UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Physics

2425-1-E1301Q007

Aims

1. Knowledge and understanding
   At the end of the course the student will have to know the basics of physics useful for understanding the physical processes and the bases for the physical description of nature.
2. Ability to apply knowledge and understanding
   At the end of the course, the student must be able to apply the knowledge acquired to the subjects he will face in the following years of study and during the thesis work using fundamental tools to represent the state and evolution of a physical system and the interactions involved
3. Independent judgment
   The student must be able to independently process what he has learned and be able to independently interpret the physical problems he will have to face in his school or work career.
4. Communication skills
   At the end of the course the student will be able to express himself appropriately in the description of physical events and with confidence in exposure.
5. Learning ability
   At the end of the course the student will have to demonstrate that they have learned the fundamental notions of physics that are of interest to the biological world and that they have developed a learning ability that is useful not only for passing the exam but more generally for their studies. future and future work activity.

Contents

The course will cover topics of:

Fundamentals of mechanics, Energy, Work and Conservation, Fluid mechanics, Thermodynamics, Electromagnetism. Overview of optics, modern physics and spectroscopy

Detailed program

Vector description
Measurable, scalar and vector quantities, data analysis
Equations of motion
Straight, parabolic, circular, harmonious motions
Fundamental interactions and principles of dynamics
Forces and momentum, moments of forces and angular moments
Work, energy
Theorem of kinetic energy, conservative and non-conservative forces, potential energy
Conservation principles
Amount of motion and impacts, angular momentum and orbital motions, conservation of energy
Principles of fluidostatics and fluid dynamics
Laws of Pascal, Stevino, Archimede, Equation of continuity, Bernoulli's equation
Thermal energy, heat, temperature, entropy
Kinetic theory of perfect gas - I and II principle of thermodynamics
Electrostatic interactions
Electric charge, electric field - Gauss theorem - electric potential - capacity
Charge transportation
Laws of Ohm and Kirchhoff, Joule effect - currents as sources of magnetic fields
Magnetic fields and electromagnetic induction
Lorentz force, Biot-Savart law, Ampere law, Faraday law
The maxwell equations
Description of electromagnetic phenomena, Light, energy equation and momentum

Hints of optical phenomena:

- Laws of reflection and refraction,
- interference and diffraction,
- microscopy and light-matter interaction

Hints of modern physics:
Photoelectric effect, photons,
Quantum aspects of matter
Bohr's atom, wave function, Schrodinger's equation, spectroscopic techniques
Physical principles underlying optical spectroscopy, magnetic resonance spectroscopy, and mass spectrometry

Prerequisites

Basic knowledge of mathematical analysis is required

Teaching form

The teaching will be delivered in the form of frontal lessons, trying to actively involve students (interactive teaching) with simple classroom demonstrations of physical processes and solving exercises together, highlighting the application of the theory learned in class. Theoretical topics will then be addressed alternating them with exercises closely linked to the topics covered. Summary exercises will also be carried out in preparation for the partial

assignments.

Textbook and teaching resource

- Andrea Alessandrini Fisica per le scienze della vita Casa Editrice Ambrosiana. Distribuzione esclusiva Zanichelli 2023
- J.W. Jewett & R.A. Serway “Principi di Fisica”, EdiSES, vol.1 e 2,

Semester

Second semester

Assessment method

Students' knowledge will be assessed through a written and oral exam.
In the written exam the student must solve exercises regarding the main topics of the course
• equations of motion
• fundamental interactions and principles of dynamics
• work, energy
• conservation principles
• momentum and shocks
• principles of fluid statics and fluid dynamics
• thermal energy, heat, temperature, entropy
• electrostatic interactions
• Charge transportation
• magnetic fields and electromagnetic induction
• Maxwell's equations
• optical phenomena (reflection, transmission and absorption – diffraction interference)

The assignment is made up of 3 problems, 2 open theory questions, 3 exercises and 3 quizzes. The questions do not have the same value for the final score. In particular, the value is the following:
problems 4 points, open questions 3 points, exercises 3 points and quizzes 1 point.
The problems differ from the exercises in terms of complexity and the number of answers that must be given. Quizzes generally have only one answer.
For the assignment, students are given a question paper. On this sheet they must report the results of the problems and exercises and the answers to the questions and quizzes.
The assignment must however be carried out on paper sheets which will be delivered by the teacher. A tablet is not permitted but the use of a calculator is permitted.
Anyone who obtains a grade equal to or greater than 25 in the assignment can choose not to take the oral exam and accept the grade obtained. Anyone who obtains a grade between 18 and 24 must take the oral exam.
In the oral exam, the topics covered in the course are discussed from a conceptual point of view to evaluate the knowledge acquired.
Three partial tasks are organized during the year.
The first partial task will concern:
• equations of motion
• fundamental interactions and principles of dynamics

• work, energy
• conservation principles
• momentum and shocks

The second part will concern:
• principles of fluid statics and fluid dynamics
• thermal energy, heat, temperature, entropy

The third part will concern:
• electrostatic interactions
• Charge transportation
• magnetic fields and electromagnetic induction
• Maxwell's equations
• optical phenomena (reflection, transmission and absorption – diffraction interference)
The methods of carrying out the partial exams are the same as those of the general writings.
Anyone who ultimately obtains an overall average grade in the partials equal to or greater than 25 can choose not to take the oral exam and accept the grade in the partials. Anyone who obtains a grade between 18 and 24 must take the oral exam.

Anyone who has not done the partial homework must take the written exam in the open exams.
Availability to take exams in English for Erasmus students (for those who wish).

Office hours

At the end of lessons or by appointment.

Sustainable Development Goals

QUALITY EDUCATION | AFFORDABLE AND CLEAN ENERGY | RESPONSIBLE CONSUMPTION AND PRODUCTION | CLIMATE ACTION