



## (\*)Escola de Enxeñaría Industrial

### Information

For additional information about the centre and its degrees visit the centre's website <https://eei.uvigo.es/>

## Grado en Ingeniería en Química Industrial

### Subjects

#### Year 1st

| Code          | Name   | Quadmester | Total Cr. |
|---------------|--|------------|-----------|
| V12G350V01101 | Graphic expression:<br>Fundamentals of engineering<br>graphics | 1st        | 9         |
| V12G350V01102 |  | 1st        | 6         |
| V12G350V01103 |  | 1st        | 9         |
| V12G350V01104 |  | 1st        | 6         |
| V12G350V01201 | Business: Introduction to<br>business management               | 2nd        | 6         |
| V12G350V01202 |  | 2nd        | 6         |
| V12G350V01203 | Computer science:<br>Computing for engineering                 | 2nd        | 6         |
| V12G350V01204 |  | 2nd        | 6         |
| V12G350V01205 | Chemistry: Chemistry   | 2nd        | 6         |

**IDENTIFYING DATA****Graphic expression: Fundamentals of engineering graphics**

|                     |   |                 |      |            |
|---------------------|---|-----------------|------|------------|
| Subject             | Graphic expression: Fundamentals of engineering graphics  |                 |      |            |
| Code                | V12G350V01101   |                 |      |            |
| Study programme     | Grado en Ingeniería en Química Industrial   |                 |      |            |
| Descriptors         | ECTS Credits  | Choose          | Year | Quadmester |
|                     | 9   | Basic education | 1st  | 1st        |
| Teaching language   |   |                 |      |            |
| Department          |   |                 |      |            |
| Coordinator         | Troncoso Saracho, José Carlos<br>Fernández Álvarez, Antonio   |                 |      |            |
| Lecturers           | Alegre Fidalgo, Paulino<br>Comesaña Campos, Alberto<br>Fernández Álvarez, Antonio<br>González Rodríguez, Elena<br>López Saiz, Esteban<br>Patiño Barbeito, Faustino<br>Prado Cerqueira, María Teresa<br>Troncoso Saracho, José Carlos  |                 |      |            |
| E-mail              | antfdez@uvigo.es<br>tsaracho@uvigo.es   |                 |      |            |
| Web                 | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>   |                 |      |            |
| General description | The main objective of this course is to train students in the use of the most commonly used geometric shapes and projections in engineering drawing. The subject of Engineering Graphics also aims to improve the student's spatial vision and to introduce him/her to the concept of standardisation. To achieve these objectives, we will use both manual and computer-based drawing methods. |                 |      |            |

**Skills**

|      |   |
|------|---|
| 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.   |
| B4   | CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering specializing in Industrial Chemistry. |
| B6   | CG6 Capacity for handling specifications, regulations and mandatory standards.  |
| C5   | CE5 Capacity for spatial vision and knowledge of the techniques of graphic representation, using traditional methods of metric geometry and descriptive geometry, and through the application of computer-aided design.                     |
| D2   | CT2 Problems resolution.  |
| D6   | CT6 Application of computer science in the field of study.  |
| D9   | CT9 Apply knowledge.  |

**Learning outcomes**

| Expected results from this subject   | Training and Learning Results |    |          |
|--|-------------------------------|----|----------|
| - Know, understand, and apply a body of knowledge about the basics of drawing and standardization of industrial engineering, in its broadest sense, while promoting the development of space capacity.                       | B3<br>B4                      | C5 | D6       |
| Purchase the capacity for the abstract reasoning and the establishment of strategies and efficient procedures in the resolution of the graphic problems inside the context of the works and own projects of the engineering. | B3<br>B4                      | C5 | D2       |
| Use the graphic communication between technicians, by means of the realisation and interpretation of planes in accordance with the Norms of Technical Drawing, involving the use of the new technologies.                    | B6                            | C5 | D6<br>D9 |
| Assume a favourable attitude to the permanent learning in the profession, showing *proactivo, participatory and with spirit of *superación.  | B4                            |    | D9       |

