UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Experimental Physics for Ai

2425-1-E311PV001

Obiettivi

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.

Contenuti sintetici

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.

Programma esteso

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)

Prerequisiti

Knowledge of mathematics at the level of high schools.

Modalità didattica

Si avvale sia di didattica erogativa (lezione i frontali) e interattiva (lavori di gruppo e sessioni di laboratorio in laboratori didattici dedicati).
In particolare, loper quanto riguarda l'aula, si tratta di lezioni frontali , esercizi da svolgere alla lavagna e in gruppo. Perquanto riguarda il laboratorio, ogni studente svolge almeno due esperimenti di Fisica classica in laboratori didattici attrezzati.

Materiale didattico

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

Periodo di erogazione dell'insegnamento

first semester

Modalità di verifica del profitto e valutazione

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.

Orario di ricevimento

Monday afternoon

Sustainable Development Goals

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