



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Fisica I

2021-1-E3002Q006

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#### 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.

\_\_\_\_\_ dimension \_\_\_\_\_

#### Detailed program

**Introduction.** Physics laws, theory. Physical 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 acceleration. Angular speed and acceleration. Vector angular velocity, with  $\mathbf{v} = \boldsymbol{\omega} \times \mathbf{r}$ . 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. Huygens-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 knowledge of mathematics; algebra, trigonometry, and elements of calculus (see Istituzioni di matematica I, 1st semester).

## Teaching methods

Lessons and exercises.

## 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.

**Oral examination** about the whole course content.

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

**NOTE: due to Covid-19 emergency, the exams are only oral examinations, starting with a problem, to be solved and discussed with the teachers. Link to the exams is available through this elearning page.**

## **Textbooks and Reading Materials**

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

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

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