UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Experimental Physics for Ai

2425-1-E311PV001

Aims

Acquire the knowledge of classical mechanics, mechanical waves, resonance and geometric optics. Be able to discuss the basics and solve practical exercises. Being able to discuss the sources of uncertainty in an experiment and how to mathematically treat them.

Contents

Mechanics and dynamics of the point massive object. Typse of forces and the free body diagram.
Rotations and torques for extended objects.
Geometrical optics.
Waves: sounds with an introduction to physical optics.
Introduction to the Fourier analysis of a signal.
Electricity and magnetism: currents and relation to magnetism.

Detailed program

1. Description of motion
   1.1 1D motion: units in kinematics, position, velocity, acceleration, graphical description;
   1.2 description of 2D motions: vectors, meaning and their operations;
   1.3 measurement of position, velocity and acceleration and numerical integration of the motion laws.
   (on the limit of the finite differences to small time steps, on
   the use of the finite differences)

2. Newton’s law (single “massive point”):

2.1 mass, momentum and the concept of force
2.2 II law and its integration
2.3 types of forces (macroscopic view and microscopic origin)

3. Mechanical work and energy
   3.1 the mechanical work and the kinetic energy (a disclaimer about thermodynamics);
   3.2 Work of friction forces
   3.3 potential energy (elastic and gravitational energy), (non) conservation of energy.

4. Systems of bodies
   4.1 center of mass, rigid body and moment of inertia.
   4.2 rotational motion, the angular momentum and its conservation;
   4.3 Rotational kinetic energy

5. Waves I.
   5.1 damped and forced oscillations: resonance;
   5.2 from oscillatory motion to a mechanical wave. Description of the propagation of a wave, the wave front, the phase of the local oscillators.
   5.3 Period, wavelength, speed, wave vector, types of waves
   5.4 Energy of a wave (outline of the wave equation in 1D).
   5.5 Transversal, longitudinal waves, sound

6. Waves II.
   6.1 refraction and reflection of waves: conservation of energy
   6.2 interference of 2 or more coherent waves, coherence length and time
   6.3 Stationary waves: analysis of Kundt’s tube and of pipes

7. Light propagation.
   7.1 wave front, Huygens principle and light ray;
   7.2 reflection and refraction of light, the refraction index, Snell laws
   7.3 light polarization, Brewster and critical angles
   7.4 prisms

8. lenses and mirrors.
   8.1 paraxial lens law: what is an image (conjugate planes)
   8.2 composition of lenses, principal planes
   8.3 mirrors

9. Diffraction and interference
   9.1 diffraction from a single indefinite slit (Fraunhofer)
   9.2 interference between discrete sources (Fraunhofer)

Prerequisites

Knowledge of mathematics at the level of high schools.

Teaching form

It makes use of both lecture-based teaching (lectures) and interactive teaching (group work and laboratory sessions in dedicated teaching laboratories). Specifically, regarding the classroom, it involves lectures, exercises to be carried out on the blackboard, and group work. Regarding the laboratory, each student performs at least two experiments in Classical Physics in well-equipped teaching laboratories.

Textbook and teaching resource

Serway, Principles of Physics. Brooks/Cole Pub Co; 5° edition (2012)
ISBN-13 ? : ? 978-1133104261

Semester

first semester

Assessment method

Home works for self-evaluation, reports of the lab sessions, written exam with exercises.
The access to the written exam is given by the presentation of the written report of one lab session.

Office hours

Monday afternoon

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | INDUSTRY, INNOVATION AND INFRASTRUCTURE | RESPONSIBLE CONSUMPTION AND PRODUCTION