods

oral examen (100%)

Resources

Ressources en bibliothèque

- Introduction to Plasma Physcs / Chen
- Plasma Physics and Fusion Energy / Freidberg

Websites

- https://spcnet.epfl.ch/nuclfus/