FISICA I A - Co

FIS/01 - 9 CFU - 2° Semester

Teaching Staff

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Office Hours: Lunedì e Mercoledì dalle 10:00 alle 12:00 (si consiglia di contattare anticipatamente il docente per verificare che il ricevimento non sia stato spostato per impegni istituzionali del docente o cause terze). Contattare il docente per altri orari o giorni.

LEARNING OBJECTIVES

The course aims at providing basic knowlegde of classical mechanics and thermodynamics topics included in the "Course Content" (see below) as well as the capability to apply the Scientific Method to the resolution of real and concrete problems. In particular, the course has the objectives to provide the bachelor students with the following knowledge and abilities.

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

- Applying knowledge and understanding ability
Ability to recognize the main physical laws that govern a mechanic 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.

- Ability of making judgements

- Evaluation of the order of magnitude of the variables that describe a mechanic or thermodynamic phenomenon;
- Evaluation of the relevance of a physical law (axiom, principle of conservation, universal law, theorem, law in global/integral or local/differential form and its generality, etc.).

- Communication skills
Capability to expose scientific concepts in a proper and inambiguous manner.

- Learning skills
Application to Physics of theoretical/mathematical techniques.

COURSE STRUCTURE

Prerequisites

- good knowledge of elementary mathematics (algebra, geometry, and trigonometry);
- elementary knowledge of differential and integral calculus.

Planned learning activities and teaching methods

- the course is mainly organized in lectures (7 CFU) and exercises (2 CFU). "Innovative" teaching and learning strategies (e.g. problem based learning, interactive lecturing, problem solving) are also used. A strong "Teacher-Student Interaction" is also encuraged.

Attendance to lectures

Although it is not mandatory, attendance to classroom lectures is recommended.

Learning verification

The final exam consists of a written test followed by an oral exam. Ongoing tests (so-called "prove in itinere") are not planned.

DETAILED COURSE CONTENT

INTRODUCTION

-) Physical description of reality
Physical quantities and units, coordinate systems.

-) Vectors
Generalities, vector operations (addition, subtraction, product of a vector for a scalar, dot product, vector product), components of a vector, derivative and integral of a vector.

MECHANICS

-) Particle kinematics
Velocity, acceleration, uniform linear motion, uniformly accelerated linear motion, free fall and projectile motion.

-) Particle dynamics

Newton's first law, inertial mass, conservation of momentum, force, Newton's second law, resultant of forces, equilibrium, Newton's third law, friction forces, inclined plane.

-) Mechanical energy and conservative systems
Work, power, kinetic energy, potential energy, conservation of mechanical energy.

-) Collisions and systems of material points
Impulse, elastic collision, inelastic and completely inelastic collision, motions with variable mass, points systems, the center of mass of a particles system and its motion.

-) Rigid body and rotational mechanics
Rigid body and its center of mass, rotational kinematics, rotational vectorial magnitudes, the moment of a force, stationary rotation, the moment of inertia, Huygens-Steiner theorem, angular momentum, combined motions of translation and rotation.

-) Elasticity
Hooke's law, the elasticity of volume and form, relations between elastic constants.

-) Oscillations
Simple harmonic motion, mass-spring system, simple pendulum, physical pendulums, damped harmonic oscillator, forced harmonic oscillator.

-) Gravitation

Central forces, Kepler's laws, the universal gravitation law, inertial mass and gravitational mass, gravitational field and gravitational potential energy, escape velocity, trajectory of a body in the gravitational field of another body.

THERMODYNAMICS

-) Temperature and heat
Thermometry, calorimetry, the first law of thermodynamics, thermal capacity and latent heat, heat transmission.

-) Ideal and real gases
Laws of gases and equation of state of ideal gases, transformations of a gas and work, real gases,

Clausius-Clapeyron equation, kinetic theory of gases.

-) Entropy
Thermal machines, the ideal machine of Carnot, the second law of thermodynamics, entropy, irreversible processes, statistical interpretation of entropy.

TEXTBOOK INFORMATION

- Mazzoldi, Nigro, Voci – Elementi di Fisica - Meccanica e Termodinamica - EdiSES - Seconda Edizione.

In-depth books:

- Halliday, Resnick, Walker – Fondamenti di Fisica - Meccanica, Onde, Termodinamica - CEA - Settima Edizione;
- Roller, Blum - Fisica vol.1 - Meccanica onde e termodinamica - Zanichelli;
- Feynman, Leighton, Sands - La Fisica di Feynman – Volume 1, Parte 1 e Parte 2 - Zanichelli (this book is also in English).
