

PHYS-201(d)

General physics: electromagnetism

Grundler Dirk

Cursus	Sem.	Type
Electrical and Electronical Engineering	BA3	Obl.
HES - EL	H	Obl.
Materials Science and Engineering	BA3	Obl.

Language of teaching	English
Credits	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	6 weekly
Courses	4 weekly
Exercises	2 weekly
Number of positions	

Summary

The topics covered by the course are concepts of fluid mechanics, waves, and electromagnetism.

Content**Concepts of fluid mechanics**

- Statics and dynamics of ideal fluids

Waves

- General understanding of wave motion, including energetic aspects
- Description of different waves propagating in a dense medium
- Electromagnetic waves, Poynting vector, energy considerations
- Superposition of waves: reflection, stationary waves via interference

Electromagnetism

- Electrostatics: Coulomb law and electric field, Gauss law, electric potential, capacity and energy, electric fields in dielectric matter
- Electrical currents and AC circuits
- Magnetostatics: electric current and magnetic field, the two fundamental laws, magnetic properties of matter, ferromagnetism.
- The Faraday law: the electromotive force, the law of induction, self and mutual inductances, the magnetic energy
- Maxwell equations: the displacement current and Maxwell equations in vacuum and materials

Keywords

Electromagnetism, electricity and magnetism, interference, Poynting vector, Maxwell's equations, vector calculus, div, grad, curl, Laplacian (in different coordinate systems), vector and integral identities

Learning Prerequisites**Required courses**

General Physics I, II

Recommended courses

Mathematics courses 1st year

Learning Outcomes

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

- Integrate topics of the course
- Manipulate equations given in the course

- Apply concepts given in the course to practical problems
- Solve problems using the concepts given in the course
- Choose appropriate method for solving a problem
- Deduce properties on the basis of fundamental laws
- Analyze quantitatively consequences of a charge moving in a magnetic field, radiation of an electromagnetic wave from an antenna, reflection of photons at a metal surface, etc.

Transversal skills

- Use a work methodology appropriate to the task.
- Communicate effectively, being understood, including across different languages and cultures.
- Give feedback (critique) in an appropriate fashion.

Teaching methods

Ex cathedra with demonstrations and exercises in class; clickers

Expected student activities

Attendance at lectures and exercise classes, completing exercises, revision of lecture contents by consulting relevant books, feedback (also via e.g. electronic means (clickers))

Assessment methods

Written Exam

Supervision

Office hours	Yes
Assistants	Yes

Resources

Bibliography

There are several textbooks that address concepts and aspects of the lecture (on different levels). Among them there are the following: (in French or English) M. Alonso and E.J. Finn: "Physique generale - 2. Champs et ondes", 2. Ed. - Dunod (Paris); F. A. Reuse, "Electrodynamique", PPUR; (in English) A. Zangwill, "Modern Electrodynamics", Cambridge University Press; (advanced level) J. D. Jackson, "Classical Electrodynamics, 3rd Edition, Wiley. Introduction to electrodynamics, David J. Griffiths, 2014. Fluid mechanics - fundamentals and applications, Yunus A.Çengel, John M. Cimbala, 2010. Further textbooks are available in the library.

Websites

- <http://clickers.epfl.ch/students>

Moodle Link

- <http://moodle.epfl.ch/course/view.php?id=15266>

Prerequisite for

General physics IV and Electromagnetism II