COURSE DATA

Data Subject	
Code	34233
Name	General physics I
Cycle	Grade
ECTS Credits	6.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Faculty of Physics	1	First term
1928 - D.D. in Physics-Mathematics	Double Degree Program Physics and Mathematics	1	First term
1929 - D.D. in Physics-Chemistry	Double Degree Program Physics and Chemistry	1	First term

Subject-matter

Degree	Subject-matter	Character
1105 - Degree in Physics	1 - Physics	Basic Training
1928 - D.D. in Physics-Mathematics	1 - Primer Curso (Obligatorio)	Obligatory
1929 - D.D. in Physics-Chemistry	1 - Primer Curso (Obligatorio)	Obligatory

Coordination

Name	Department
FERRER ROCA, CHANTAL MARIA	175 - Applied Physics and Electromagnetism
NEBOT GOMEZ, MIGUEL RUBEN	185 - Theoretical Physics
QUILIS QUILIS, VICENTE	16 - Astronomy and Astrophysics

SUMMARY

This course aims to provide students with a comprehensive and wide overview of Physics, from a theoretical as well as an experimental or phenomenological point of view, in order to acquire reasoning skills and explain phenomena in terms of basic physical concepts.

The aim, in short, is that students learn to express accurately in the fieldof science, formulating ideas, concepts and relations between them. They should be capable of reasoning in a scientific way to understand qualitative and quantitative aspects of the world around us, and develop skills in problem solving.

We will develop the basics concepts , emphasizing phenomenological aspects to ensure the background needed in future courses of the program , covered with higher degree of formalism and depth. This will be done considering the historical context of the progress of the various branches of physics and the basic experiments that have led to different concepts and theoretical formulations of the most important applications in science and technology.

"General Physics I" is a 1st year basic course. It is scheduled in the first semester with 6 ECTS credits assigned. In the lectures, both theoretical concepts and problem solving will be addressed. Together with “General Physics II" and “General Physics III ", the fundamentals of the Physics subject are fully covered. It needs mathematical tools from algebra, geometry and calculus , also scheduled in the 1st semester, and is complemented with a course (second semester) in which laboratory experiments are carried out.

The topics proposed in the official document of the Physics Degree are: kinematics and dynamics, work and energy, particle systems, rigid body rotation, gravitation and Kepler's laws.

This course teaches the basics of Newtonian mechanics, which are subsequently treated with a greater degree of formalism on the courses "Mechanics I" and "Mechanics II”.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

In order to follow this course, students should have previously studied physics, chemistry and mathematics at a high school level. It is also important that students reinforce and extend the mathematical background in the courses on mathematics to be taken simultaneously with General Physics I in the first semester.

OUTCOMES

1105 - Degree in Physics

- Knowledge and understanding of the fundamentals of physics in theoretical and experimental aspects, and the mathematical background needed for its formulation.
- To know how to apply the knowledge acquired to professional activity, to know how to solve problems and develop and defend arguments, relying on this knowledge.

- Ability to collect and interpret relevant data in order to make judgements.
- Problem solving: be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems .
- Theoretical understanding of physical phenomena: have a good understanding of the most important physical theories (logical and mathematical structure, experimental support, described physical phenomena).
- Modelling & Problem solving skills: be able to identify the essentials of a process / situation and to set up a working model of the same; be able to perform the required approximations so as to reduce a problem to an approachable one. Critical thinking to construct physical models.
- Physics general culture: Be familiar with the most important areas of physics and with those approaches which span many areas in physics, or connections of physics with other sciences.
- Prob. solving and computer skills: be able to perform calculations independently, even when a small PC or a large computer is needed, including the development of software programmes.
- Basic & applied Research: acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving the existing results.
- Foreign Language skills: Have improved command of English (or other foreign languages of interest) through: use of the basic literature, written and oral communication (scientific and technical English), participation in courses, study abroad via exchange programmes, and recognition of credits at foreign universities or research centres.
- Literature Search: be able to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development.
- Learning ability: be able to enter new fields through independent study, in physics and science and technology in general.
- Communication Skills (written and oral): Being able to communicate information, ideas, problems and solutions through argumentation and reasoning which are characteristic of the scientific activity, using basic concepts and tools of physics.
- Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.

- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

LEARNING OUTCOMES

General:

- Operative capacity to apply and relate laws and concepts, as well as to master the different procedures for the resolution of problems, including the necessary mathematical skills. Ability to perform symbolic calculations with all generality and, ultimately, numerical results, including common algebraic calculations, derivation, integration, function analysis, vector operations in Cartesian coordinates and trigonometric relationships.
- Correct use of units of the different magnitudes, order of magnitude estimates and dimensional analysis of physical expressions. Ability to verify problems results on the basis of these procedures.
- Ability to explain and justify physical problems, using the basic Physics terminology, expressing with the precision required in Science, formulating ideas, concepts and relationships between them and appealing to the general principles and laws of physics.
- Ability to study and plan activities for learning, either individually or in groups, searching, select and synthesize information in different bibliographical sources.

Specific:

- Ability to solve kinematic problems obtaining basic vector magnitudes (a(t), v(t), r(t)). mainly: uniform and uniformly accelerated movements in one and two dimensions, rectilinear, parabolic (impact on arbitrary ground function) and circular (use of tangent and normal components). Capacity to represent graphically and analyze those movements prior to the numerical resolution of each particular case.
- Understand Galileo's principle of relativity and Galileo transformations. Calculation of position, speed or time interval of a body movement in different inertial systems.
- Understand Newton's second law (law of dynamics) and its application to simple problems, especially in cases of constant and uniform forces or central forces. Ability to identify and draw all the forces that act on each body of a system, knowing its nature. In particular, gravitational force, contact, friction (kinematic and dynamic) and tensions. Problem solving in one and two dimensions (rectilinear, parabolic and circular motion). Application of Newton's second law in tangential and centripetal directions. Weightlessness concept.
- Understand the concept of work of a force as a path integral between two points, kinetic and potential energy and the principle of conservation of mechanical energy. Application to the resolution of simple problems, as an alternative to the direct use of Newton's 2nd law, both with conservative forces (gravitational, elastic) and in the presence of dissipative forces (fundamentally friction between surfaces).
- Understand of the concept of particle system and the definition of the center of mass (CM). Obtain the CM of different systems (punctual or extensive) by direct calculation and by superposition. Final position or speed of some system or system particle when it is isolated (without external forces).
- Point-Particle collision problems in which the previous principles are involved (especially in one and two dimensions). In particular, inelastic collisions (between blocks, projectiles with pendulums or spring masses, etc.). Ability to discern the magnitudes that are conserved in the collision, before and after it and regarding which system part.

- Understand the concept of moment of a force, angular momentum and moment of inertia of a rigid body around an axis (scalar) as fundamental magnitude of rotation dynamics. Calculation of the moment of inertia of simple geometric figures and often homogeneous, with respect to an axis in the center of mass or at a certain distance from it (Steiner), using one integration variable: rod, rectangle, cylinder, sphere, etc. and their combinations (superposition). Resolution of simple dynamic two-dimensional problems in which rigid bodies and moments of forces intervene.
- Understand of the conservation principle of angular momentum and application to simple problems in which there are changes in the spatial distribution of system bodies. Calculation of the mechanical energy of a rigid body and resolution of simple collision problems involving solids.
- Ability to calculate the field and gravitational force (and potential and potential energy) that one or more bodies exert on a third one, including the case when the latter is not a point mass. Understanding Kepler's empirical laws and their deduction from fundamental physical principles in the circular case. Ability to solve problems using Newton's 2nd law and conservation of angular momentum and mechanical energy or in those in which the orbit is known to be circular or elliptic (periapsis and apsis points). Deduction of the velocity of a body in different points of its gravitational potential or orbit.

DESCRIPTION OF CONTENTS

1. Introduction

Units. Dimensions. Dimensional analysis. Figures and orders of magnitude. Review of basic concepts of vector calculus, derivatives and integrals.

2. Particle Kinematics

Motion in one dimension: position, velocity, acceleration; uniformly accelerated motion. Generalization to three dimensions: position, velocity and acceleration vectors. Projectile motion. Normal and tangential acceleration in two dimensions. Relative motion.

3. Particle dynamics

Newton's laws. Types of forces and gravitational force. Applications and examples: free body diagrams. Static and kinetic friction, drag forces, terminal velocity. Circular motion: centripetal component of the acceleration. Weightlessness.

4. Work and energy

Work done by a force. Kinetic energy. Work-kinetic- energy theorem. Power. Conservative forces. Potential energy. Equilibrium. Mechanical energy: conservation. Conservative and non-conservative forces: Principle of conservation of energy in a system.

