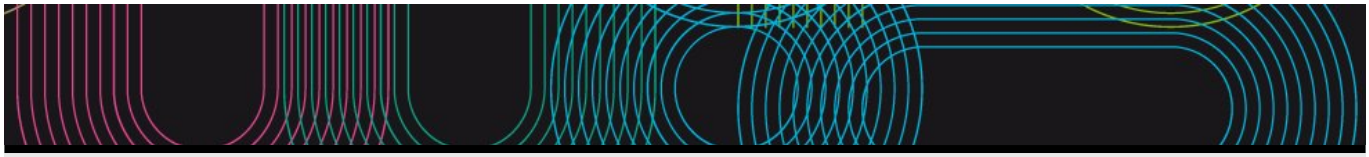

IDENTIFYING DATA				
Physics: Physics 2				
Subject	Physics: Physics 2			
Code	V12G320V01202			
Study programme	Grado en Ingeniería Eléctrica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Fernández Fernández, José Luís			
Lecturers	Añel Cabanelas, Juan Antonio Blanco García, Jesús Cabaleiro Álvarez, David Fernández Fernández, José Luís Hermida Merino, Daniel Lusquiños Rodríguez, Fernando Paredes Galán, Ángel Quintero Martínez, Félix Ribas Pérez, Fernando Agustín Salgueiriño Maceira, Verónica Soto Costas, Ramón Francisco Varela Benvenuto, Ramiro Alberto Vázquez Besteiro, Lucas			
E-mail	jlfdez@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	This undergraduate course is the second quarter of introductory physics. The focus is on electricity, magnetism and thermodynamics			

Training and Learning Results	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
C2	CE2 Understanding and mastering the basics of the general laws of mechanics, thermodynamics, waves and electromagnetic fields, as well as their application for solving engineering problems.
D2	CT2 Problems resolution.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.

Expected results from this subject	Training and Learning Results		
Understanding the basic concepts of electromagnetism and thermodynamics.	B3	C2	
Knowing the basic instruments for the measurement of physical quantities.		C2	
Knowing the basic techniques for experimental data evaluation.	B3	C2	D9 D10
Ability to develop practical solutions to basic technical problems in engineering, within the framework of electromagnetism and thermodynamics.	B3	C2	D2 D9 D10

Contents
Topic

1.- ELECTRIC CHARGE AND ELECTRIC FIELD	1.1.- Electric Charge. 1.2.- Conductors, Insulators and Induced Charges. 1.3.- Coulomb's Law. 1.4.- Electric Field and Electric Forces. 1.5.- Electric Field Calculations. 1.6.- Electric Field Lines. 1.7.- Electric Dipoles.
2.- GAUSS'S LAW	2.1.- Charge and Electric Flux. 2.2.- Calculating Electric Flux. 2.3.- Gauss's Law. 2.4.- Applications of Gauss's Law. 2.5.- Conductors in Electrostatic Equilibrium.
3.- ELECTRIC POTENTIAL	3.1.- Electric Potential Energy. 3.2.- Electric Potential. 3.3.- Calculating Electric Potential. 3.4.- Equipotential Surfaces. 3.5.- Potential Gradient.
4.- CAPACITANCE AND DIELECTRICS	4.1.- Capacitors and Capacitance. 4.2.- Capacitors in Series and Parallel. 4.3.- Energy Storage in Capacitors and Electric-Field Energy. 4.4.- Dielectrics, Molecular Model of Induced Charge, and Polarization Vector. 4.5.- Gauss's Law in Dielectrics. 4.6.- Dielectric Constant and Permittivity.
5.- CURRENT, RESISTANCE, AND ELECTROMOTIVE FORCE	5.1.- Electric Current. 5.2.- Current and Current Density. 5.3.- Ohm's Law and Resistance. 5.4.- Electromotive Force and Circuits. 5.5.- Energy and Power in Electrical Circuits. 5.6.- Basic Theory of Electrical Conduction.
6.- MAGNETIC FIELD	6.1.- Magnetic Field. 6.2.- Motion of Charged Particles in a Magnetic Field. 6.3.- Magnetic Force on a Current-Carrying Conductor. 6.4.- Force and Torque on a Current Loop. 6.5.- Biot-Savart's Law. 6.6.- Magnetic Field Lines and Magnetic Flux. 6.7.- Ampère's Law.
7.- MAGNETIC FIELD IN MATTER	7.1.- Magnetic Substances and Magnetization Vector. 7.2.- Ampère's Law in Magnetic Media. 7.3.- Magnetic Susceptibility and Permeability. 7.4.- Paramagnetism and Diamagnetism. 7.5.- Ferromagnetism.
8.- ELECTROMAGNETIC INDUCTION	8.1.- Induction Experiments. 8.2.- Faraday-Lenz's Law. 8.3.- Induced Electric Fields. 8.4.- Eddy Currents. 8.5.- Mutual Inductance. 8.6.- Self-Inductance and Inductors. 8.7.- Magnetic-Field Energy.
9.- THERMODYNAMIC SYSTEMS	9.1.- Classical Thermodynamics. 9.2.- Thermodynamic Systems and Classification. 9.3.- State Variables and State of a System. 9.4.- Equations of State. 9.5.- Thermodynamic Equilibrium. 9.6.- Change of State, Transformation or Process. 9.7.- Quasi-static Processes. 9.8.- State and Process Functions.
10.- TEMPERATURE AND HEAT	10.1.- Thermal Equilibrium, The Zeroth Law of Thermodynamics, and Temperature. 10.2.- Thermometers and Temperature Scales. 10.3.- Ideal Gas Thermometers and the Kelvin Scale. 10.4.- Heat. 10.5.- Calorimetry and Heat Capacities.

