27203 - Physics

Información del Plan Docente

Academic Year	2017/18
Faculty / School	100 - Facultad de Ciencias
Degree	452 - Degree in Chemistry
ECTS	12.0
Year	1
Semester	Annual
Subject Type	Basic Education
Module	---

1.General information

1.1.Introduction

Physics is a mandatory subject, amounting to 12 ECTS in the first course of the Chemistry Degree, intended to provide students with the basic physical concepts required to understand fundamental issues for Chemistry as well as some of the experimental procedures and equipment which are typically used in a chemistry laboratory. As a general Physics course, it includes notions from Classical Mechanics, Thermodynamics, Electromagnetism and Optics. Sessions at the classroom will be devoted both to explain theory and to solve problems.

At the end of the course, students must:

- Know the fundamental laws of Physics and be able to apply them in real situations.

- Use fluently the language and notation of Physics.

- Be used to solve problems, either in group or individually.

- Be capable of expressing reasoning into mathematical language.

- Be able to analyze problems and assess solutions (orders of magnitude, dimensions, ...)

- Be capable of applying the scientific method, relating results from experiments and observations with model predictions.

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

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2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

The course will be passed with a mark equal or greater than 5.0 at any of the two official calls (in June or in September).

- The grade (C) will be obtained as:

C = 0.1*L+0.9*(P1+P2)/2

being:

L = laboratory mark (from reports or a laboratory exam).

P1 = exam mark for the first half of the subject.

P2 = exam mark for the second half of the subject.

- Alternatively, the grade can be obtained (if the final result is better) as:

C = 0.1*L+0.2*T+0.7*(P1+P2)/2

being:

T = mark for continuous assessment from different works proposed by the professor.

Maximum values of C, L, P1, P2 and T are 10. To apply any formula L must be greater than 3.0 and P1 and P2 greater than 4.5. Each exam includes theory and problems and the mark is the average of those from each part provided they are greater than 3.0.

In February there will be a non-official exam for the first half of the subject (P1).

All marks are conserved along the whole course.

5.Methodology, learning tasks, syllabus and resources

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5.1.Methodological overview

The designed learning process is based on:

- Interactive lecture classes for the whole group and (individual and/or small group) tutorials for activity 1 (see section 5.2) (8 ECTS).
- Problem-based learning and team and individual work for activity 2 (2.2 ECTS)
- Laboratory work and elaboration of reports for activity 3 (0.6 ECTS)
- Case-based learning, search for information from different sources, team and individual work for activity 4 (1.2 ECTS).

5.2.Learning tasks

The following activities are programmed to help students reach the learning outcomes:

ACTIVITY 1: Lecture sessions (80 hours onsite in the classroom) are used to explain the fundamental concepts of Physics, subsequent autonomous work (120 hours) is required to work on such concepts, using personal notes and recommended bibliographic resources.

ACTIVITY 2: Problem-solving activities and case analysis in small groups (30 hours for onsite work in the classroom plus 25 hours of autonomous work).

ACTIVITY 3: Laboratory work to observe physical phenomena (5 sessions x 2 hours each at the Physics Laboratory + 5 hours for autonomous elaboration of reports).

The goals of the laboratory sessions are:

1. Study of damped and driven oscillations and mechanical resonance.
2. Determination of thermal properties: specific heat capacity of metals, fusion latent heat of water.
3. Determination of electrical magnitudes. Verification of Ohm's law. Analysis of resistors in series and in parallel. Measurement of resistivity of different materials.
4. Measurement of the magnetic field created by coils and solenoids. Determination of the horizontal component of the Earth's magnetic field. Measurement of magnetic forces on a current element.
5. Observation of wave properties of light: polarization, interference and diffraction. Verification of Malus' law and characterization of the optical activity in sugar solutions.

ACTIVITY 4: Guided and collaborative assignments in small groups on specific topics (30 hours of autonomous work, including 3 hours for tutorials).

5.3.Syllabus

I. CLASSICAL MECHANICS

1. KINEMATICS. Quantities and units. Velocity and acceleration. Vectors. Relative velocity. Circular motion.

2. FORCES AND NEWTONS'S LAWS. Newton's laws of motion. Examples of forces. Systems of particles. Center of mass. Rotation and moment of a force. Moment of inertia.

