UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Physics I

2122-1-E3002Q006

Learning area

Learning objectives

The main objectives of the course of Physics I are:

- getting familiar with physical quantities, concepts, units, and laws of the classical mechanics
- learning how a physical law is built from experiments
- understanding the link between a physical phenomenon and its formal description, in particular when wave mechanics is concerned

Contents

Kinematics. Main quantities and main kinds of motion.
Dynamics of particles and of rigid bodies. Force, work, energy. Conservation of mechanic energy. Conservation of angular momentum. Cardinal equations.
Oscillation and waves. Wave function in one dimension; wave equation; interference, stationary waves, sound.
Fluids. Main laws.

Detailed program

Introduction. Physics laws, theory. Phyiscal quantities; units.

Kinematics. Position and displacement; vector quantities; sum and difference operations between vectors. Trajectory and motion law; average speed and instantaneous speed. Uniform rectilinear motion. Average and

instant acceleration; uniformly accelerated motion; fall and throw of a body; parabolic motion. Uniform circular motion: position vectors, tangential velocity and centripetal accleration. Angular speed and acceleration. Vector angular velocity, with v = ? × r. Vector product: definition, meaning and properties. Harmonic motion.

Particle dynamics. Newton's principles: mass and strength. The weight. Object on a plane surface and normal reaction. Inclined plane; suspended body; simple pendulum. Elastic force and free harmonic oscillator. Static and dynamic friction. Viscous friction and limit speed. Definition of work; scalar product: definition, meaning and properties. Work accomplished by an elastic force and weight. Kinetic energy; work-energy theorem. Work, power, kinetic energy. Conservative forces and systems. Potential energy and conservation of mechanical energy; examples: weight and elastic force. Potential energy and balance. Non-conservative forces and systems and energy conservation in the general case. Central forces and their conservativeness. Law of universal gravitation, gravitational potential energy. The concept of field and gravitational field.

Systems and rigid bodies. Center of mass: position, speed, acceleration. Motion of the center of mass and first cardinal equation of dynamics. Impulse of a force and momentum; conservation of momentum. Impacts: elastic and inelastic one-dimensional impacts; impacts in two and three dimensions. The ballistic pendulum. Definitions of rigid body and moment of a force. Center of gravity and center of mass. Translational and rotational equilibrium. Kinetic energy of rotation and moment of inertia. Hyugens-Steiner's theorem (sentence). Total kinetic energy for a body that translates and rotates. Rigid body that rolls. Angular momentum of a particle; total angular momentum and rotation of a rigid body. Conservation of angular momentum. Cardinal equations. Work performed during rotation and work-energy theorem for rotation.

Oscillations and waves. Pulses and waves: general characteristics and representation; wave function. Longitudinal and transversal waves. D'Alembert's equation. Harmonic waves and D'Alembert's equation for harmonic waves. Interference of harmonic waves; groups and wave packets (outline); stationary waves. The sound: general characteristics; the characters of sound.

Fluids. Principles of Stevino; Pascal's law; Archimede's law. Flow and laminar flow; Bernoulli's theorem.

Prerequisites

Basis knowlege of mathematics; algebra, trigonometry, and elements of calculus (see Istituzioni di matematica I, 1st semester).

Teaching methods

Lessons and exercises taught in Italian.

Assessment methods

Written exam (tests + simple problems). For both parts there are threshold values of the marks necessary to be admitted to the oral exam: 50/60 and 6/10 for test and problems, respectively. Main goal is the extensive check of preparation on the program and of the acquired problem solving skills.

Oral examination about the whole course content with intensive check on the skills of autonomous reflection on critical points of the program.

Upon student request, the exam can be taken in English

The evaluation of the written exams and the oral examinations are posted on the **e-learning page.**

Textbooks and Reading Materials

Any university Physics book about Classical Mechanics can be suitable (plesae, check with the teacher).

A book af the proper level is: P. Mazzoldi, M. Nigro, C. Voci , Elementi di Fisica, meccanica e termodinamica (Edises Università).