**Contents**

|       |
|-------|
| Topic |
|-------|

|   |  |
|---|--|
| Block 0.<br>Computer-aided drawing. Sketching and application of standards. | <ul style="list-style-type: none"> <li>- Introduction to Computer-aided Drawing.</li> <li>- Working environment. Coordinate systems.</li> <li>- Drawing commands. Graphical entities. Drawing aids. Object snapping.</li> <li>- Modify tools. Visualization options. Inquiry commands.</li> <li>- Plotting scaled drawings.</li> <li>- Sketching and application of standards.</li> </ul>  |
| Block 1. 2D geometry.   | <ul style="list-style-type: none"> <li>- Review of fundamental geometry concepts.</li> <li>- Conics: definitions, focal and major circles, drawing a tangent to a conic curve.</li> <li>- Constructing tangencies through loci, expansion/contraction and inversive geometry.</li> <li>- Technical curves (roulettes): trochoids and involutes (evolvents).</li> </ul>   |
| Block 2. Projections.   | <ul style="list-style-type: none"> <li>- Introduction: Types of projection. Projective invariants.</li> <li>- Topographic projection: Representation of basic elements (points, lines, planes). Elementary constructions, intersections, parallelism and perpendicularity. Roof plans. Landform drawing.</li> <li>- Multiview projection: Representation of basic elements (points, lines, planes). Parallelism and perpendicularity, true length of a segment, true size of a planar figure, planar sections.</li> <li>- Pictorial representation: Axonometric projection (isometric, dimetric, trimetric). Oblique projection (cavalier and cabinet projection).</li> <li>- Central projection: one-point perspective, two-point perspective and three-point perspective.</li> <li>- Surfaces: Polyhedra. Curved surfaces (ruled surfaces and surfaces of revolution). Intersection between two surfaces.</li> </ul>   |
| Block 3. Standardisation.   | <ul style="list-style-type: none"> <li>- Technical Drawing: Generalities. The graphic language of engineering. Major fields of application (architectural, topographical and engineering). Different forms of technical drawings (sketch, diagram, assembly drawing, part drawing, etc.).</li> <li>- Introduction to standardisation: Benefits of standardization. Specifications, regulations and technical standards.</li> <li>- Basic standards for Technical Drawing: Drawing sheets. Title blocks. Types of lines. Lettering. Scales. Folding of drawing sheets.</li> <li>- General principles of representation: Basic conventions for views. Standard arrangements of the 6 principal orthographic views (first-angle and third-angle methods). Views (auxiliary, partial, local, symmetric, enlarged features). Sectional views (cuts and sections) and variations (offset sections, aligned sections, sections revolved in the relevant view, removed sections, half sections, local cuts, auxiliary sections). General conventions for hatching. Conventional representation (repeated features, simplified intersections, runouts, initial outlines).</li> <li>- Dimensioning: Principles of dimensioning. Types of dimensioning. Types of dimensions. Elements of dimensioning (dimension line, nominal dimension value, terminator, etc.). Arrangement of dimensions (chain, parallel and running dimensioning). Dimensioning of common manufactured features (radii, diameters, spheres, chamfers, counterbores, countersinks, etc.).</li> <li>- Threads. Elements of a thread. Types of threads. Standard representation of threads. Threads in assembly. Thread specification. Simplified representation.</li> <li>- Working drawings: Assembly drawings (definition and types). General rules and conventions for assembly drawings. Parts list. Part drawings. Drawing numbering system. Examples.</li> <li>- Tolerancing: Types of tolerances (dimensional and geometrical). Specifying dimensional tolerances (linear and angular). ISO system of tolerances ISO (tolerance grades, fundamental deviations, symbols). Fits. Examples.</li> </ul> |

## Planning

|                        | Class hours | Hours outside the classroom | Total hours |
|------------------------|-------------|-----------------------------|-------------|
| Lecturing              | 38          | 116                         | 154         |
| Problem solving        | 34          | 0                           | 34          |
| Seminars               | 4           | 0                           | 4           |
| Project based learning | 0           | 27                          | 27          |
| Essay questions exam   | 2           | 0                           | 2           |
| Laboratory practice    | 4           | 0                           | 4           |

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

| <b>Methodologies</b>   |   |
|------------------------|---|
|                        | Description   |
| Lecturing              | Active masterclass. The professor will give a presentation of each module. The students will be encouraged to take an active role in the lectures through questions, discussions and exercises. |
| Problem solving        | Exercises and/or problems will be posed and solved individually or in groups.   |
| Seminars               | Carrying out activities to reinforce learning through the tutored group resolution of practical cases linked to the theoretical content of the subject.   |
| Project based learning | Carrying out of activities that require active participation and collaboration among the students.  |

| <b>Personalized assistance</b> |                    |
|--------------------------------|--------------------|
| <b>Methodologies</b>           | <b>Description</b> |
| Seminars                       |                    |

| <b>Assessment</b>    |  |               |                               |                      |
|----------------------|--|---------------|-------------------------------|----------------------|
|                      | Description  | Qualification | Training and Learning Results |                      |
| Essay questions exam | There will be a final exam that will cover all the contents of the course, both theoretical and practical, and may include multiple-choice questions, reasoning questions, problem solving and development of practical cases. A minimum grade of 4/10 is required to pass the course. | 65            | B3<br>B4                      | C5<br>D2<br>D9       |
| Laboratory practice  | Throughout the course, in certain labs, students will be asked to work out exercises and problems. These assignments will be assessed according to criteria that will have been communicated to them beforehand.   | 35            | B4                            | C5<br>D2<br>D6<br>D9 |

### **Other comments on the Evaluation**

A grade of 5/10 is required to pass the course. Students who did not achieve a pass mark can re-sit the final exam.

Honor code: Students are expected to observe academic integrity. If any type of unethical behaviour is detected (e.g. cheating, plagiarism, use of unauthorised electronic devices, etc.) the student will be considered as not meeting the requirements to pass the course and will be assigned a failing grade (0).

### **Sources of information**

#### **Basic Bibliography**

Corbella Barros, David, **Trazados de Dibujo Geométrico 1**, Madrid 1970,  
 Ladero Lorente, Ricardo, **Teoría do Debuxo Técnico**, Vigo 2012,  
 Asociación Española de Normalización (AENOR), **Normas UNE de Dibujo Técnico**, Versión en vigor,  
 Félez, Jesús; Martínez, M<sup>a</sup> Luisa, **DIBUJO INDUSTRIAL**, 3<sup>a</sup> Edición, ISBN: 84-7738-331-6,  
 Casasola Fernández, M<sup>a</sup> Isabel y otros, **Sistemas de representación I, Teoría y problemas**, ISBN 978-84-615-3553-8, Ed. Asociación de Investigación, 2011

#### **Complementary Bibliography**

López Poza, Ramón y otros, **Sistemas de Representacion I**, ISBN 84-400-2331--6,  
 Izquierdo Asensi, Fernando, **Geometría Descriptiva**, 24<sup>a</sup> Edición. ISBN 84-922109-5-8,  
 Auria, José M.; Ibáñez Carabantes, Pedro; Ubieto Artur, Pedro, **DIBUJO INDUSTRIAL. CONJUNTOS Y DESPIECES**, 2<sup>a</sup> Edición, ISBN: 84-9732-390-4,  
 Guirado Fernández, Juan José, **INICIACIÓN Á EXPRESIÓN GRÁFICA NA ENXEÑERÍA**, ISBN: 84-95046-27-X,  
 Ramos Barbero, Basilio; García Maté, Esteban, **DIBUJO TÉCNICO**, 2<sup>a</sup> Edición, ISBN: 84-8143-261-X,

