



## IDENTIFYING DATA

### (\*)Física: Física I

|                     |   |                 |      |            |
|---------------------|---|-----------------|------|------------|
| Subject             | (*)Física: Física I   |                 |      |            |
| Code                | V12G350V01102   |                 |      |            |
| Study programme     | Grado en Ingeniería en Química Industrial   |                 |      |            |
| Descriptors         | ECTS Credits  | Choose          | Year | Quadmester |
|                     | 6   | Basic education | 1st  | 1st        |
| Teaching language   | Spanish<br>Galician   |                 |      |            |
| Department          |   |                 |      |            |
| Coordinator         | Lusquiños Rodríguez, Fernando   |                 |      |            |
| Lecturers           | Añel Cabanelas, Juan Antonio<br>Barro Guizán, Óscar<br>Blanco García, Jesús<br>Boutinguiza Larosi, Mohamed<br>Fernández Arias, Mónica<br>Lusquiños Rodríguez, Fernando<br>Pou Álvarez, Pablo<br>Ribas Pérez, Fernando Agustín<br>Serra Rodríguez, Julia Asunción<br>Soto Costas, Ramón Francisco<br>Trillo Yáñez, María Cristina<br>Varela Benvenuto, Ramiro Alberto<br>Vázquez Besteiro, Lucas |                 |      |            |
| E-mail              | flusqui@uvigo.es  |                 |      |            |
| Web                 | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>   |                 |      |            |
| General description | Physics course for 1st year bachelor degrees  |                 |      |            |

## 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

| Expected results from this subject  | Training and Learning Results |    |                 |
|---|-------------------------------|----|-----------------|
| (*)FB2a. Comprensión y dominio de los conceptos básicos sobre las leyes generales de la mecánica y campos y ondas y su aplicación para la resolución de problemas propios de la ingeniería. | B3                            | C2 |                 |
| (*)CG3. Conocimiento en materias básicas y tecnológicas, que les capacite para el aprendizaje de nuevos métodos y teorías, y les dote de versatilidad para adaptarse a nuevas situaciones.  |                               |    | C2              |
| (*)CS2. Aprendizaje y trabajo autónomos.  | B3                            | C2 | D9<br>D10       |
| New   | B3                            | C2 | D2<br>D9<br>D10 |

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**Contents**

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**Topic**

|  |   |
|--|---|
| 1.- UNITS, PHYSICAL QUANTITIES AND VECTORS | 1.1.- The nature of Physics.<br>1.2.- Consistency and conversions of units.<br>1.3.- Uncertainty and significant figures.<br>1.4.- Estimates and orders of magnitude.<br>1.5.- Vectors and sum of vectors.<br>1.6.- Vector components.<br>1.7.- Unitary vectors.<br>1.8.- Vector products.<br>1.9.- Sliding Vectors   |
| 2.- KINEMATICS                             | 2.1.- Position, speed and acceleration vectors. Average and instantaneous values.<br>2.2.- Angular speed and angular acceleration. Average and instantaneous values.<br>2.3.- Relation between linear kinematic magnitudes and angular magnitudes.<br>2.4.- Intrinsic components.<br>2.5.- Study of simple movements: linear motion in 1D, circular motion, projectile motion.<br>2.6.- Expression of kinematic magnitudes in cartesian and polar coordinates   |
| 3.- NEWTON'S LAWS OF MOTION                | 3.1.- Force and interactions.<br>3.2.- Newton's first law. Inertial and non-inertial reference systems.<br>3.3.- Newton's second law.<br>3.4.- Mass and weight.<br>3.5.- Newton's third law.<br>3.6.- Momentum. Mechanical impulse. Angular momentum.<br>3.7.- Contact forces.  |
| 4.- WORK AND KINETIC ENERGY                | 4.1.- Work done by a force. Power.<br>4.2.- Kinetic energy.<br>4.3.- Conservative Forces<br>4.4.- Elastic potential energy.<br>4.5.- Potential energy in the gravitatory field.<br>4.6.- Mechanical energy.<br>4.7.- Force and potential energy.<br>4.8.- Principle of conservation of mechanical energy.   |
| 5.- KINEMATICS OF SYSTEM OF PARTICLES      | 5.1.- System of particles.<br>5.2.- Rigid body.<br>5.3.- Translation movement.<br>5.4.- Movement of rotation around a fixed axis.<br>5.5.- General movement.<br>5.6.- Instantaneous center of rotation.<br>5.7.- Rolling motion.<br>5.8.- Relative movement.  |
| 6.- DYNAMICS OF SYSTEMS OF PARTICLES       | 6.1.- Systems of particles. Internal and external forces.<br>6.2.- Centre of mass. Movement of the centre of mass.<br>6.3.- Equations of the movement of a system of particles.<br>6.4.- Linear momentum. Conservation of linear momentum.<br>6.5.- Angular moment of a system of particles. Conservation of angular momentum.<br>6.6.- Work and power.<br>6.7.- Potential energy and kinetics of a system of particles.<br>6.8.- Conservation of energy of a system of particles.<br>6.9.- Collisions. |
| 7.- RIGID BODY DYNAMICS                    | 7.1.- Rotation of a rigid body around a fixed axis.<br>7.2.- Moments and products of inertia.<br>7.3.- Calculation of moments of inertia.<br>7.4.- Steiner's theorem.<br>7.5.- Moment of a force and pair of forces.<br>7.6.- Equations of the general movement of a rigid body.<br>7.7.- Kinetic energy in the general movement of a rigid body.<br>7.8.- Work in the general movement of a rigid body.<br>7.9.- Angular momentum of a rigid body. Conservation theorem.                               |
| 8.- STATICS                                | 8.1.- Equilibrium of rigid bodies.<br>8.2.- Center of gravity.<br>8.3.- Stability.<br>8.4.- Degrees of freedom and links  |

