# FISICA GENERALE I

FIS/01 - 9 CFU - 1° Semester

**Teaching Staff**

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## LEARNING OBJECTIVES

The student will acquire the basics for the understanding of classical mechanics, wave phenomena, fluid mechanics, thermal phenomena in fluids and solids. Moreover, through exercises and problems to be solved in the classroom and at home, the student will be accustomed to solving concrete problems. The student who will have acquired the topics and methodologies of the course, will be able to face and solve problems of various kinds through a logical-scientific approach. In particular, the course proposes the following objectives:

- **Knowledge and ability to understand (knowledge and understanding):** the student will be introduced to the basic knowledge of the laws of classical physics (mechanics, fluids and thermodynamics). The student will develop the ability to understand the most important physical phenomena related to the course program.
- **Applying knowledge and understanding:** the student will be initiated to an application in practical fields of acquired knowledge, with continuous examples of applied physics for the understanding of the real world.
- **Making judgments:** the student will be induced to a critical analysis of the level of knowledge acquired, pushing him to a self-assessment of his knowledge and skills, trying to develop an autonomy of judgment on the objectives achieved.
- **Communication skills**: The interaction with the teacher and colleagues will be stimulated to increase students' communication skills.

## COURSE STRUCTURE

Theory lessons and resolutions of issues and problems in the classroom. Final exam based on written and oral exam.

## DETAILED COURSE CONTENT

**INTRODUCTION:** scientific method, physical quantities and units of measurement

**VECTORS:** scalar and vectorial quantities; calculus with vectors

**KINEMATICS OF A PARTICLE:** frame of reference; law of motion, trajectory, velocity, acceleration; rectilinear motion; free fall of body; projectile motion; circular motion

**DYNAMICS OF A PARTICLE:** fundamental principles: Newton's laws; inertial and gravitational mass; forces: force of gravity, normal and friction force, tension, elastic force, air resistance; the simple gravity pendulum; moment of a force; linear momentum and angular momentum of a particle; work; kinetic energy; potential energy; total energy and its conservation

**OSCILLATIONS:** Oscillating phenomena: oscillating systems, the harmonic oscillator, simple harmonic motion and its correlation with the uniform circular motion, damped harmonic motion, forced oscillations and resonance.

**UNIVERSAL GRAVITATION:** Kepler's laws of planetary motion; law of universal gravitation; energy in a gravitational field

**DYNAMICS OF MANY PARTICLES AND RIGID BODIES:** center of mass; theorems of the center of mass; density of a material; Konig's theorems, moment of inertia; Huygens-Steiner's theorem; motion of rigid bodies: translation and rotation; the compound pendulum

**HYDROSTATICS AND HYDRODYNAMICS:** Fluid mechanics: definition and classification of fluids, static of fluids, pressure of a fluid, fluids in quiet subject to gravity: Stevino's law, Archimedes' thrust, surface tension and capillarity. Dynamics of ideal fluids in stationary motion, definition of line and flow tube, Bernoulli's theorem, Torricelli theorem and Venturi tube, real fuides, vortex regime, Stokes law.

**TERMODYNAMICS:** Introduction to thermodynamics: zero principle of thermodynamics, definition of temperature and choice of the thermometric scale, constant volume thermometer, Celsius and Kelvin scale.Kinetic theory of perfect gases, molecular properties of gases, free medium path, microscopic description of pressure, distribution of molecular gas velocities, intermolecular forces, energy equalization theorem. Laws of Boyle-Mariotte, Charles and Gay-Lussac, perfect state of gas equation. Work of thermodynamic transformations, heat, internal energy, first principle of thermodynamics, heat transfer, heat capacity, specific thermal capacity at constant pressure or volume, Mayer relation for perfect gases, latent heat. Thermal expansion. Heat transferred into any thermodynamic transformations for a perfect gas, adiabatic transformations, cyclic transformations and definition of efficiency or coefficient of performance, ideal Carnot cycle. Second principle of thermodynamics: Kelvin-Planck and Clausius postulates and their equivalence. Theorem of Carnot and real machines, theorem and inequality of Clausius, definition of entropy and its properties, variation of entropy of the universe, real gases and thermodynamic potentials.

**EXERCISES on the above topics**

## TEXTBOOK INFORMATION

1. R. Davidson *"Metodi matematici per un corso introduttivo di Fisica"* casa editrice EdiSES;

2. S.Focardi, I.Massa, A.Uguzzoni: “*Fisica Generale”* *Volume 1: Meccanica*, II edizione, casa editrice Ambrosiana;
3. S.Focardi, I.Massa, A.Uguzzoni: “*Fisica Generale”* *Volume 2: Termodinamica e Fluidi*, II edizione, casa editrice Ambrosiana;
4. P.Mazzoldi, M. Nigro, C. Voci: “*Elementi di Fisica”* *Meccanica e Termodinamica*, II edizione, casa editrice EdiSES;
5. C.Mencuccini, V.Silvestrini: "*Fisica. Meccanica e termodinamica*" anno 2016, Editore CEA
6. R. Bellotti, G.E.Bruno, G.Florio, N.Manna “Esercizi di Fisica” Meccanica e Termodinamica casa editrice Ambrosiana

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