#### **Manuales de usuario y tutoriales del software DAO empleado en la asignatura,**

Giesecke, Mitchell, Spencer, Hill, Dygdon, Novak, Lockhart, □ **Technical Drawing with Engineering Graphics**, 14<sup>a</sup>, Prentice Hall, 2012  
 David A. Madsen, David P. Madsen, □ **Engineering Drawing & Design**, 5<sup>a</sup>, Delmar Cengage Learning, 2012

### **Recommendations**

#### **Other comments**

To be successful in this course, it is recommended to have a background in technical drawing, standardisation and computer-aided drafting at high school level.

In case of discrepancies, the Spanish version of this guide shall prevail.

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| <b>IDENTIFYING DATA</b>    |   |                 |      |            |
|----------------------------|---|-----------------|------|------------|
| <b>(*)Física: Física I</b> |   |                 |      |            |
| 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                  | Blanco García, Jesús<br>Boutinguiza Larosi, Mohamed<br>Lusquiños Rodríguez, Fernando<br>Paredes Galán, Ángel<br>Pérez Rodríguez, Martín<br>Ribas Pérez, Fernando Agustín<br>Roson Porto, Gabriel<br>Serra Rodríguez, Julia Asunción<br>Soto Costas, Ramón Francisco<br>Souto Torres, Carlos Alberto<br>Trillo Yáñez, María Cristina<br>Varela Benvenuto, Ramiro Alberto |                 |      |            |
| E-mail                     | flusqui@uvigo.es  |                 |      |            |
| Web                        | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>   |                 |      |            |
| General description        | (*)Física do primeiro curso das Enxeñarías da rama Industrial   |                 |      |            |

| <b>Skills</b> |   |
|---------------|---|
| 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.  |

| <b>Learning outcomes</b>  |                               |    |                 |
|---|-------------------------------|----|-----------------|
| 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 |

| <b>Contents</b>                         |   |
|---|---|
| Topic                                   |   |
| 1.- UNITS, PHYSICAL AMOUNTS 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.- CINEMATIC OF THE POINT               | <p>2.1.- Vectors of position, speed and acceleration. Half and instantaneous values</p> <p>2.2.- Vectors angular speed and angular acceleration. Half and instantaneous values.</p> <p>2.3.- Relation between linear cinematic magnitudes and angular</p> <p>2.4.- Intrinsic components.</p> <p>2.5.- Study of simple movements: *mov. Rectilinear, *mov. Circulate, shot *oblicuo</p> <p>2.6.- Expressions of cinematic magnitudes in coordinates *cartesianas and polar</p>  |
| 3.- LAWS OF THE MOVEMENT OF NEWTON       | <p>3.1.- Strength and interactions.</p> <p>3.2.- First law of Newton. Systems of inertial and non inertial references</p> <p>3.3.- Second law of Newton.</p> <p>3.4.- Mass and weight.</p> <p>3.5.- Third law of Newton.</p> <p>3.6.- Quantity of movement. Mechanical impulse. Angular moment.</p> <p>3.7.- Strengths of contact: active, of *ligadura.</p>   |
| 4.- WORK AND KINETIC ENERGY              | <p>4.1.- Work realized by a Force. Power.</p> <p>4.2.- Kinetic Energy.</p> <p>4.3.- Conservative Forces</p> <p>4.4.- Elastic potential energy.</p> <p>4.5.- Potential energy in the gravitatory field.</p> <p>4.6.- Mechanical energy.</p> <p>4.7.- Strength and potential energy.</p> <p>4.8.- Principle of conservation of the mechanical energy.</p>  |
| 5.- KINEMATICS OF SYSTEM OF POINTS       | <p>5.1.- Points system.</p> <p>5.2.- Rigid solid.</p> <p>5.3.- Translation movement.</p> <p>5.4.- Movement of rotation around a fixed axis.</p> <p>5.5.- General movement.</p> <p>5.6.- Instant center of rotation.</p> <p>5.7.- Rolling motion.</p> <p>5.8.- Relative movement.</p>   |
| 6.- DYNAMICS OF THE SYSTEMS OF PARTICLES | <p>6.1.- Systems of particles. Inner and exterior strengths.</p> <p>6.2.- Center of masses of the system. Movement of the c.o.m.</p> <p>6.3.- Equations of the movement of a system of particles.</p> <p>6.4.- Linear moment. Theorem Of conservation.</p> <p>6.5.- Angular moment of a system of particles. Theorem Of conservation.</p> <p>6.6.- Work and power.</p> <p>6.7.- Potential energy and kinetics of a system of particles.</p> <p>6.8.- Theorem Of the energy of a system of particles.</p> <p>6.9.- Crashes.</p> |
| 7.- DYNAMICS OF THE RIGID SOLID          | <p>7.1.- Rotation of a rigid solid around a fixed axis.</p> <p>7.2.- Moments and products of inertia.</p> <p>7.3.- Calculation of moments of inertia.</p> <p>7.4.- Steiner's theorem.</p> <p>7.5.- Moment of a force and pair of forces.</p> <p>7.6.- Equations of the general movement of the rigid solid.</p> <p>7.7.- Kinetic energy in the general movement of the rigid solid.</p> <p>7.8.-Work in the general movement of the rigid solid.</p> <p>7.9.- Angular moment of a rigid solid. Conservation theorem.</p>       |
| 8.- STATIC                               | <p>8.1.- Balance of rigid solids.</p> <p>8.2.- Center of gravity.</p> <p>8.3.- Stability.</p> <p>8.4.- Degrees of freedom and ligatures</p>  |
| 9.- PERIODIC MOVEMENT                    | <p>9.1.- Description of the oscillation.</p> <p>9.2.- Simple harmonic movement.</p> <p>9.3.- Energy in the simple harmonic movement.</p> <p>9.4.- Applications of simple harmonic movement.</p> <p>9.5.- The simple pendulum.</p> <p>9.6.- The physical pendulum.</p> <p>9.7.- Damped oscillations.</p> <p>9.8.- Forced oscillations and resonance.</p>  |
| 10.- FLUID MECHANICS                     | <p>10.1.- Density.</p> <p>10.2.- Pressure in a fluid.</p> <p>10.3.- Fundamental principles of Fluidostática.</p> <p>10.4.- Continuity equation.</p> <p>10.5.- Bernoulli equation.</p>  |

