Lectures

The lectures part of the Physics course offers knowledge and skills in key topics of Classical Physics (Mechanics and Waves) and is organized into five sections:

First section: Introductory concepts

- Physical quantities (units, conversion factors).
- Mathematics review (differential and integral calculus).
- Dimensional analysis.

Second section: Kinematics, Dynamics, Conservation of Energy

- Motion in one dimension, motion in space, circular motion.
- Fundamental Forces, Newton's laws of motion.
- Momentum, work, power, kinetic energy.
- Potential energy, conservative forces, conservation of mechanical energy.

Third section: Kinematics and Dynamics of a Rigid Object

- Center of mass, torque, moment of inertia, rotation of a rigid object about a fixed axis.
- Angular momentum, rolling motion of a rigid object, dynamics of a rigid body.

Fouth section: Oscillations and Mechanical waves

- Oscillations, oscillatory motion.
- Harmonic transverse waves, wave equation, speed, energy, superposition principle, interference, standing waves, normal modes of oscillations.
- Sound waves, intensity, superposition, interference, standing waves, normal modes of oscillations, shock waves, Doppler effect.

Fifth section: Conceptual understanding of the course's subject matter

- Problems analysis-solving.
- Practical examples, mechanics, and waves applications in engineering disciplines
- Review essential concepts, principles, and definitions.

Laboratory

In the laboratory part of the Physics course, students experiment on selected topics of Classical Physics (Mechanics and Waves) to deepen fundamental concepts and principles and be introduced to the experimental scientific process (measurement uncertainties, validation of laws, linear regression techniques for estimating unknown parameters). The lab is organized into 13 sessions:

1. Introduction to measurements, uncertainties, and analysis of the dependence between variables.
2. Introduction to graphical representations of data, linearization of variables dependency, linear regression, and extraction of unknown variables.
3. Detailed presentation of the laboratory sessions.
4. Study of the motion in one dimension under constant acceleration. Measuring the acceleration.

5. Measuring the acceleration of gravity with a simple pendulum.
6. Measuring the spring constant with a vertically hanging mass.
7. Measuring the speed of sound in air.
8. Electrical–mechanical analogies.
9. The mechanical analogous of the resistance: measuring viscosity via a capillary tube.
10. The mechanical analogous of the capacitor discharge through a resistor.
11. The mechanical analogous of an RLC circuit (in series).
12. Recapitulation session
13. Final written examination