Mechanics and thermodynamics

Academic Year: (2023 / 2024) **Review date: 17/04/2023 18:12:24**

Department assigned to the subject: Physics Department

Coordinating teacher: SANTALLA ARRIBAS, SILVIA NOEMI

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)

Having studied Physics and Mathematics at high school is recommended.
Calculus (Course 1 - Semester 1)

LEARNING OUTCOMES

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- Identify the relevant physical concepts in a specific problem and establish their relationship with the essence of physical phenomena.
- Manage the basic conceptual schemes of physics: particle, wave, field, reference system, energy.
- Momentum, conservation laws, microscopic and macroscopic points of view, etc.
- Acquire a panoramic view of current physics.
- Analyze, pose, and solve simple physical problems with confidence.
- Act with social and ethical responsibility and applying professional ethics.
- Recognize the ethical dimension of scientific and technical development.
- Interpret world news based on physical, economic, social and cultural diversity.
- Maintain an ethical commitment
- Recognize the implications of scientific knowledge in the development of the gender perspective.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Point particle kinematics
- Position, path and displacement. Speed. Acceleration, intrinsic components of acceleration
- Integration of equations of motion
- Types of movement
- Integration of equations of motion without explicit dependence on time
- Reference systems

2. Point particle dynamics
- Newton's Laws
- Types of forces: ad hoc, constraint, friction, elastic, damped and forced elastic...
- Linear momentum and impulse
- Moment of a force and angular momentum

3. Work and energy.
- Work
- Power
- Kinetic energy
- Conservative forces and potential energy. Energy conservation
- Non-conservative forces, energy balance.
- Scalar and vector fields

4. Point particle systems
- Center of masses of a particle system

- Kinematics and dynamics of a particle system
- Conservation theorems for a particle system

5. Rigid solid
- Movement of a rigid solid in one plane
- Kinetic energy of rotation
- Moment of inertia, parallel axis theorem
- Statics and dynamics of a rigid solid
- Work and power of rotation
- Physical pendulum

6. Waves
- Wave motion in 1D
- Wave interference, boundary conditions and superposition
- Standing waves on a string
- Normal single-string modes
- Doppler effect

7. Introduction to Thermodynamics
- Thermodynamic systems
- Temperature: principle of equipartition of energy, zero principle of thermodynamics, thermometers and temperature scale
- Thermodynamic state
- Equation of state: diagrams and thermodynamic processes, thermal coefficients

8. First principle of thermodynamics
- Heat: heat capacity, specific heat, latent heat, calorimetry
- Work: pV diagrams
- Internal energy
- First Law of thermodynamics
- Reversible processes in ideal gases

9. Second principle of thermodynamics
- Thermodynamic processes
- Heat machines: heat engine, refrigerating machine and heat pump
- Second law of thermodynamics: Kelvin-Planck statement, Clausius statement, Irreversibility.
- Cycles with ideal gases: Carnot cycle...
- Clausius inequality
- Entropy: TS diagram
- Entropy in processes with ideal gases
- Fundamental equation of thermodynamic

LEARNING ACTIVITIES AND METHODOLOGY

Training activities
Presential activities
AF1: Master Classes (in synchronous on-line format): these are systematic and orderly exposition sessions of the subject's agenda and selected problems are solved in detail to exemplify the implementation of the theoretical contents. Their objective will be that students acquire the specific competences of each subject and/or course.
AF2: Classroom practical classes: in these sessions we work on the applications of the contents of the subjects, including numerical examples, case analysis, data search, directed work, gamma sessions, etc. The aim is to show students how to act on new problems
AF3: Practical laboratory classes and computer practices: the student will carry out supervised experimental or computer work in specialized laboratories in which he/she will put into practice the theoretical knowledge acquired in the different subjects and will learn to work safely in the laboratory.
AF6: Individual and/or small group tutorials: this is a personalized attention to students, in a face-to-face way and where a teacher attends, facilitates and guides one or several students in the training process. They allow the teacher to follow the learning process of each student in a more individualized way.
AF10: Evaluation Tests
Non-presential activities
FY12: Individual Study and Self-Employment: to develop the capacity for self-learning Includes the same activities as group work, but done individually. It also includes personal study (preparing examinations,

further reading, problem solving and exercises) which is essential for autonomous learning.

Methodologies
MD1: Expository method: oral presentations by the teacher supported, if necessary, with computer material (PowerPoint, videos, etc.). They provide the transmission of knowledge and activation of cognitive processes in the student.
MD2: Problem-based learning: development of active learning through problem solving, which confronts students with new situations in which they have to seek information and apply new knowledge to solve problems.
MD3: Project-oriented learning: carrying out projects in a given time to solve a problem or tackle a task by planning, designing and carrying out a series of activities, all based on the development and application of acquired learning and the effective use of resources.
MD4: Cooperative learning: encourages the development of autonomous learning, through collaboration between peers.

ASSESSMENT SYSTEM

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

- A continuous evaluation of the laboratory will be carried out, taking into account the student's participation in the practices and the preparation of reports. The grade obtained for this concept will represent 15% of the final grade of the course. The attendance to the laboratory and the delivery of the reports is compulsory.
- The knowledge, skills and theoretical-practical competences not specific to the laboratory will be evaluated by means of knowledge tests, distributed throughout the course, and delivery of individual or small group works. The mark obtained for these concepts will be 25% of the final mark. In this way, continuous evaluation will contribute 40% to the final mark.
- The rest of the grade (60% of the final qualification) will be obtained by means of a knowledge test at the end of the course. In order to pass the course, the minimum grade for this test must be above 3 (out of 10).

BASIC BIBLIOGRAPHY

- David Halliday, Robert Resnick, Jearl Walker Fundamentals of physics, John Wiley and Sons.

- Francis W Sears, Mark Waldo Zemansky, Hugh D Young, Roger A Freedman Física universitaria / University Physics, Pearson.

- Paul Allen Tipler, Gene Mosca Física para la ciencia y la tecnología / Physics for scientists and engineers , Reverté / W.H. Freeman.

- Raymond A. Serway John W Jewett Física / Physics, Thomson / Paraninfo.

ADDITIONAL BIBLIOGRAPHY

- Douglas C. Giancoli Física : principios con aplicaciones / Physics : principles with applications, Prentice-Hall Hispanoamericana / Pearson Education International .

- Marcelo Alonso, Edward J Finn Física, Pearson Educación.

- Paul G. Hewitt Física conceptual, Addison-Wesley Iberoamericana.

BASIC ELECTRONIC RESOURCES

- University of Colorado . Phet interactive simulation: https://phet.colorado.edu/en/simulations/category/physics

- Walter Fendt . Apps on Physics: https://www.walter-fendt.de/html5/phen/