

PHYS-445

**Nuclear fusion and plasma physics**

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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
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**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

- [Plasma Physics and Fusion Energy / Freidberg](#)
- [Introduction to Plasma Physics / Chen](#)

#### Websites

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