FUNDAMENTALS OF PHYSICS

Code: 322044

Main Scientific Area: Applied physical sciences

Lecturer: Daniela Sofia Ferreira da Costa

Language of Instruction: Portuguese

Regime: S1

Contact Hours: 60h Total Workload: 108h

ECTS: 6,0

Objectives

The aim of the Fundamentals of Physics is to acquire technical knowledge based in the classical physics and analysis of mechanical challenges, through the simplification, logics and applying the correct mathematical tools (trigonometry, algebra, vectors and differential calculus) in order to adress the analysis of real-world problems of Physics and Technology. The aim is to students develop personal skills and professional attitudes that enable them to tackle problems of classical mechanics, both from a theoretical and/or experimental point of view.

Learning Outcomes

The program includes a review of basic concepts of mathematics and geometry that are essential for subsequent topics. In Fundamentals of Physics aims to give students the ability to understand and apply basic concepts of classical physics to problems of static and dynamic, hydrostatic, and harmonic motion, among others. Thus, it is intended to equip students with tools and professional attitudes to enable it to address the problems of classical mechanics to a range of everyday situations.

Course Contents

1. PHYSICAL QUANTITIES, UNITS AND DIMENSIONS

1.1 Definition of greatness: quantities fundamental and derived

1.2 Measuring a physical quantity

1.3 Systems of units, SI and CGS system

2.SUPPLEMENTS OF MATHEMATICS

2.1 Trigonometry: trigonometric functions, trigonometric triangle

2.2 Vector calculus

2.3 Differential calculus

3. KINEMATICS OF A MATERIAL POINT

3.1 One-Dimensional Motion

3.1.1 Equation of motion: rectilinear and uniform, and uniformly varied rectilinear

3.1.2 Average speed and instantaneous velocity

3.1.3 Acceleration average and instantaneous acceleration

3.1.4 Free fall of a body

3.1.5 Bidimensional motion

3.1.6 Cartesian coordinates

3.1.7 Motion of a projectile

3.1.8 Circular motion. Angular velocity and angular acceleration

4. DYNAMIC

4.1 Introduction. Momentum and force

4.2 Newton`s Laws

4.3 Fundamentals forces (gravity, electroweak and strong) and derivatives (normal reaction, tension in a rope, friction force and elastic)

4.4 Application of the 1st and 2nd and 3rd law of Newton: free body diagram

4.5 Law of universal gravitation. Gravitational field. Satellite Movement

5. STATIC

5.1 Equilibrium of a particle

5.2 Equilibrium of a rigid body

5.3 Moment of a force

5.4 Examples of application

6.WORK AND ENERGY

6.1 Work of a force

6.2 Work and kinetic energy. Kinetic energy theorem

6.3 Potencial energy associated with a conservative force: gravitational potential energy and elastic

6.4 Conservative and non-conservative forces

6.5 Mechanical energy

6.6 Principle of conservation of mechanical energy

6.7 Power and efficiency

7. Oscillatory motion

7.1 Simple harmonic motion

7.1.1 Characteristics of simple harmonic motion

7.1.2 Equations of motion

7.1.3 The simple pendulum

7.2 Energy of simple harmonic oscillator

7.2.1 Potential energy elastic

7.2.2 Kinetic energy

7.2.3 Mechanical energy

8.FLUID MECHANICS

8.1 Introduction

8.2 Hydrostatic

8.2.1 Density

8.2.2 Pressure

8.2.3 Pascal`s principle

8.2.4 Measurement of pressure

8.2.5 Fluctuation in body fluids; Archimedes` principle

8.3. Hydrodynamics

8.3.1 Fluid ideal and real fluids

8.3.2 Equation of Continuity

8.3.3 Bernoulli Theorem

Recommended Bibliography

Halliday D., Resnick R., and Walker J., Fundamentals of Physics, 7th Edition, Editora John Wiley.

Frederick J. Bueche/Eugene Hecht, Física (9ª edição), Editora McGraw-Hill, 2001.

Almeida, G. Sistema Internacional de Unidades (SI). Grandezas e Unidades Físicas, 2ª ed., Plátano Editora, 1997.

Halliday, D., Resnick, R. e Krana, K.S., Física 1-4, Livros Técnicos e Científicos Editora S.A, 4ª ed., 1996.

Valadares, J. e Silva, L. Manual de Física, mecânica, 13ª ed., Didática Editora, cap 1-5, 1994.

Learning and Teaching Methods

Contents: PHYSICAL QUANTITIES, UNITS AND DIMENSIONS

Main objectives: To learn the concept of greatness: fundamental and derived quantities. Knowing systems units: SI and CGS system. Learn to correctly represent the value of a quantity in terms of units and scientific notation. Learn to do the dimensional analysis of a physical equation.

Contents: MATH SUPPLEMENTS

Main objectives: Remember basics of trigonometry. Learn represented graphically and analytically a vector in terms of its components in 2 and 3 dimensions. Learn to add vectors graphically and analytically as a function of its components. Know the scalar productand the vector product of vectors. Remember derived functions using derivation rules.

Contents: KINEMATICS OF A MATERIAL POINT

Main objectives: Know and apply the laws of rectilinear and uniform motion, rectilinear and uniformly varied motion in solving exercises. Know calculate average/instantaneous velocity, average/instantaneous acceleration of a body. Learn to study the motion of a projectile. Learn to calculate the tangential acceleration/normal acceleration in circular motion.

Contents: DYNAMIC

Main objectives: To learn the concept of force and momentum. Knowing Newton`s laws and apply them in the interpretation of specific situations. Knowing the fundamental forces (gravitation, electroweak and strong) and derivatives (normal reaction, tension in the rope, friction force and elastic). To apply Newton`s laws in the construction of free body diagram to study the dynamics of a particle material.

Contents: STATIC

Main objectives: Learn to study the equilibrium of a particle, equilibrium of a rigid body. Learn to calculate the

moment of a force and the resultant moment of a system of forces and apply it in the study of equilibrium of a rigid body.

Contents: WORK AND ENERGY

Main objectives: Learn to calculate the work done by a force / force system. Knowing the law of work and kinetic energy in solving exercises. Knowing the different forms of mechanical energy: potential energy associated with a conservative force: gravitational and elastic potential energy. Know and give examples of conservative forces and forces non-conservative. To apply the principle of conservation of mechanical energy in solving exercises.

Contents: MOVE OSCILLATORY

Main objectives: Know and determine the characteristics of Simple Harmonic Motion. Know and apply the equations of MHS in solving exercises. Know some simple harmonic oscillators: simple pendulum; elastic spring and be able to determine the respective characteristics. Learn different ways to calculate the simple harmonic oscillator and how they relate during its movement.

Contents: MECHANICS OF FLUIDS

Main objectives: Understanding the basic law of hydrostatic and how to apply it in solving exercises. Know and apply the concepts of density and pressure. Know the Pascal`s principle and apply it. Know some pressure gauges. Learn to study the fluctuation of bodies in fluids and apply the principle of Archimedes. Know what an ideal fluid Understand and apply in solving the equation of continuity and Bernoulli's Theorem. Know some consequences of applying Bernoulli's Theorem.

Assessment Methods

A written evaluation interim approximately half the length of the semester, and a written evaluation at the final of the semester.

Practical works (mandatory) throughout the semester and during the class - written or oral.

The final grade is weighted between the following classifications:

Practical works during classes (15%)

Test 1 (42.5%)

Test 2 (42.5%)

Global Test (85%)