## 11.- MECHANICAL WAVES

- 11.1.- Types of mechanical waves.
- 11.2.- Periodic waves.
- 11.3.- Mathematical description of a wave.
- 11.4.- Speed of a transverse wave.
- 11.5.- Energy of the wave movement.
- 11.6.- Wave interference, boundary conditions and superposition.
- 11.7.- Stationary waves on a string.
- 11.8.- Normal modes of a rope.

|            |   |
|------------|---|
| LABORATORY | <ul style="list-style-type: none"> <li>1.- Theory of Measurements, Errors, Graphs and Adjustments. Examples</li> <li>2.- Reaction Time.</li> <li>3.- Determination of the density of a body.</li> <li>4.- Relative Movement.</li> <li>5.- Instantaneous speed.</li> <li>6.- Study of the Simple Pendulum.</li> <li>7.- Experiences with a helical spring.</li> <li>8.- Damped and forced oscillations.</li> <li>9.- Moments of inertia. Determination of the radius of rotation of a body.</li> <li>10.- Stationary waves.</li> </ul> |
|------------|---|

|                          |   |
|--------------------------|---|
| LABORATORY NO STRUCTURED | 1. Sessions with activities no structured (open practice) that range the theoretical contents of the practices enumerated up. The groups of students have to resolve a practical problem proposed by the professor, selecting the theoretical frame and experimental tools to obtain the solution; for this, dispondrán of basic information and 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            | Exhibition by part of the professor of the contents on the subject object of study, theoretical bases and/or guidelines of a work, exercise or project to develop by the student.  |
| Problem solving      | Activity in which formulate problem and/or exercises related with the asignatura. The student has to develop the felicitous or correct solutions by means of the ejercitación of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. suele Use as I complement of the lesson magistral. |
| Laboratory practical | Activities of application of the knowledges to concrete situations and of acquisition of basic skills and procedimentales related with the subject object of study. They develop in special spaces with equipment especializado (laboratories, classrooms informáticas, 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  | 10            | B3 C2                         |
| 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.                    |               |                               |
| Problem and/or exercise solving   | 40            | B3 C2 D2                      |
| 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.  |               |                               |
| Essay questions exam  | 40            | B3 C2                         |
| 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.  |               |                               |
| Report of practices, practicum and external practices   | 10            | B3 C2 D9 D10                  |
| 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. |               |                               |

### Other comments on the Evaluation

The qualification of the continuous evaluation (which we will call EC) will have a weight of 40% of the final grade and will include both the contents of the laboratory practices (weight of 20%, which we will call ECL qualification) and of the classroom (weight of 20% , which we will call ECA qualification).

The ECA qualification will be obtained through theoretical-practical tests (they will be able to understand objective questions and / or development questions) on classroom content.

The ECL qualification will be obtained as the sum of the qualification of the Reports / memories of practices on laboratory contents.

Those students who can not follow the continuous assessment and who have been granted the rejection of the continuous assessment will have the possibility of taking a final written test to obtain a REC grade that will weigh 40% of the final grade and will include both the contents of the laboratory practices (weight of 20%, which we will call RECL rating) as classroom (weight of 20%, which we will call RECA rating).

The remaining 60% of the final grade will be obtained by completing a final exam that will consist of two parts: a theoretical part (which we will call T) that will weigh 20% of the final grade and another part of problem solving ( which we will call P) that will have a weight of 40% of the final grade. The theoretical part will consist of a theoretical-practical test ( objective questions and / or development questions). Those students who do not appear for the final exam will obtain a grade of not presented.

Both the final exams and those that are held on dates and / or times different from those officially set by the center, may have an exam format different from the one previously described, although the parts of the exam retain the same value in the final grade.

Final grade G of the subject for the continuous assessment modality:

$$G = ECL + ECA + T + P$$

Final grade G of the subject for the evaluation modality at the end of the semester and July (the RECL and RECA options only for students with waiver granted):

$$G = ECL \text{ (or RECL)} + ECA \text{ (or RECA)} + T + P.$$

To pass the subject, it is a necessary and sufficient condition to have obtained a final grade G greater than or equal to 5.

Ethical commitment: The student is expected to exhibit adequate ethical behavior. In the case of detecting unethical behavior (copying, plagiarism, unauthorized use of electronic devices, etc.), the student will be considered not to meet the necessary requirements to pass the subject. In this case, the overall grade in the current academic year will be suspended (0.0).

The use of any electronic device during the evaluation tests will not be allowed unless expressly authorized. The fact of introducing an electronic device not authorized in the exam room will be considered a reason for not passing the subject in this academic year and the overall rating will be suspended (0,0).