3. LINEAR MOMENTUM AND ANGULAR MOMENTUM. Linear momentum of a system of particles and conservation law.

Angular momentum of a system of particles and conservation law.

4. WORK AND KINETIC ENERGY. Work definition. Kinetic energy of a system of particles. Rotational kinetic energy. Collisions.

5. CONSERVATIVE FORCES AND POTENTIAL ENERGY. Potential energy. Principle of conservation of mechanical energy. Force and potential energy: equilibrium points. Central forces. Effective potential energy: the two-body problem.

6. OSCILLATIONS. Simple harmonic oscillator. Energy for the simple harmonic motion. Motion near an equilibrium point. Simple pendulum. Damped and driven oscillations.

II. THERMODYNAMICS

7. STATISTICAL MECHANICS AND THE KINETIC THEORY OF GASES. Microscopic and macroscopic descriptions of an ideal gas. Equation of state for an ideal gas. Definition of temperature. Theorem of equipartition. Distribution of molecular velocities.

8. HEAT AND THE FIRST LAW OF THERMODYNAMICS. Heat. Heat capacity and specific heat capacity. Phase transition and latent heat. Thermal equilibrium. Heat transfer: conduction, convection and radiation. First law of thermodynamics. Internal energy. Heat capacity of solids and gases. Failures of the equipartition theorem: energy quantization.

9. THERMODYNAMIC PROCESSES AND STATE EQUATIONS. Quasi-static processes. Work and *PV* diagram for a gas. Quasi-static adiabatic expansion of an ideal gas. Van der Waals equation. Phase diagrams. Reversible and irreversible processes.

10. THERMODYNAMIC CYCLES AND THE SECOND LAW OF THERMODYNAMICS. Heat engines: second law of thermodynamics. Refrigerators and heat pumps. The Carnot cycle. Other relevant cycles. Entropy definition. Entropy of an ideal gas. Entropy and disorder.

III. ELECTROSTATICS

11. ELECTROSTATIC FIELD. Conservation of the electric charge. Coulomb's law. Electrostatic field. Field calculation for point charges and continuous charge distributions. Gauss's theorem: application examples.

12. ELECTROSTATIC POTENTIAL. Potential difference. Field and potential. Examples of calculation of the electrostatic potential. Electrostatic potential energy. Electric dipoles and motion inside a uniform electric field.

13. DIELECTRICS AND CONDUCTORS. Charge and field for conductors in electrostatic equilibrium. Capacity and capacitors. Storage of electric energy. Capacitor combinations. Polarization: free and bound charges. Polarization vector and displacement vector. Gauss's theorem in a dielectric medium.

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IV. ELECTROMAGNETISM

14. ELECTRIC CURRENT. Current density and intensity. Electrical resistance and Ohm's law. Electric power. Electromotive force and batteries. Resistors in series and in parallel. Instruments for electrical measurements: ammeter and voltmeter. Charge and discharge of a capacitor.

15. MAGNETIC FIELD. Lorentz force on electric charges. Motion of charged particles inside a magnetic field: velocity selector and mass spectrometer. Force on a current element. Torque on a current loop: magnetic dipole moment and the potential energy of a magnetic dipole. The Hall effect.

16. SOURCES OF MAGNETIC FIELD. Field created by moving electric charges. Field created by currents: law of Biot and Savart. Gauss's law for magnetism. Law of Ampère.

17. MAGNETIC INDUCTION. Law of Faraday and law of Lenz. Inductance and RL circuits. Magnetic energy. Generation of alternating current.

18. MAGNETIC PROPERTIES OF MATERIALS. Atomic magnetic moment. Magnetization and magnetic susceptibility. Paramagnetism. Ferromagnetism. Diamagnetism.

19. ELECTROMAGNETIC FIELD AND ELECTROMAGNETIC WAVES. Displacement current. Maxwell's equations. Wave equation. Plane and spherical electromagnetic waves. Energy of an electromagnetic wave and the Poynting vector. Electromagnetic spectrum.

V. OPTICS

20. LIGHT: PROPAGATION IN ISOTROPIC MEDIA. The nature of light. Light propagation: wavefront and Huygens's principle. Reflection and refraction: Snell's law, total internal reflection, continuous refractions and mirages. Absorption, dispersion and diffusion.

