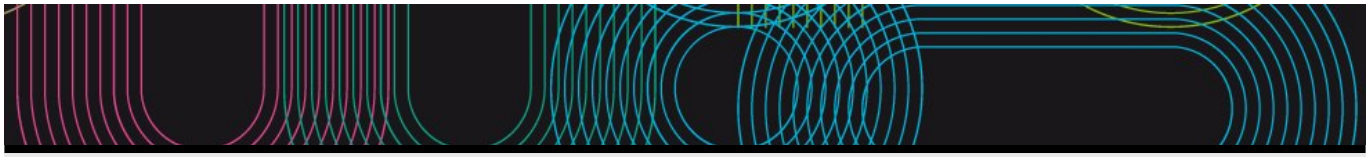

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Physics: Physics II** | | | | |
| Subject | Physics: Physics II | | | |
| Code | V12G750V01106 | | | |
| Study programme | PCEO Grado en Ingeniería Biomédica/Grado en Ingeniería Mecánica | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Basic education | 1st | 2nd |
| Teaching language | Spanish | | | |
| Department | | | | |
| Coordinator | Fernández Fernández, José Luís | | | |
| Lecturers | Añel Cabanelas, Juan Antonio<br>Blanco García, Jesús<br>Cabaleiro Álvarez, David<br>Fernández Fernández, José Luís<br>Hermida Merino, Daniel<br>López Vázquez, José Carlos<br>Lugo Latas, Luis<br>Lusquiños Rodríguez, Fernando<br>Paredes Galán, Ángel<br>Pérez Rodríguez, Martín<br>Quintero Martínez, Félix<br>Ribas Pérez, Fernando Agustín<br>Sánchez Carnero, Noela Belén<br>Soto Costas, Ramón Francisco<br>Varela Benvenuto, Ramiro Alberto | | | |
| 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 | | | |

| Skills |
|---|
| Code |

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

| Contents | |
|---|---|
| Topic | |
| 1.- ELECTRIC CHARGE AND ELECTRIC FIELD | 1.1.- Electric Charge.<br>1.2.- Conductors, Insulators and Induced Charges.<br>1.3.- Coulomb□s Law.<br>1.4.- Electric Field and Electric Forces.<br>1.5.- Electric Field Calculations.<br>1.6.- Electric Field Lines.<br>1.7.- Electric Dipoles. |

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|---|---|
| 2.- GAUSS'S LAW | 2.1.- Charge and Electric Flux.<br>2.2.- Calculating Electric Flux.<br>2.3.- Gauss's Law.<br>2.4.- Applications of Gauss's Law.<br>2.5.- Conductors in Electrostatic Equilibrium. |
| 3.- ELECTRIC POTENTIAL | 3.1.- Electric Potential Energy.<br>3.2.- Electric Potential.<br>3.3.- Calculating Electric Potential.<br>3.4.- Equipotential Surfaces.<br>3.5.- Potential Gradient. |
| 4.- CAPACITANCE AND DIELECTRICS | 4.1.- Capacitors and Capacitance.<br>4.2.- Capacitors in Series and Parallel.<br>4.3.- Energy Storage in Capacitors and Electric-Field Energy.<br>4.4.- Dielectrics, Molecular Model of Induced Charge, and Polarization Vector.<br>4.5.- Gauss's Law in Dielectrics.<br>4.6.- Dielectric Constant and Permittivity. |
| 5.- CURRENT, RESISTANCE, AND ELECTROMOTIVE FORCE | 5.1.- Electric Current.<br>5.2.- Current and Current Density.<br>5.3.- Ohm□s Law and Resistance.<br>5.4.- Electromotive Force and Circuits.<br>5.5.- Energy and Power in Electrical Circuits.<br>5.6.- Basic Theory of Electrical Conduction. |
| 6.- MAGNETIC FIELD | 6.1.- Magnetic Field.<br>6.2.- Motion of Charged Particles in a Magnetic Field.<br>6.3.- Magnetic Force on a Current-Carrying Conductor.<br>6.4.- Force and Torque on a Current Loop.<br>6.5.- Biot-Savart□s Law.<br>6.6.- Magnetic Field Lines and Magnetic Flux.<br>6.7.- Ampère□s Law. |
| 7.- MAGNETIC FIELD IN MATTER | 7.1.- Magnetic Substances and Magnetization Vector.<br>7.2.- Ampère□s Law in Magnetic Media.<br>7.3.- Magnetic Susceptibility and Permeability.<br>7.4.- Paramagnetism and Diamagnetism.<br>7.5.- Ferromagnetism. |
| 8.- ELECTROMAGNETIC INDUCTION | 8.1.- Induction Experiments.<br>8.2.- Faraday-Lenz's Law.<br>8.3.- Induced Electric Fields.<br>8.4.- Eddy Currents.<br>8.5.- Mutual Inductance.<br>8.6.- Self-Inductance and Inductors.<br>8.7.- Magnetic-Field Energy. |
| 9.- THERMODYNAMIC SYSTEMS | 9.1.- Classical Thermodynamics.<br>9.2.- Thermodynamic Systems and Classification.<br>9.3.- State Variables and State of a System.<br>9.4.- Equations of State.<br>9.5.- Thermodynamic Equilibrium.<br>9.6.- Change of State, Transformation or Process.<br>9.7.- Quasi-static Processes.<br>9.8.- State and Process Functions. |
| 10.- TEMPERATURE AND HEAT | 10.1.- Thermal Equilibrium, The Zeroth Law of Thermodynamics, and Temperature.<br>10.2.- Thermometers and Temperature Scales.<br>10.3.- Ideal Gas Thermometers and the Kelvin Scale.<br>10.4.- Heat.<br>10.5.- Calorimetry and Heat Capacities. |
| 11.- THE FIRST LAW OF THERMODYNAMICS | 11.1.- Work.<br>11.2.- Work Done During Volume Changes.<br>11.3.- Internal Energy.<br>11.4.- The First Law of Thermodynamics.<br>11.5.- Internal Energy of an Ideal Gas.<br>11.6.- Molar Heat Capacities of an Ideal Gas.<br>11.7.- Adiabatic, Isothermal, Isobaric and Isochoric Processes for an Ideal Gas.<br>11.8.- Enthalpy. |

