UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Physics II

2627-3-E3501Q069

Aims

1. Knowledge and understanding
   Students will acquire a basic understanding of Maxwell's equations and special relativity, with particular focus on conceptual foundations and the connection between electric, magnetic, and relativistic phenomena.

2. Applying Knowledge and understanding
   Students will be able to apply the principles of electromagnetism to solve simple problems in electrostatics, magnetostatics, electromagnetic induction, and RLC circuits.

3. Making judgments
   Students will develop the ability to critically analyze results, assessing the physical consistency of solutions and the validity of the models used.

4. Communication skills
   Students will be able to clearly and rigorously explain fundamental concepts of electromagnetism and relativity, using appropriate scientific terminology.

5. Learning skills
   Students will acquire the methodological tools to independently deepen their understanding of the course content and approach related subjects in classical and modern physics.

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, Analysis II.

Teaching form

24 lectures, 2 hours each, delivered didactics, in presence (6 CFU).
12 exercise sessions, 2 hours each, delivered didactics, in presence (2 CFU).
In Italian.

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 exam. Four exercises, three hours.
It is possible to hold the written exam in two partial sessions. Each of them will consist of three exercises, in two hours.
Both for the normal written exam and for the partial sessions, object of evaluation will mostly be the logic used in the resolution of the problems.
It is possible to hold the exam in English.

Office hours

by appointment.

Sustainable Development Goals

QUALITY EDUCATION