21. POLARIZATION OF LIGHT. PROPAGATION IN ANISOTROPIC MEDIA. Polarization of a wave. Polarization by absorption and by reflection. Light propagation in anisotropic media. Birefringence. Optical activity.

22. INTERFERENCE AND DIFFRACTION. Phase difference and coherence. Interference between light waves. Interference pattern from two slits. Diffraction pattern from one slit. Fraunhofer and Fresnel diffraction. Diffraction and resolution. Diffraction gratings: spectroscope and X-ray diffraction.

23. FORMATION OF OPTICAL IMAGES (GEOMETRICAL OPTICS). Formation of images at the paraxial approximation: definitions and rules, the Abbe invariant, focuses and focal planes. Thin lenses. The human eye.

5.4.Course planning and calendar

For further details concerning the timetable, the classroom assigned for the lectures and further information regarding this course, please refer to the "Facultad de Ciencias" website (https://ciencias.unizar.es/node/7073).

Practical sessions

There will be five laboratory sessions (two hours each) during the course:

1. Driven oscillations. Mechanical resonance (in November)
2. Measurement of thermal properties of materials (in December)
3. Measurement of electrical quantities (in March)
4. Measurement of magnetic fields and effects of magnetic fields on conductors (in April)
5. Observation of wave properties of light: polarization, interference and diffraction (in May)

Particular dates for each session and distributions of groups will be announced well in advance.

5.5.Bibliography and recommended resources

BB	Serway, Raymond A. Física / Raymond A. Serway, John W. Jewett, Jr. ; revisión técnica, José García Solé, Francisco Jaque Rechea. - 3ª ed. Madrid [etc.] : Thomson : Paraninfo, D.L. 2003
BB	Serway, Raymond A. Física para ciencias e ingenierías / Raymond A. Serway, John W. Jewett, Jr. . 6ª ed. México [etc.] : Thomson, cop. 2004
BB	Tipler, Paul A.. Física para la ciencia y la tecnología. Vol. 1, Mecánica , oscilaciones y ondas, termodinámica / Paul A. Tipler , Gene Mosca; [coordinador y traductor, José Casas-Vázquez; traductores, Albert Bramon Planas...[et al.]]. 6ª ed. Barcelona [etc.] : Reverté, 2010
BB	Tipler, Paul A.. Física para la ciencia y la tecnología. Vol. 2, Electricidad y magnetismo, luz / Paul A. Tipler, Gene Mosca; [coordinador y traductor, José Casas-Vázquez; traductores, Albert Bramon Planas...[et al.]]. 6ª ed. Barcelona [etc.] : Reverté, 2010
BB	Young, Hugh D. Física universitaria con física moderna. Volumen 2 / Hugh D. Young, Roger A. Freedman ; con la colaboración de A. Lewis Ford ; traducción Javier Enríquez Brito. - 12ª ed. México [etc.] : Pearson, 2009

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BB	Young, Hugh D. Física universitaria. Volumen 1 / Hugh D. Young, Roger A. Freedman ; con la colaboración de A. Lewis Ford ; traducción Victoria A. Flores Flores. - 12ª ed. México [etc.] : Pearson, 2009
BC	Ablanque, L. [et al.]. Laboratorio de Física con soporte interactivo en Moodle Pearson Educación (2010)
BC	Alonso, Marcelo. Física / Marcelo Alonso, Edward J. Finn ; versión en español de Homero Flores Samaniego México : Addison-Wesley Iberoamericana, cop. 2000
BC	Burbano de Ercilla, Santiago. Física general / Santiago Burbano de Ercilla, Enrique Burbano García, Carlos Gracia Muñoz . - 32ª ed. Madrid : Tébar, D.L. 2003
BC	Gettys, W. Edward. Física clásica y moderna / W. Edward Gettys, Frederick J. Keller, Malcolm J. Skove ; traducción Luis Arizmendi López...[et al.] Madrid [etc] : McGraw-Hill, D.L.1992
BC	Spiegel, Murray R.. Manual de fórmulas y tablas matemáticas : 2400 fórmulas y 60 tablas / Murray R. Spiegel ; traducción y adaptación Orlando Guerrero Ribero . - [1a ed. reimp.] Madrid [etc] : McGraw-Hill, D.L.1995