11.- THE FIRST LAW OF THERMODYNAMICS	11.1.- Work. 11.2.- Work Done During Volume Changes. 11.3.- Internal Energy. 11.4.- The First Law of Thermodynamics. 11.5.- Internal Energy of an Ideal Gas. 11.6.- Molar Heat Capacities of an Ideal Gas. 11.7.- Adiabatic, Isothermal, Isobaric and Isochoric Processes for an Ideal Gas. 11.8.- Enthalpy.
12.- THE SECOND LAW OF THERMODYNAMICS	12.1.- Directions of Thermodynamic Processes. 12.2.- Heat Engines, Refrigerators, and Heat Pumps. 12.3.- The Second Law of Thermodynamics: Clausius and Kelvin-Planck Statements. 12.4.- Carnot Engine. 12.5.- Carnot Theorems. 12.6.- Thermodynamic Temperature. 12.7.- Entropy. 12.8.- Increase of Entropy Principle. 12.9.- Entropy Change of an Ideal Gas.
LABORATORY	1.- How to Use a Multimeter. Ohm's Law. Direct Current. Circuit with Resistors. 2.- Linear and Non-Linear Conductors. 3.- Charge and Discharge of a Capacitor. 4.- Analysis of a Parallel Plate Capacitor with Dielectrics. 5.- Utilization of an Oscilloscope to Analyze Charge and Discharge Processes. 6.- Study of the Magnetic Field. Helmholtz Coils. Magnetic Moment. Hall Effect. 7.- Calorimetry. Water Equivalent of Calorimeter. Latent Heat of Fusion. 8.- Thermodynamics of the Ideal Gas. Heat Capacity Ratio. Adiabatic Work.
LABORATORY: UNSTRUCTURED ACTIVITY (OPEN LAB) SESSIONS	Unstructured activity (open lab) sessions that cover the topics of the above cited regular laboratory sessions. A practical problem will be assigned to each team. Then, under the teacher's supervision, each team must analyse the problem, select a theoretical model and experimental means to obtain a solution.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24.5	45	69.5
Problem solving	8	20	28
Laboratory practical	18	18	36
Objective questions exam	1	0	1
Problem and/or exercise solving	3.5	0	3.5
Essay questions exam	3	0	3
Report of practices, practicum and external practices	0	9	9

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Lectures are given by the teacher on the contents of the subject, theoretical bases and / or guidelines of a work, exercise or project to be performed by the students.
Problem solving	Activity in which problems and / or exercises related to the subject are formulated. The student must develop the appropriate or correct solutions through the repetition of routines, the application of formulas or algorithms, the application of procedures for transforming the available information and the interpretation of the results. It is usually used as a complement to the lecture sessions.
Laboratory practical	Activities for applying the knowledge to particular situations and for the acquisition of basic and procedural skills related to the subject. They are developed in dedicated rooms with specialized equipment (laboratories, computer rooms, etc.).