### Sources of information

#### Basic Bibliography

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

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### **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,

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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,

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**

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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**IDENTIFYING DATA****(\*)Matemáticas: Álgebra e estatística**

|                     |   |                 |      |            |
|---------------------|---|-----------------|------|------------|
| Subject             | (*)Matemáticas:<br>Álgebra e<br>estatística   |                 |      |            |
| Code                | V12G350V01103   |                 |      |            |
| Study programme     | Grado en<br>Ingeniería en<br>Química Industrial   |                 |      |            |
| Descriptors         | ECTS Credits  | Choose          | Year | Quadmester |
|                     | 9   | Basic education | 1st  | 1st        |
| Teaching language   | Spanish<br>Galician<br>English  |                 |      |            |
| Department          |   |                 |      |            |
| Coordinator         | Matías Fernández, José María<br>Castejón Lafuente, Alberto Elias  |                 |      |            |
| Lecturers           | Bazarra García, Noelia<br>Castejón Lafuente, Alberto Elias<br>Godoy Malvar, Eduardo<br>Gómez Rúa, María<br>Martín Méndez, Alberto Lucio<br>Matías Fernández, José María<br>Meniño Cotón, Carlos<br>Rodal Vila, Jaime Alberto<br>Rodríguez Campos, María Celia<br>Sestelo Pérez, Marta |                 |      |            |
| E-mail              | jmmatias@uvigo.es<br>acaste@uvigo.es  |                 |      |            |
| Web                 | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>   |                 |      |            |
| General description | The aim of this course is to provide the student with the basic techniques in Algebra and Statistics that will be necessary in other courses of the degree.   |                 |      |            |
|                     | English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.   |                 |      |            |

**Skills**

|      |   |
|------|---|
| 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.   |
| C1   | CE1 Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differential equations, numerical methods, numerical algorithms, statistics and optimization. |
| D2   | CT2 Problems resolution.  |
| D5   | CT5 Information Management.   |
| D6   | CT6 Application of computer science in the field of study.  |
| D9   | CT9 Apply knowledge.  |

**Learning outcomes**

|  |                               |    |          |
|--|-------------------------------|----|----------|
| Expected results from this subject   | Training and Learning Results |    |          |
| Acquire the basic knowledge on matrices, vector spaces and linear maps.  | B3                            | C1 |          |
| Handle the operations of the matrix calculation and use it to solve problems to systems of linear equations.   | B3                            | C1 | D2       |
| Understand the basic concepts on eigenvalues and eigenvectors, vector spaces with scalar product and quadratic forms used in other courses and solve basic problems related to these subjects. | B3                            | C1 | D2<br>D9 |
| Perform basic exploratory analysis of databases.   | B3                            | C1 | D5       |
| Model situations under uncertainty by means of probability.  | B3                            | C1 | D2       |
| Know basic statistical models and their application to industry and perform inferences from data samples.  | B3                            | C1 | D2<br>D9 |
| Use computer tools to solve problems of the contents of the course.  | B3                            |    | D2<br>D6 |

**Contents**

|  |  |
|--|--|
| Topic  |  |
| Preliminaries  | The field of complex numbers.  |
| Matrices, determinants and systems of linear equations.    | Definition and types of matrices.<br>Matrices operations.<br>Elementary transformations, row echelon forms, rank of a matrix.<br>Inverse and determinant of a square matrix.<br>Consistency of systems of linear equations and their solutions.  |
| Vector spaces and linear maps.                             | Vector space. Subspaces.<br>Linear independence, basis and dimension.<br>Coordinates, change of basis.<br>Basic notions on linear maps.  |
| Eigenvalues and eigenvectors.                              | Definition of eigenvalue and eigenvector of a square matrix.<br>Diagonalization of matrices by similarity transformation.<br>Applications of eigenvalues and eigenvectors.   |
| Vector spaces with scalar product and quadratic forms.     | Vectorial spaces with scalar product. Associated norm and properties.<br>Orthogonality. Gram-Schmidt orthonormalization process.<br>Orthogonal diagonalization of a real and symmetric matrix.<br>Quadratic forms.   |
| Probability.   | Concept and properties.<br>Conditional probability and independence of events.<br>Bayes Theorem.   |
| Discrete random variables and continuous random variables. | Definition of random variable. Types of random variables.<br>Distribution function.<br>Discrete random variables. Continuous random variables.<br>Characteristics of a random variable.<br>Main distributions: Binomial, Geometric, Poisson, Hypergeometric, Uniform, Exponential, Normal.<br>Central Limit Theorem. |
| Statistical inference.                                     | General concepts.<br>Sampling distributions.<br>Point estimation.<br>Confidence intervals.<br>Tests of hypotheses.   |
| Regression.  | Scatterplot. Correlation.<br>Linear regression: regression line.<br>Inference about the parameters of the regression line.   |

### Planning

|                            | Class hours | Hours outside the classroom | Total hours |
|----------------------------|-------------|-----------------------------|-------------|
| Lecturing                  | 40          | 81                          | 121         |
| Problem solving            | 36          | 24                          | 60          |
| Autonomous problem solving | 0           | 40                          | 40          |
| Essay questions exam       | 4           | 0                           | 4           |

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

### Methodologies

|                            | Description  |
|----------------------------|--|
| Lecturing                  | The lecturer will explain the contents of the course.  |
| Problem solving            | Problems and exercises will be solved during the classes. Students will also solve similar problems and exercises. |
| Autonomous problem solving | Student will have to solve problems and exercises by their own.  |

### Personalized assistance

| Methodologies              | Description |
|----------------------------|-------------|
| Lecturing                  |             |
| Problem solving            |             |
| Autonomous problem solving |             |