|                          |   |
|--------------------------|---|
| 9.- PERIODIC MOTION      | 9.1.- Description of the oscillation.<br>9.2.- Simple harmonic motion.<br>9.3.- Energy in the simple harmonic motion.<br>9.4.- Applications of simple harmonic motion.<br>9.5.- The simple pendulum.<br>9.6.- The physical pendulum.<br>9.7.- Damped oscillations.<br>9.8.- Forced oscillations and resonance.  |
| 10.- FLUID MECHANICS     | 10.1.- Density.<br>10.2.- Pressure in a fluid.<br>10.3.- Fundamental principles of fluidostatics.<br>10.4.- Continuity equation.<br>10.5.- Bernoulli equation.  |
| 11.- MECHANICAL WAVES    | 11.1.- Types of mechanical waves.<br>11.2.- Periodic waves.<br>11.3.- Mathematical description of a wave.<br>11.4.- Speed of a transverse wave.<br>11.5.- Energy of the wave movement.<br>11.6.- Wave interference, boundary conditions and superposition.<br>11.7.- Stationary waves on a string.<br>11.8.- Normal modes of a rope.  |
| LABORATORY               | 1.- Theory of Measurements, Errors, Graphs and Fittings. Examples.<br>2.- Reaction Time.<br>3.- Determination of the density of a body.<br>4.- Relative Movement.<br>5.- Instantaneous speed.<br>6.- Study of the Simple Pendulum.<br>7.- Experiences with a helical spring.<br>8.- Damped and forced oscillations.<br>9.- Moments of inertia. Determination of the radius of rotation of a body.<br>10.- Stationary waves. |
| LABORATORY NO STRUCTURED | 1. Sessions with no structured activities (open practice) from the theoretical contents of the practices enumerated above. The groups of students shall resolve a practical problem proposed by the professor, selecting the theoretical frame and experimental tools to obtain the solution; for this, they will have basic information and the guide of the professor.  |

## 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            | Explanation by the professor of the contents of the subject, theoretical bases and/or guidelines of a work, exercise or project to be developed by the student.  |
| Problem solving      | Problems and/or exercises related to the subject are formulated. The student has to arrive to the correct solution by application of routines, formulas or algorithms, procedures of transformation of the available information and the interpretation of the results. It is usually employed to complement the lectures. |
| Laboratory practical | Activities to apply the knowledge to specific situations and to acquire basic skills and procedures related with the subject. They are developed in special spaces 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    |
| <b>Tests</b>  | <b>Description</b> |
| 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    |

| <b>Assessment</b>                                     |   | Qualification | Training and Learning Results |           |
|---|---|---------------|-------------------------------|-----------|
|   | Description   |               |                               |           |
| Objective questions exam                              | Tests for evaluating the acquired competences that include closed questions with different answer alternatives (true / false, multiple choice, pairing of elements ...). Students select an answer from a limited number of possibilities.                    | 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 / condition established by the teacher. In this way, the student must apply the knowledge they have acquired.  | 50            | B3                            | C2 D2     |
| Essay questions exam                                  | Competency assessment tests that include open-ended questions on a topic. Students must develop, relate, organize and present the knowledge they have on the subject in an extensive answer.  | 30            | B3                            | C2        |
| Report of practices, practicum and external practices | Preparation of a document by the student that reflects the characteristics of the work carried out. Students must describe the tasks and procedures developed, show the results obtained or observations made, as well as the analysis and treatment of data. | 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 ECF1 (or both) can choose between: a) answering the exam(s) corresponding to mark ECC2 and/or mark ECF2, 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  $\square$ suspense $\square$  (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  $\square$ suspense $\square$  (0.0).

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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:  $EC = ECC1 (40\%) + ECF1 (40\%) + ECLI (10\%) + ECLE (10\%)$ .

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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.

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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.

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### Sources of information

#### Basic Bibliography

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

#### Complementary Bibliography

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

3. Serway R. A., **Física para ciencias e ingeniería**, V1, 7ª Ed., Thomson,

4. Juana Sardón, José María de, **Física general**, V1, 2ª Ed., Pearson Prentice-Hall,

5. Bronshtein, I. Semendiaev, K., **Handbook of Mathematics**, 5ª Ed., Springer Berlín,

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,

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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**, 2ª Ed., AIP  
Press/Springer-Verlag,

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## Recommendations

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### Other comments

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Recommendations:

1. Basic knowledge acquired in the subjects of Physics and Mathematics in previous courses.
2. Capacity for written and oral comprehension.
3. Abstraction capacity, basic calculation and synthesis of information.
4. Skills for group work and group communication.

In case of discrepancy between versions, the Spanish version of this guide will prevail.

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