Personalized assistance

Methodologies	Description
Lecturing	In office hours.
Laboratory practical	In office hours.
Problem solving	In office hours.

Tests	Description
Objective questions exam	In office hours.
Problem and/or exercise solving	In office hours.
Essay questions exam	In office hours.
Report of practices, practicum and external practices	In office hours.

Assessment

	Description	Qualification	Training and Learning Results
Objective questions exam	Tests for the assessment of acquired knowledge that include closed questions with different response options (true/false, multiple choice, matching of elements...). Students select a response among a limited number of choices.	10	B3 C2
Problem and/or exercise solving	Test in which the student must solve a series of problems and / or exercises in a time / conditions set by the teacher. In this way, the student should apply the acquired knowledge.	50	B3 C2 D2
Essay questions exam	Tests that include open questions on a topic. Students should develop, relate, organize and present knowledge on the subject in an argued response.	30	B3 C2
Report of practices, practicum and external practices	Preparation of a report by the students which reflects the characteristics of the work that has been carried out. Students must describe the developed tasks and procedures, show the results or observations made, as well as the data analysis and processing.	10	B3 C2 D9 D10

Other comments on the Evaluation

1. CONTINUOUS ASSESSMENT (EC)

Continuous assessment (denoted EC) comprises the mark ECA on the topics covered in the lectures, with a weight of 80% in the final mark, and the mark ECL on the laboratory topics, with a weight of 20% in the final mark: EC = ECA (80%) + ECL (20%).

In the ordinary exam, the mark ECA will be evaluated by means of tests to be taken during the course, with a weight of 40% in the final mark (mark ECC1), and a final test, with a weight of 40% in the final mark (mark ECF1). The mark scheme for the extraordinary exam will be the same as for the ordinary one so that it will comprise two tests, ECC2 and ECF2, equivalent in content and evaluation methodology (objective questions, essay questions and problem solving) to ECC1 and ECF1, respectively.

The mark ECL will be evaluated by means of practices reports, with a weight of 10% in the final mark (mark ECLI), and tests, with a weight of 10% in the final mark (mark ECLE). It is mandatory the attendance to all lab sessions to obtain the mark ECL, otherwise, the mark ECL will be 0.0.

Final mark EC for the continuous assessment modality:

- Ordinary exam: EC = ECC1 (40%) + ECF1 (40%) + ECLI (10%) + ECLE (10%).

- Extraordinary exam: EC = ECC2 (40%) + ECF2 (40%) + ECLI (10%) + ECLE (10%).

In the extraordinary exam, a student who has previously obtained marks ECC1 or EFC1 (or both) can choose between: a) answering the exam(s) corresponding to mark ECC2 and/or mark EFC2, in such a way that the new mark ECC2 replaces ECC1 and/or the new mark ECF2 replaces ECF1, and b) maintaining mark ECC1 and/or mark ECF1 instead of taking the exam(s) corresponding to mark ECC2 and/or mark ECF2, respectively.

2. GLOBAL ASSESSMENT (EG)

Those students who have been granted the waiver of the continuous assessment have the possibility of taking a written global test to obtain a mark EG with a weight of 100% of the final mark. This test will include the following parts: a test on topics covered in the lectures, with a weight of 80% in the final mark (mark denoted EGA1 in the ordinary exam and EGA2 in the extraordinary exam), and a test on laboratory topics, with a weight of 20% in the final mark (mark denoted EGL1 in the ordinary exam and EGL2 in the extraordinary exam).

Final mark EG for the global assessment modality:

- Ordinary exam: EG = EGA1 (80%) + EGL1 (20%).