### Assessment

| Description | Qualification | Training and Learning Results |
|-------------|---------------|-------------------------------|
|             |               |                               |

|                      |   |  |    |    |                      |
|----------------------|---|--|----|----|----------------------|
| Problem solving      | Students will make several mid-term exams of Algebra and Statistics during the course.        | 40 por cento en Álgebra; 20 por cento en Estadística | B3 | C1 | D2<br>D5<br>D6<br>D9 |
| Essay questions exam | At the end of the semestre there will a final exam of Algebra and a final exam of Statistics. | 60 por cento en Álgebra; 80 por cento en Estadística | B3 | C1 | D2<br>D5<br>D6<br>D9 |

### Other comments on the Evaluation

At the end of the first quarter, once the mid-term exams and the final exams have been done, the student will have a grade out of 10 points in Algebra (A) and a grade out of 10 points in Statistics (S). The final qualification of the subject will be calculated as follows:

- If both grades, A and S, are greater or equal to 3.5, then the final grade will be  $(A+S)/2$ .
- Any of the grades A or S is less than 3.5, then the final qualification will be the minimum of the quantities  $(A+S)/2$  and 4.5.

The students who are exempted by the School from taking the mid-term exams will be evaluated through a final exam of Algebra (100% of the grade of this part) and a final exam of Statistics (100% of the grade of this part). The final grade will be calculated according to procedure described above.

A student will be assigned to NP ("absent") if he/she is absent in both final exams (i.e. Algebra and Statistics); otherwise he/she will be graded according to the procedure described above.

The assessment in the second call (June/July) will be done by means of a final exam of Algebra and a final exam of Statistics (100% of the grade of each part). The final grade will be calculated according to procedure described above.

If at the end of the first quarter a student obtains a grade equal to or greater than 5 out of 10 in any of the parts of the subject (Algebra or Statistics) then he/she will keep this grade in the second call (June/July) without retaking the corresponding exam.

**Ethical commitment:** Students are expected to commit themselves to an adequate and ethical behaviour. Students showing unethical behaviours (exam cheating, plagiarism, unauthorized use of electronic devices, etc.) will be rated with the minimum grade (0.0) in the current academic year.

As a general rule, the use of any electronic device for the assessment tests is not allowed unless explicitly authorized.

### Sources of information

#### Basic Bibliography

Lay, David C., **Álgebra lineal y sus aplicaciones**, 4ª,

Nakos, George; Joyner, David, **Álgebra lineal con aplicaciones**, 1ª,

de la Villa, A., **Problemas de álgebra**, 4ª,

Cao, Ricardo et al., **Introducción a la Estadística y sus aplicaciones**, 1ª,

Devore, Jay L., **Probabilidad y estadística para ingeniería y ciencias.**, 8ª,

Devore, Jay L., **Probability and statistics for engineering and sciences**, 8ª,

#### Complementary Bibliography

### Recommendations

#### Subjects that are recommended to be taken simultaneously

Mathematics: Calculus I/V12G380V01104

**IDENTIFYING DATA****(\*)Matemáticas: Cálculo I**

|                     |  |                 |      |            |
|---------------------|--|-----------------|------|------------|
| Subject             | (*)Matemáticas:<br>Cálculo I   |                 |      |            |
| Code                | V12G350V01104  |                 |      |            |
| Study programme     | Grado en<br>Ingeniería en<br>Química Industrial  |                 |      |            |
| Descriptors         | ECTS Credits   | Choose          | Year | Quadmester |
|                     | 6  | Basic education | 1st  | 1st        |
| Teaching language   | Spanish<br>Galician  |                 |      |            |
| Department          |  |                 |      |            |
| Coordinator         | Martínez Martínez, Antonio   |                 |      |            |
| Lecturers           | Bajo Palacio, Ignacio<br>Busto Ulloa, Saray<br>Díaz de Bustamante, Jaime<br>Estévez Martínez, Emilio<br>Martínez Martínez, Antonio<br>Martínez Torres, Javier<br>Meniño Cotón, Carlos<br>Prieto Gómez, Cristina Magdalena<br>Rodal Vila, Jaime Alberto<br>Vidal Vázquez, Ricardo |                 |      |            |
| E-mail              | antonmar@uvigo.es  |                 |      |            |
| Web                 | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>  |                 |      |            |
| General description | (*)O obxectivo desta materia é que o estudante adquira o dominio das técnicas básicas de cálculo diferencial nunha e en varias variables e de cálculo integral nunha variable que son necesarias para outras materias que debe cursar na titulación.                             |                 |      |            |

**Skills**

|      |   |
|------|---|
| 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.   |
| B4   | CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering specializing in Industrial Chemistry.   |
| C1   | CE1 Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differential equations, numerical methods, numerical algorithms, statistics and optimization. |
| D1   | CT1 Analysis and synthesis.   |
| D2   | CT2 Problems resolution.  |
| D6   | CT6 Application of computer science in the field of study.  |
| D9   | CT9 Apply knowledge.  |
| D14  | CT14 Creativity.  |
| D16  | CT16 Critical thinking.   |

**Learning outcomes**

| Expected results from this subject | Training and Learning Results |    |     |
|------------------------------------|-------------------------------|----|-----|
| (*)                                | B3                            | C1 | D1  |
| (*)                                | B3                            | C1 | D1  |
| (*)                                | B3                            | C1 | D2  |
|                                    | B4                            |    | D9  |
|                                    |                               |    | D14 |
|                                    |                               |    | D16 |
| (*)                                | B3                            | C1 | D1  |
|                                    | B4                            |    | D2  |
|                                    |                               |    | D9  |
|                                    |                               |    | D14 |
|                                    |                               |    | D16 |
| (*)                                | B4                            | C1 | D2  |
|                                    |                               |    | D6  |
|                                    |                               |    | D9  |
|                                    |                               |    | D16 |

