FISICA I A - Co

FIS/01 - 9 CFU - 2° Semester

Teaching Staff

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LEARNING OBJECTIVES

The course aims to provide qualitative and quantitative basic knowledge on the foundations of Classical Mechanics and Thermodynamics, as well as the ability to know how to apply the Scientific Method to solve real and concrete problems.

In particular, the course proposes the following objectives:

Knowledge and understanding (knowledge and understanding):

Knowledge of the main phenomenological aspects related to mechanics and thermodynamics, understanding their physical implications and their mathematical description.

Ability to apply knowledge and understanding (applying knowledge and understanding):

Ability to recognize the main physical laws that govern a mechanical or thermodynamic phenomenon, and to apply them to solve problems and exercises at different levels of complexity and therefore of approximation, with the use of appropriate analytical and numerical techniques.

Making judgments (making judgments):

Estimate and processing of the order of magnitude of the variables that describe a mechanical or thermodynamic phenomenon. Estimation of the level of importance of a physical law (axiom, principle of conservation, universal law, theorem, law in global / integral or local / differential and its generality, properties of materials, etc.).

Communication skills (communication skills):

Ability to expose scientific concepts with properties and inambiguities of language, at different levels.

Learning skills (learning skills):

Application of theoretical-mathematical concepts and techniques to Physics.

COURSE STRUCTURE

The Course is structured in two main parts.

Part I. Classical Mechanics

Part. II Thermodynamics

Teaching activity:

Lectures and exercises in the classroom. Guided exercises for individual study (homework) and classroom exercises led by student-tutors (if available).REQUIRED REQUIREMENTS

Prerequisites:

Although no propedeuticià is officially imposed, it is extremely useful that the student has mastered the topics of elementary mathematics (algebra, geometry, trigonometry, analytical geometry) and knowledge of those of mathematical analysis (differential and integral calculus).

LESSON FREQUENCY

Although not mandatory, the frequency of lessons is strongly recommended.

DETAILED COURSE CONTENT

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Physical quantities and units of measurement(*). Physical size and unit of measurement. The International System (SI). Mechanical and thermodynamic quantities. Dimensional issues. Measurement errors and approximation. Scientific notation.

Scalars and vectors(*). Scalar and vector quantities. Invariance and symmetry. Algebra of the vectors. Derivatives and integrals of vectors.

Kinematics(*). Speed, acceleration and hourly law of motion. Straight and uniformly accelerated rectilinear motion. Vertical motion. Simple harmonic motion. Motions in the plane: parabolic motion. Circular motion. Motions in space.

Work and energy(*). Work, power and kinetic energy. Examples of work done by forces. Conservative forces and potential energy. Non-conservative forces. Principle of conservation of mechanical energy. Relationship between force and potential energy. Angular momentum. Torque.

Classical particle dynamics. Points systems**(*)**. Internal and perhaps external forces**(*)**. Mass center and its properties**(*)**. Principle of conservation of the momentum**(*)**. Conservation principle of angular momentum**(*)**. The König theorems. Theorem of kinetic energy.

Collisions. Elastic collisions. Unelastic collisions. Two-body problem.

Oscillations and waves(*). Simple harmonic oscillator: motion equation and its solution. Motion of a mass connected to a spring. Energy of simple harmonic oscillator. Sum of harmonic motions in 1 and 2 dimensions. Softened and forced harmonic oscillator. Resonance. Simple Pendulum.

Gravitation(*). Central forces. The law of Universal Gravitation. Inertial mass and gravitational mass. Gravitational field and gravitational potential energy. Kepler's laws.

Dynamics of the rigid body. Definition of rigid body and its properties. Motion of a rigid body. Rigid rotations around an axis in an inertial reference system. Rotational energy and work. Moment of inertia. Huygens-Steiner's theorem. Pure rolling motion. Conservation laws in the motion of a rigid body. Compound pendulum.

First Principle of Thermodynamics. Thermodynamic systems and states**(*)**. Thermodynamic equilibrium and the principle of thermal equilibrium**(*)**. Temperature and thermometers**(*)**. Equivalence of work and heat: Joule experiments**(*)**. First Principle of Thermodynamics**(*)**. Internal energy**(*)**. Thermodynamic transformations**(*)**. Calorimetry**(*)**. Phase changes. Heat transmission.

I**deal and real gases.** Laws of gases**(*)**. Equation of state of ideal gases**(*)**. Transformations of a gas**(*)**. Work. Specific heat and internal energy of an ideal gas**(*)**. Analytical study of some transformations**(*)**. Notes on the physics of real gases. Kinetic theory of gases.

Second Principle of Thermodynamics. Reversibility and irreversibility**(*)**. Carnot's theorem**(*)**. Absolute thermodynamic temperature**(*)**. Clausius theorem**(*)**. Entropy**(*)**. The principle of increasing entropy**(*)**. Unusable energy.

(*) Minimal requisite to pass the exam.

TEXTBOOK INFORMATION

1. P. Mazzoldi, M. Nigro e C. Voci, Fisica – Volume I, Seconda Edizione (EdiSES, Napoli, 2003);

2. R. P. Feynman, R. B. Leighton e M. Sands, La Fisica di Feynman – Vol. 1, Parte 1 e Parte 2

(Zanichelli; Bologna, 2007) - per approfondimenti

A collection of exercises, many of which are assigned during the written exam tests, will be made available to the students.