- Extraordinary exam: EG = EGA2 (80%) + EGL2 (20%).

In the extraordinary exam, a student who has previously obtained marks EGA1 or EGL1 (or both) can choose between: a) answering the exam(s) corresponding to mark EGA2 and/or mark EGL2, in such a way that the new mark EGA2 replaces EGA1 and/or the new mark EGL2 replaces EGL1, and b) maintaining mark EGA1 and/or mark EGL1 instead of taking the exam(s) corresponding to mark EGA2 and/or mark EGL2, respectively.

3. END-OF-PROGRAM EXAM (FC)

The end-of-program exam follows the same scheme as the global assessment EG.

Final mark FC for the end-of-program exam:

FC = FCA (80%) + FCL (20%).

4. GENERAL RULES

To pass the course, a student must obtain a final mark equal to or higher than 5 (out of 10).

Within the specifications detailed in the preceding sections, the tests and exams may consist of different variants within the same classroom or laboratory group.

Ethical commitment: Every student is expected to behave in an appropriate ethical manner. Should unethical conduct be detected (copying, plagiarism, utilisation of unauthorised electronic devices, or others), the student will be considered not to have fulfilled the necessary requirements to pass the subject. In this case, the final mark in the corresponding edition of the academic record for the subject will be "suspenso" (0.0).

Students should not have access to or use any electronic device during the tests and exams, unless specifically authorised. The mere fact of taking an unauthorised electronic device into the examination room will result in the student failing the subject and the final mark in the corresponding edition of the academic record for the subject will be "suspenso" (0.0).

Sources of information

Basic Bibliography

1. Young H. D., Freedman R. A., **Física Universitaria, V1 y V2**, 13ª ed., Pearson,

1en. Young H. D., Freedman R. A, **University physics: with modern physics**, 14th ed., Pearson,

Complementary Bibliography

2. Tipler P., Mosca G., **Física para la ciencia y la tecnología, V1 y V2**, 5ª ed., Reverté,

2en. Tipler P., Mosca G, **Physics for Scientists and Engineers, V1 and V2**, 6th ed., W. H. Freeman and Company,

3. Serway R. A., Jewett J. W, **Física para ciencias e ingeniería, V1 y V2**, 9ª ed., Cengage Learning,

3en. Serway R. A., Jewett J. W, **Physics for Scientists and Engineers**, 9th ed., Brooks/Cole,

4. Juana Sardón, J. M., **Física general, V1 y V2**, 2ª ed., Pearson Prentice-Hall,

5. Bronshtein, I., Semendiaev, K., **Manual de matemáticas para ingenieros y estudiantes**, 4ªed., MIR 1982; MIR-Rubiños 1993,

5en. Bronshtein, I., Semendiaev, K., **Handbook of Mathematics**, 5th Ed., Springer Berlin,

6. Jou Mirabent, D., Pérez García, C., Llebot Rabagliati, J. E., **Física para ciencias de la vida**, 2ª ed., McGraw-Hill Interamericana de España S.L.,

7. Cussó Pérez, F., López Martínez, C., Villar Lázaro, R., **Fundamentos Físicos de los Procesos Biológicos**, 1ª ed., ECU,

8. Cussó Pérez, F., López Martínez, C., Villar Lázaro, R., **Fundamentos Físicos de los Procesos Biológicos, Volumen II**, 1ª ed., ECU,

9. Villar Lázaro, R, López Martínez, C., Cussó Pérez, F., **Fundamentos Físicos de los Procesos Biológicos, Volumen III**, 1ª ed., ECU,

10en. Villars, F., Benedek, G. B., **Physics with Illustrative Examples from Medicine and Biology**, 2nd ed., AIP Press/Springer-Verlag,

Recommendations

Other comments

Basic recommendations:
1. Basic knowledge acquired in the subjects of Physics and Mathematics in previous courses.
2. Oral and written comprehension.
3. Capacity for abstraction, basic calculus, and synthesis of information.
4. Skills for group work and communication.

In the event of discrepancy, the Spanish version of this syllabus prevails.