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|---|---|
| 12.- THE SECOND LAW OF THERMODYNAMICS | 12.1.- Directions of Thermodynamic Processes.<br>12.2.- Heat Engines, Refrigerators, and Heat Pumps.<br>12.3.- The Second Law of Thermodynamics: Clausius and Kelvin-Planck Statements.<br>12.4.- Carnot Engine.<br>12.5.- Carnot Theorems.<br>12.6.- Thermodynamic Temperature.<br>12.7.- Entropy.<br>12.8.- Increase of Entropy Principle.<br>12.9.- Entropy Change of an Ideal Gas. |
| LABORATORY | 1.- How to Use a Multimeter. Ohm's Law. Direct Current. Circuit with Resistors.<br>2.- Linear and Non-Linear Conductors.<br>3.- Charge and Discharge of a Capacitor.<br>4.- Analysis of a Parallel Plate Capacitor with Dielectrics.<br>5.- Utilization of an Oscilloscope to Analyze Charge and Discharge Processes.<br>6.- Study of the Magnetic Field. Helmholtz Coils. Magnetic Moment. Hall Effect.<br>7.- Calorimetry. Water Equivalent of Calorimeter. Latent Heat of Fusion.<br>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 | |
| 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. | 40 | |
| 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. | 40 | |
| 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 | |

**Other comments on the Evaluation**

Continuous assessment (denoted EC) will have a weight of 40% in the final mark, and will include the lab mark (20%, denoted ECL) and the class mark (20%, denoted ECA).

The mark ECA will be evaluated by means of tests on the topics covered in the lectures. These tests will comprise objective questions and/or essay questions.

The mark ECL will be evaluated by the lab reports and tests on the topics covered in the laboratory sessions.

Those students unable to attend the continuous assessment and who have been granted the waiver of the continuous assessment have the possibility of taking a final test to obtain a REC mark with a weight of 40% of the final mark. This test will include the contents of the lab sessions (weight of 20%, denoted RECL) and the topics covered in the lectures (weight of 20%, denoted RECA).

The remaining 60% of the final mark will be obtained by taking a final exam. This will consist of two parts: a theoretical part (denoted T) with a weight of 20% of the final mark, and another part on problem solving (denoted P) with a weight of 40% of the final mark. The theoretical part will consist of a test comprising objective questions and/or essay questions. Those students not attending the final exam will obtain a mark of non-presented.

Both the "fin de carrera" exam and any other ones held on dates and/or times different from those officially set by the School of Industrial Engineering (E.E.I.), could have an exam format different from the one previously described, although each part of the exam (EC or REC, T and P) will hold its weight in the final mark.

Final mark G for the continuous assessment modality:

G = ECL + ECA + T + P.

Final mark G for the assessment at the end of the course and July (RECL and RECA only for those students who have been granted the waiver of the continuous assessment):

G = ECL (or RECL) + ECA (or RECA) + T + P.

To pass the course, a student must obtain a final mark G equal to or higher than 5.

Ethical commitment: Every student is expected to follow an appropriate ethical behaviour. In the case that unethical conduct is detected (copy, plagiarism, utilisation of unauthorised electronic devices, or others), it will be considered that the student does not fulfil the necessary requirements to pass the subject. In this case, the final mark in the present academic year will be "suspenso" (0.0).

Students should not possess or use any electronic device during the tests and exams, unless specifically authorised to do so. The mere fact that a student carries an unauthorised electronic device into the examination room will result in failing the subject in the present academic year and the final mark 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.