5. Systems of particles. Collisions

Center of mass. Equation of motion. Linear momentum: conservation. Kinetic and potential energy of a system of particles. Impulse and average force. Collisions in one dimension. Coefficient of restitution. Collisions in two dimensions. The center of mass reference frame.

6. Rotation of a Rigid Body

Angular velocity and angular acceleration. Torque. Newtons second law for rotation. Rotation around a fixed axis: moment of inertia. Steiner theorem. Calculating moments of inertia.
Applications and examples of the Newtons second law for rotation. Rotational kinetic energy. Work and power. Rolling objects. Angular momentum. The gyroscope. Conservation of angular momentum.

7. The gravitational field

Kepler's laws and their deduction from physicial principles. Newton's law of gravitation. Measurement of G: the Cavendish experiment. The gravitational field. Gravitational potential energy: escape velocity, energy and orbits.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	45,00	100
Tutorials	15,00	100
Development of individual work	30,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	30,00	0
Preparation of practical classes and problem	15,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Direct Instruction (40 %):

Lectures (Theory and problems) will cover the basic theoretical concepts and the techniques to tackle physics problems which will be developed through illustrative examples. These lectures will make an intensive and extensive use of tools like demonstrations, physlets or videos, graphical solutions, etc.

Practical problem-solving classes in small groups: focused on the student’s work and its active participation, providing a better understanding of basic concepts and problem solving strategies, reinforcing the more difficult ones, and following the student progress, associated with a component of continuous assessment.

Student's personal work (60%):

- Study of the theoretical basis.

- Resolution of problems and conceptual questions.

- Individual tutorials: Students ask questions to the lecturers regarding doubts and difficulties encountered while studying and solving problems.

EVALUATION

1) Written exam: with two parts. The first is focused on the understanding of the theoretical-conceptual aspects and the formalism of the subject (theoretical and demonstrative questions, conceptual and numerical questions or simple specific cases) and the second assesses the ability to apply formalism, by solving problems, as well as the critical capacity regarding the results obtained. In both parts the symbolic calculation, correct argumentation and an adequate justification will be assessed.

2) Continuous assessment of problems solved by the students, questions proposed and discussed online or during problem solving classes or oral presentation of solved problems.

The final grade will be obtained from the average of these two types: exam (minimum 60%) and continuous assessment (maximum 40%), provided that in the written exam a minimum of 4 out of 10 is obtained. In any case, the final grade will be the maximum value of the exam grade and the average. The total qualification needed to pass the course is 5 out of 10.

NOTE: Whenever the criteria specified by the CAT (Academic Degree Committee) are fullfilled, the course grade will be averaged with those obtained in "General Physics II" and "General Physics III".

REFERENCES

Basic

- P.A. Tipler, G. Mosca, Física para la ciencia y la tecnología, Volumen 1 y 2. Reverté. 6ª edición, 2010.

Additional

- P.M. Fishbane, S. Gasiorowicz, S. T. Thornton, Física para ciencias e ingenieria , Vol 1 y 2, Prentice Hall, 1993.
  - Gerald Holton & Stephen G. Brush, Introducción a los conceptos y teorías de las ciencias físicas. Ed. Reverté 1987, 2004. 2ª ed. corregida y revisada.
  - R.A. Serway y J.W. Jewett, Física, Volumen 1 y 2, Tomson.3ª edición, 2003.
  - R.A. Serway, Physics for Scientists and Engineers, Saunders. 3ª edición, 1990.
  - R. Wolfson, J.M. Pasachoff, Physics, Addison-Wesley, 3ª edición, 1999.
  - M. Alonso y E.J. Finn, Física, Pearson Educación, 2000.

- J.W. Kane, M.M. Sternheim. Física, Editorial Reverté. 1992.
-V. Martínez Sancho. Fonaments de Física, Enciclopedia Catalana.
-J. Aguilar y F. Senent. Cuestiones de Física, Editorial Reverté.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

TEACHING METHODOLOGY:

In case that health situation requires blended teaching, the teaching model approved by the Academic Degree Committee on July 23, 2020 will be adopted, consisting of 100% student attendance in all activities, with 50% capacity in classrooms for lectures.

If a total reduction in attendance is necessary, classes will be broadcast by synchronous videoconference at their regular schedule, along the period determined by the Health Authority.