UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Fisica II

2425-2-E2702Q004

Aims

The course aims at teaching the fundamentals of the electromagnetic theory and wave optics.

Contents

Electric field and potential, Coulomb law, Gauss theorem. Electrical currents and some simple circuits. Magnetic field, Lorentz force, Biot-Savart and Ampere laws. Magnetic induction, Faraday and Lenz laws. Maxwell equations and electromagnetic waves. Poynting vector and energy. Elements of geometrical optics and fundamentals of wave optics: Huygens principle, interference and diffraction.

Detailed program

Part one: vacuum electrostatic, electrical currents and vacuum magnetostatic

- Electric fields
Experimental aspects of the electrical interactions. Coulomb's law. Electric field: definition, superposition principle and results for point charges. Electric field by a generic charge distribution. Electric field lines. Motion of a charge in a uniform electric field.

- Gauss's law
Electric flux, Gauss's theorem and applications. Properties of the electric field in a conductor at equilibrium.

- Electric potential
Electric potential and potential difference. Potential difference for a uniform electric field and for the eletric field due

to point charges. Relation between electric field and eletric potential. Potential due to continuous charge distributions. Properties of the electric potential in conductors and applications.

- *Capacitance, capacitors and dieletrics*
Definition and calculation of the capacitance of a conductor and of a capacitor. Series and parallel connection of two capacitors. Energy stored in a capacitor. Brief description of the properties of capacitors filled by dielectric materials.

- *Electrical current and applications*
Definition of electrical current and its microscopic interpretation. Resistance, resistivity and Ohm's law. Brief description of the properties of the resistance as a function of temperature. Electric power. Series and parallel connection of two resistors. Properties of capacitors in an RC circuit.

- *Magnetic fields*
Experimental aspects of magnetic interactions. Force on a moving charge in a magnetic field. Motion of a charge in a uniform magnetic field and applications. Force acting on a infinite current carrying wire. Magnetic moment and mechanical moment acting on a coil. Principle of operation of the electric engine. Hall effect and magnetic field measurements.

- *Sources of magnetic field*
Oersted's experiment and Biot-Savart's law. Properties of the magnetic field produced by an infinite current carrying wire and by a circular coil. Magnetic force between two nearby current carrying wires and practical definition of Ampere. Ampere's law and its application to an infinite current carrying wire, a toroid and an infinite solenoid. Gauss's theorem for the magnetic field.

Part two: electromagnetism, optics and elements of modern physics

- *Faraday's law*
Faraday's induction law and e.m.f. on a moving circuit. Lenz's law and induced electric fields. Electric generators and engines.

- *Induction*

Self induction and self induction coefficient. RL circuits. Energy stored in a magnetic field.

- *Electromagnetic waves*
Displacement current and Maxwell's equations. Plane electromagnetic waves, energy and momentum carried by an electromagnetic wave. Electromagnetic spectrum.

- *Nature of light and laws of ray optics*
Main properties of light and ray optics. Huygens' principle.

- *Wave optics*

Interference between two light waves and Young's experiment. Phase shift from wave reflection and interference from thin films. Michelson's interferometer and some applications.

- *Diffraction*
Diffraction from thin slits. Limitation to the resolution of optical instruments due to diffraction. Diffraction grating and diffraction from crystals. Elements of light polarization.

Prerequisites

Content of the physics and mathematics courses taught during the first academic year

Teaching form

Frontal lessons on theory and problem solving. Lectures will be in Italian and will include:
• 21 in-person lectures on theory (2 hours each; 42 hours in total)
• 12 in-person lectures on problem solving (2 hours each; 24 hours in total)

Textbook and teaching resource

Textbooks:

- Serway, Jewett, "Fisica per Scienze ed Ingegneria", vol. 2, ed. EdiSES (also available in English)

Further study material:

- Solved written exams published on the e-learning page of this course

- Solutions to the problems found in the textbook Serway, Jewett, "Fisica per Scienze ed Ingegneria", vol. 2, ed. EdiSES (also available in English) as provided by the Editor.

Semester

First semester

Assessment method

One written test at the end of the course. This can be followed by an oral exam if deemed necessary by the teacher or if requested by the student. The maximum score that can be obtained in a written test is 32. If the score obtained in the written test is less than 20, the oral test is compulsory. If the oral test is not taken, the final score of the exam is the rounded up score obtained in the written test. Written tests can also be taken during classes, tentatively in November and January.

Each written test is made of 4 questions to be answered in 120 minutes. The questions can be theoretical or practical (problem solving). Students cannot use books or personal notes during written exams. They can however use a printed copy of the formulary available on the course web page. Please refer to the Italian version of the syllabus for more details.

Students can take exams in Italian or English.

Office hours

By appointment via email

Sustainable Development Goals

QUALITY EDUCATION | DECENT WORK AND ECONOMIC GROWTH