UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Fisica I

2122-1-E2702Q003

Aims

The course provides the basic notions of classical mechanics for the material point, rigid bodies, fluids and mechanical waves. Furthermore, the course trains the students to apply the acquired theoretical knowledge to the solution of real world problems. In particular, it teaches the abstraction process necessary for the modeling of the investigated system and its conversion into mathematical relations.

Contents

1.
2. Vectors

Detailed program

1. Physics and measurement

2. Vectors

- Vector and scalar quantities
- Some properties of vectors
- Components of a vector and unit vectors

- Instantaneous velocity and speed
- Particle under constant velocity
- Acceleration
- Motion diagrams
- Particle under constant acceleration
- Freely falling objects
- Kinematic equations derived from calculus

- Two- and three- dimensional motion with constant acceleration
- Projectile motion
- Particle in uniform circular motion
- Tangential and radial acceleration
- Relative velocity and relative acceleration

5. The laws of motion

- The laws of motion
- The concept of force
- Newton’s first law and inertial frames
- Mass
- Newton’s second law
- The gravitational force and weight
- Newton’s third law
- Analysis models using Newton’s second law
- Forces of friction

- Nonuniform circular motion
- Motion in accelerated frames
- Motion in the presence of resistive forces

- Work done by a constant force
- The scalar product of two vectors
- Work done by a varying force
- Kinetic energy and the work–kinetic energy theorem
- Potential energy of a system
- Conservative and nonconservative forces
- Relationship between conservative forces and potential energy
- Energy diagrams and equilibrium of a system

- Isolated system (energy)
- Situations involving kinetic friction
- Changes in mechanical energy for nonconservative forces
- Power

9. Linear momentum and collisions

- Linear momentum
- Isolated system (momentum)
- Nonisolated system (momentum)
- Collisions in one dimension
- Collisions in two and three dimensions
- The center of mass

- Systems of many particles
- Deformable systems
- Rocket propulsion

- Rigid object under constant angular acceleration
- Angular and translational quantities
- Torque
- Rigid object under a net torque
- Calculation of moments of inertia
- Rotational kinetic energy
- Energy considerations in rotational motion
- Rolling motion of a rigid object

- Nonisolated system (angular momentum)
- Angular momentum of a rotating rigid object
- Isolated system (angular momentum)
- The motion of gyroscopes and tops

- More on the center of gravity
- Examples of rigid objects in static equilibrium
- Elastic properties of solids

13. Universal gravitation

- Newton’s law of universal gravitation
- Free-fall acceleration and the gravitational force
- Particle in a field (gravitational)
- Kepler’s laws and the motion of planets
- Gravitational potential energy
- Energy considerations in planetary and satellite motion

- Variation of pressure with depth
- Pressure measurements
- Buoyant forces and Archimedes’s principle
- Fluid dynamics
- Bernoulli’s equation

- Other applications of fluid dynamics

- Particle in simple harmonic motion
- Energy of the simple harmonic oscillator
- Comparing simple harmonic motion with uniform circular motion
- The pendulum
- Damped oscillations
- Forced oscillations

- Traveling wave
- The speed of waves on strings
- Reflection and transmission
- Rate of energy transfer by sinusoidal waves on strings
- The linear wave equation

Prerequisites

A good algebra and trigonometry background is required, as well as the knowledge progressively acquired in the Mathematics I lectures during the same semester, in particular, calculus (derivatives and integrals).

Teaching form

Lectures and exercises (in Italian).

Textbook and teaching resource

Serway, Jewett
Physics for Scientists and Engineers (9th edition)
Brooks/Cole Cengage Learning

Other options:

Halliday, Resnick, Walker

Fundamentals of Physics – Volume One (10th edition)
Wiley

Semester

October 2021 – January 2022

March 2022 - June 2022

Assessment method

The grading is based on both a written test and an oral exam. Passing the written test is required to access to the oral exam.

The written test is split into four sections, each one dealing with the concepts of the four different parts the course is split into. Each section is graded separately (A: Excellent, B: Good, C: Satisfactory, D: Unsatisfactory, E: Extremely unsatisfactory). The test is considered passed if at least three out of four parts are satisfactory, not necessarily in the same test. That is, positive outcomes in each specific section stack. Furthermore, in case in a future test the student wants to improve the grade of a specific section, only the best grade will be considered.

Four intermediate tests are also scheduled, one for each one of the four parts of the course. Passing an intermediate test, implies the passing of the respective part in the final written exam.

During the final written exam, as well as the intermediate ones, it is possible to use only a scientific calculator and a cheat sheet, as long as it is strictly handwritten by the student on a personal sheet of paper, in A4 format, provided by the teacher.

The oral exam has not to be necessarily taken at the same time as the written test. A passed written test, in fact, is considered valid until the last exam of the current academic year (i.e. until April-May 2021) also in case of a failed oral exam.

Rating

At the student's request, the exam can be taken in English.

Office hours

Any day by appointment via e-mail.