UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Physics II - Module I

2122-2-E3001Q042-T1

Aims

Teaching of electromagnetism and physical optics: phenomenology, fundamental laws, problem

solving.

Contents

1. Vector analysis, 2. Electrostatics in vacuum, 3. Stationary electric current, 4. Magnetostatics in vacuum, 5. Electromagnetic induction, 6. Electrostatics in materials, 7. Magnetostatics in materials, 8. Electromagnetic waves and fields, 9. Optics.

Detailed program

1. Vector analysis:

field lines, differential and integral operators, divergence and curl theorems.

2. Electrostatics in vacuum:

Coulomb's law, electric field, electric potential and potential energy, Gauss' theorem, conductors and

insulators, electrostatic induction, electrostatic equations, capacitance, capacitor, electrostatic energy.

3. Stationary electric current:

current intensity and current density, electric conductivity, resistivity and Ohm's law, relaxation time,

electromotive force, connections between resistors, Joule’s law, electric circuits in CC.

4. Magnetostatics in vacuum:

magnetic induction, force on a moving charge, force on a current loop, magnetic dipole moment, Laplace’s second formula, Biot-Savart’s law, Laplace’s first formula, force between currents, Ampére’s law, magnetic flux.

5. Electromagnetic induction:

Faraday-Neumann-Lenz’s law, Self- and mutual-inductance, energy of the electromagnetic field. Alternate currents, Circuits in CC and CA.

6. Electrostatics in materials:

multipole expansion, force and potential energy of a dipole, electrical polarization, Gauss’ theorem in dielectrics, dielectric susceptivity and permittivity.

7. Magnetostatics in materials:

magnetization, Ampére’s law with magnetized materials, magnetic susceptibility and permittivity, dia-, para- and ferro-magnetic materials.

8. Electromagnetic waves and fields:

Maxwell’s equations, Poynting’s theorem, momentum, energy and intensity of electromagnetic waves, radiation from an accelerated charge, dipole radiation, boundary conditions for electromagnetic fields.

9. Optics:

reflection and refraction, Eiconal law, Fermat’s principle, polarization, interference, phase and group velocity, Huygens-Fresnel’s principle, diffraction, dispersion, atomic model of dispersion, anisotropic media.

Prerequisites

First year physics and maths courses.

Teaching form

lessons (10 credits), classes (4 credits) and tutors, all in Italian language

Textbook and teaching resource

Caldirola-Fontanesi-Sindoni, “Elettromagnetismo”, Masson (fuori commercio)

Mazzoldi-Nigro-Voci, “Fisica Generale (vol.2)”, Edises

A. Bettini, “Elettromagnetismo”, Zanichelli

A. Bettini, “Le onde e la luce”, Zanichelli

In English: Hallyday-Resnick-Krane, “Physics (vol.2)”, J Wiley & Sons

Other resources on e-learning website

Semester

First and second semester

Assessment method

The examination is divided in three parts: a written examination in two parts (concerning in problem solving for the first and the second part of the program, 120 minutes each part) and an oral examination (an interview on the topics covering all the program). Each written examination will be evaluated in 5 ranking levels (from insufficient to good). Students with both written examinations ranked insufficient will not be admitted to the oral examination. The final score (18-30/30) will return a global evaluation of the students (taking into account the two written examinations and the oral examination). In case of final score below 18/30, the student will have to repeat also the written examinations.

Written tests can also be taken during classes, tentatively in December and April. Further info are available in the italian pages and in the regulation of the course (available in the elearning webpages).

Office hours

By appointment via email