Physics I

Academic Year: (2024 / 2025) **Review date: 19-12-2023**

Department assigned to the subject: Physics Department

Coordinating teacher: RAMIREZ JIMENEZ, RAFAEL

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 2

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus I.
Linear Algebra.

SKILLS AND LEARNING OUTCOMES

RA1: Acquire knowledge and understanding of the basic general fundamentals of engineering and biomedical sciences.
RA2: Be able to solve basic engineering and biomedical science problems through a process of analysis, identifying the problem, establishing different methods of resolution, selecting the most appropriate one and its correct implementation.
CB1: Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2: Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CG1: Adequate knowledge and skills to analyse and synthesise basic problems related to engineering and biomedical sciences, solve them and communicate them efficiently.
CG3: Knowledge of basic scientific and technical subjects that enables them to learn new methods and technologies, as well as providing them with great versatility to adapt to new situations.
CG4: Ability to solve problems with initiative, decision-making, creativity, and to communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the biomedical engineer's activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG8: Ability to solve mathematical, physical, chemical and biochemical problems that may arise in biomedical engineering.
CG12: Ability to solve mathematically formulated problems applied to biology, physics and chemistry, using numerical algorithms and computational techniques.
ECRT2: Ability to solve physical problems that may arise in engineering and biomedicine. Ability to apply knowledge of: kinematics; dynamics; electromagnetism; waves; small oscillations; thermodynamics.
CT1: Ability to communicate knowledge orally and in writing to both specialised and non-specialised audiences.

OBJECTIVES

The goal of this course is the student can understand the physical phenomena involved in the mechanics of particles and rigid bodies, and its relation to biological systems.

In order to achieve this goal, the following competences and skills have to be acquired:

- Ability to understand and know basic concepts of mechanics of particles and rigid bodies.
- Ability to understand and use the mathematics involved in the physical models.
- Ability to understand and use the scientific method.
- Ability to understand and use the scientific language.

- Ability to develop skills to solve problems.
- Apability to use scientif instruments and analyze experimental data.
- Ability to retrieve and analyse information from different sources.
- Ability to work in a team.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Kinematics of a particle.
 1.1 Position, velocity and acceleration vectors.
 1.2 Motion in 2 and 3 dimensions.Equation of trajectory. Projectile motion.
 1.3 Intrinsic components of acceleration (normal and tangential accelerations).
 1.4 Circular motion.

2. Dynamics of a particle.
 2.1 Newton´s laws. Equations of motion.
 2.2 Examples of forces: weight, spring orce, tension, contact forces, friction forces.
 2.3 Transformations among systems of reference. Relative motion.
 2.4 Forces in linear accelerated systems and circular motion.
 2.5 Linear momentum. Angular momentum. Moment of forces.

3. Work and energy. (Conservative and non-conservative forces)
 3.1 Work. Power.
 3.2 Kinetic energy.
 3.3 Conservative forces and potential energy.
 3.4 Non-conservative forces.

4. Systems of particles.
 4.1 Internal and external forces.
 4.2 Center of mass motion.
 4.3 Collisions.
 4.4 Conservation theorems for a system of particles.Kinetic energy of a system of particles.

5. Dynamics of the Rigid Body.
 5.1 Planar motion of the rigid body.
 5.2 Moment of Inertia.Parallel axis theorem.
 5.3 Angular momentum of the rigid body.
 5.4 Planar motion equations.
 5.5 Work of forces acting on a rigid body. Kinetic energy.

6. Oscillations.
6.1 Simple Harmonic motion (force and energy).
6.2 Small oscillations.
6.3 Damped oscillations.
6.4 Forced oscillations. Resonances.

7. Fluids
7.1 Pressure and density.
7.2 Hidrostatic equilibrium. Archimedes´principle
7.3 Bernoulli's theorem. Dynamic pressure.
7.4 Laminar and turbulent regimes.

8. Waves
8.1 Wave equation.
8.2 Plane waves.
8.3 Stationary waves.
8.4 Superposition and Interference.
8.5 Sound and light waves.

LEARNING ACTIVITIES AND METHODOLOGY

Lectures where the theoretical concepts are explained (PO: a)

The lecturer will provide a file with the following information (1 week in advance):
- Main topics to be discussed during the session
- Chapters/sections in each of the text books provided in the bibliography were the studend can read about these topics

Activities in groups (~ 40 students divided in groups of 2-3 people) to solve problems (PO: a, d).

The main skills to be developed in these activities are:
- To understand the statement of the problem (for instance drawing an scheme that summarizes the statement)
- To identify the physical phenomenon involved in the statement and the physical laws related to it.
- To develop a strategy to reach the objective (for instance breaking the problem in small subproblems).
- To be careful in the use of mathematics
- To analyze the reasonability of the result (is the final result reasonable?, are dimensions consistent?)

Small works focused on the search of scientific information in different sources (mainly internet). (PO: a, d)

Laboratory sessions (~20 students divided in groups of 2 students). (PO:b, d)

The main skills to be developed in this activity are:
- To understand that physics is an experimental science and they can reproduce the laws that have been theoretically explained in the lectures.
- To use scientific instruments and to be careful in its operation.
- To be careful in the acquisiton of the experimental data.
- To learn the basis of the management of a scientific data set.
- To write a report with the main results of the experiment.
- To reason in a critical way these results: have we achieved the goals of the experiment?

ASSESSMENT SYSTEM

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

Laboratory sessions (15% of final grade) (PO: b, d)

Attendance to the laboratory sessions is compulsory.
Evaluation of the reports. The mark is shared by the members of the group.

Activities in groups (25% of final grade) (PO: a, d)

Attendance.
Midterms.
Delivery and assessment of the proposed activities.

Written exam (60% of final mark) (PO: a)

This exam is made at the end of the semester and it is the same for all the students.
Contents:
- Problems to be solved covering the topics of the program.
- Short theoretical questions as part of the problems.

The minium required grade in the final exam is 3/10.

BASIC BIBLIOGRAPHY

- Alonso, Finn Physics, Prentice Hall, 2000

- GETTYS, W.E. et al. Física clásica y moderna, McGraw-Hill.

- Tipler, Mosca Physics for Scientists and Engineers, Whfreeman, Sixth

ADDITIONAL BIBLIOGRAPHY

- Feynman, RP Feynman Lectures on Physics, Addison Wesley, 1995