**Contents**

|   |   |
|---|---|
| Topic   |   |
| (*)   | (*)   |
| (*)Cálculo diferencial de funcións dunha e varias variables | (*)Cálculo diferencial de funcións reais dunha variable real<br>Cálculo diferencial de funcións de varias variables reais |
| (*)Cálculo integral de funcións dunha variable              | (*)A integral de Riemann. Cálculo de primitivas.<br>Integrais impropias.<br>Aplicacións da integral.                      |

## Planning

|                                 | Class hours | Hours outside the classroom | Total hours |
|---------------------------------|-------------|-----------------------------|-------------|
| Problem solving                 | 20.5        | 30                          | 50.5        |
| Laboratory practical            | 12.5        | 5                           | 17.5        |
| Lecturing                       | 32          | 39                          | 71          |
| Problem and/or exercise solving | 3           | 3                           | 6           |
| Essay questions exam            | 2           | 3                           | 5           |

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

## Methodologies

|                      | Description   |
|----------------------|---|
| Problem solving      | (*)O profesor resolverá problemas e exercicios tipo e o alumno terá que resolver exercicios similares.                    |
| Laboratory practical | (*)Empregaranse ferramentas informáticas para resolver exercicios e aplicar os coñecementos obtidos nas clases de teoría. |
| Lecturing            | (*)O profesor exporá nas clases teóricas os contidos da materia.  |

## Personalized assistance

| Methodologies        | Description |
|----------------------|-------------|
| Problem solving      |             |
| Laboratory practical |             |

## Assessment

|                                 | Description  | Qualification | Training and Learning Results |    |                                    |
|---------------------------------|--|---------------|-------------------------------|----|------------------------------------|
| Problem and/or exercise solving | (*)Realizaranse probas escritas e/ou traballos.                      | 40            | B3<br>B4                      | C1 | D1<br>D2<br>D6<br>D9<br>D14<br>D16 |
| Essay questions exam            | (*)Farase un exame final sobre os contidos da totalidade da materia. | 60            | B3<br>B4                      | C1 | D1<br>D2<br>D9                     |

## Other comments on the Evaluation

The \*avaliación\* continuous \*levará\* to cape envelope the previously exposed criteria. Those students that no receive \*avaliación\* continuous \*será\* evaluated with a final examination envelope the contents of the totality of the subject, that \*suporá\* 100% of the note.

The \*avaliación\* of the students in second announcement \*consistirá\* in one examination envelope the contents of the totality of the subject, that \*suporá\* 100% of the note.

Commitment \*típic\*o:

\*\*Espérase That the present student a behaviour \*típico\* suitable. In case to detect a behaviour no \*típico\* (copy, \*plaxio\*, \*utilización\* of devices \*electrónicos\* unlicensed, and others) will consider that the student no \*reñe\* the necessary requirements to surpass the subject. In this case to \*cualificación\* global in the present course \*académica\* \*será\* of \*suspense\* (0.0)."

## Sources of information

### Basic Bibliography

Burgos, J., **Cálculo Infinitesimal de una variable**, 2ª, McGraw-Hill, 2007

Burgos, J., **Cálculo Infinitesimal de varias variables**, 2ª, McGraw-Hill, 2008

Galindo Soto, F. y otros, **Guía práctica de Cálculo Infinitesimal en una variable**, 1ª, Thomson, 2003

Galindo Soto, F. y otros, **Guía práctica de Cálculo Infinitesimal en varias variables**, 1ª, Thomson, 2005

Larson, R. y otros, **Cálculo 1**, 9ª, McGraw-Hill, 2010

Larson, R. y otros, **Cálculo 2**, 9ª, McGraw-Hill, 2010

Stewart, J., **Cálculo de una variable. Trascendentes tempranas**, 7ª, Thomson Learning, 2014

#### **Complementary Bibliography**

García, A. y otros, **Cálculo I**, 3ª, CLAGSA, 2007

García, A. y otros, **Cálculo II**, 2ª, CLAGSA, 2006

Rogawski, J., **Cálculo. Una variable**, 2ª, Reverte, 2012

Rogawski, J., **Cálculo. Varias variables**, 2ª, Reverte, 2012

Tomeo Perucha, V. y otros, **Cálculo en una variable**, 1ª, Garceta, 2011

Tomeo Perucha, V. y otros, **Cálculo en varias variables**, 1ª, Garceta, 2011

#### **Recommendations**

##### **Subjects that continue the syllabus**

Mathematics: Calculus 2 and differential equations/V12G330V01204

##### **Subjects that are recommended to be taken simultaneously**

Mathematics: Algebra and statistics/V12G330V01103



**IDENTIFYING DATA****Business: Introduction to business management**

|                     |  |                 |      |            |
|---------------------|--|-----------------|------|------------|
| Subject             | Business:<br>Introduction to<br>business<br>management   |                 |      |            |
| Code                | V12G350V01201  |                 |      |            |
| Study programme     | Grado en Ingeniería<br>en Química<br>Industrial  |                 |      |            |
| Descriptors         | ECTS Credits   | Choose          | Year | Quadmester |
|                     | 6  | Basic education | 1st  | 2nd        |
| Teaching language   | #EnglishFriendly<br>Spanish<br>Galician<br>English   |                 |      |            |
| Department          |  |                 |      |            |
| Coordinator         | Álvarez Llorente, Gema   |                 |      |            |
| Lecturers           | Álvarez Llorente, Gema<br>Arevalo Tomé, Raquel<br>Fernández Arias, María Jesús<br>González-Portela Garrido, Alicia Trinidad<br>Pérez Pereira, Santos<br>Sinde Cantorna, Ana Isabel<br>Urgal González, Begoña   |                 |      |            |
| E-mail              | galvarez@uvigo.es  |                 |      |            |
| Web                 | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>  |                 |      |            |
| General description | (*)Esta materia ten como obxectivo fundamental ofrecer ao alumno unha visión preliminar ou introdutoria, de carácter teórico-práctico, encol a natureza e o funcionamento das organizacións empresariais e a súa relación coa contorna na que operan, así como as actividades que levan a cabo. Para iso, entre outras cousas, definiremos o termo empresa dende un punto de vista multidimensional que abrangue a complexidade do seu funcionamento como sistema aberto. Posteriormente, analizaremos as relacións da empresa coa súa contorna, e entraremos no estudo das súas principais áreas funcionais que contribúen ao correcto desenvolvemento da súa actividade. |                 |      |            |

