UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Physics II

2021-3-E3501Q023

Aims

Maxwell Equations, Special Relativity.

Expected learning targets:

- knowing how to solve simple problems in electrostatics, magnetostatics, magnetic induction, RLC circuits;

- knowledge of Maxwell equations, their conceptual base and derivation, relationships among them; knowledge of the basics of special relativity, and of its relationship with electromagnetism.

Contents

Electrostatics: Coulomb's law, Gauss' Law. Electric currents: Ohm's law.

Special relativity. Magnetostatics: Biot-Savart equation, Ampere's Law.

Magnetic induction; Faraday's law. LRC circuits.

Maxwell's equations. Electromagnetic waves. Poynting vector. Relativistically covariant notation for electromagnetism.

Detailed program

- Electrostatics. Coulomb's law; electric field, electric potential. Gauss' Law. Poisson's equation; Laplacian. Energy of the electric field. Curl of the electric field. Harmonic functions. Conductors. Capacitors. Exterior calculus.
- Moving charges. Electric current; Ohm's law. RC circuits.
- Special relativity. Lorentz transformations; four-vector notation.
- Magnetostatics. Deduction of the existence of magnetic field; its divergence and curl. Vector potential.
- Magnetic induction. Circuits moving in a magnetic field; Faraday's law. Inductance. Energy of the magnetic field. LRC circuits. Applications: power lines, radio.
- Maxwell's equations. Time-dependent currents. Electromagnetic waves. Poynting vector. Relativistically covariant notation for the electromagnetic field and for Maxwell's equations. Exterior calculus in spacetime.

Prerequisites

Physics I, Analysis I & II

Teaching form

Lectures (6 CFU); Exercise sessions (2 CFU)

During the COVID-19 emergency the lectures will be held via teleconference, with periodical streaming events

Textbook and teaching resource

Lecture notes available at https://www.dropbox.com/s/s2kvegmy9t0xc5t/EM.pdf?dl=0

D. J. Griffiths, Introduction to electrodynamics. Prentice Hall, 1999.

E. M. Purcell and D. J. Morin, Electricity and magnetism. Cambridge University Press, 2013.

Semester

first semester.

Assessment method

Written and oral exam, of equal weight in the final evaluation, not necessarily in the same call.

Written exam: four exercises, three hours. Admission to the oral exam with 14/30. Object of evaluation will be the logic used in the resolution of the problems. Possibility to hold the written exam in two partial sessions.

Oral exam: open questions on the course's topics, unrelated to the written exam. Object of evaluation will be the candidate's knowledge of the theoretical part of the program.

During the COVID-19 emergency, the exams will be held in teleconference using the WebEx platform. Public links to participate will appear on this e-learning site.

Office hours

by appointment.