**Skills**

|      |   |
|------|---|
| Code |   |
| B9   | CG9 Ability to organize and plan within the sphere of a company, and other institutions and organizations.                                      |
| C6   | CE6 Adequate knowledge of the concept of enterprise and institutional and legal framework of enterprises. Organization and Business Management. |
| D1   | CT1 Analysis and synthesis.   |
| D2   | CT2 Problems resolution.  |
| D7   | CT7 Ability to organize and plan.   |
| D18  | CT18 Working in an international context.   |

**Learning outcomes**

| Expected results from this subject  | Training and Learning Results |    |                 |
|---|-------------------------------|----|-----------------|
| Know the role of the company in the field of economic activity.                   | C6                            |    | D18             |
| Understand the basic aspects that characterize the different types of companies.  | C6                            |    | D1<br>D18       |
| Know the legal framework of the different types of companies.                     | C6                            |    | D1              |
| Know the most relevant aspects of the organization and management in the company. | B9                            | C6 | D1<br>D18       |
| Acquire skills on the processes that affect business management.                  | B9                            | C6 | D2<br>D7<br>D18 |

**Contents**

|       |
|-------|
| Topic |
|-------|

|   |   |
|---|---|
| 1. THE COMPANY  | 1.1 The nature of the firm<br>1.2 The role of the company in the socio-economic system.<br>1.3 The company as a system.<br>1.4 The environment of the company.<br>1.5 Company objectives and goals.<br>1.6 Types of companies.  |
| 2. FINANCIAL MANAGEMENT (PART I). ECONOMIC AND FINANCIAL STRUCTURE OF THE COMPANY   | 2.1 Economic and financial structure of the company.<br>2.2 Working Capital<br>2.3 Operating cycle and Cash Conversion Cycle<br>2.4 Working Capital requirement   |
| 3. FINANCIAL MANAGEMENT (PART II). UNDERSTANDING THE RESULTS OF THE COMPANY   | 3.1 The results of the company.<br>3.2 The profitability of the company.<br>3.3 The competitive strategy.   |
| 4. FINANCIAL MANAGEMENT (PART III). INVESTMENT DECISIONS.   | 4.1 Definition of Investment.<br>4.2 Types of investments.<br>4.3. Investment Appraisal Techniques  |
| 5: The FINANCIAL SYSTEM (PART IV). FINANCE  | 5.1 Concept of source of finance.<br>5.2 Types of sources of finance.<br>5.3 Analyses of the solvency and liquidity of the company.   |
| 6. OPERATION MANAGEMENT (PART I). GENERAL FEATURES  | 6.1 Production system.<br>6.2 Efficiency.<br>6.3 Productivity<br>6.4 Research, development and innovation (R&D&I).  |
| 7: The SYSTEM OF PRODUCTION (PART II). The COSTS OF PRODUCTION  | 7.1 Concept of cost.<br>7.2 Classification of the costs.<br>7.3 The cost of production.<br>7.4 The margins of the company.<br>7.5 Threshold of profitability.<br>7.6 Capacity of production and location.<br>7.7 Management of inventories.   |
| 8. MARKETING MANAGEMENT   | 8.1 What is marketing?<br>8.2 Basic concepts.<br>8.3 Marketing tools: Marketing mix.  |
| 9. MANAGEMENT AND ORGANIZATION  | 9.1 Components of the organization and management system.<br>9.2 The management system.<br>9.3 The human system.<br>9.4 The cultural system.<br>9.5 The political system.   |
| PRACTICES OF THE MATTER<br>*The programming of the practical can experience changes in function of the evolution of the course. | Practice 1: Application of concepts of the subject 1.<br>Practice 2: Application of concepts of the subject 1.<br>Practice 3: Application of concepts of the subject 2.<br>Practice 4: Application of concepts of the subject 2.<br>Practice 5: Application of concepts of the subject 2.<br>Practice 6: Application of concepts of the subject 3.<br>Practice 7: Application of concepts of the subject 4.<br>Practice 8: Application of concepts of the subject 5.<br>Practice 9: Application of concepts of the subject 6.<br>Practice 10: Application of concepts of the subject 7.<br>Practice 11: Application of concepts of the subject 8.<br>Practice 12: Application of concepts of the subject 9. |

### Planning

|                          | Class hours | Hours outside the classroom | Total hours |
|--------------------------|-------------|-----------------------------|-------------|
| Lecturing                | 32.5        | 45.5                        | 78          |
| Laboratory practical     | 18          | 45                          | 63          |
| Objective questions exam | 3           | 6                           | 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 of the main contents of the course.                                    |
| Laboratory practical | Application to specific problems of the knowledge acquired in theoretical classes. |

### Personalized assistance

| Tests | Description |
|-------|-------------|
|-------|-------------|

|                          |   |
|--------------------------|---|
| Objective questions exam | The students will have occasion of acudir to tutorías in the dispatch of the professor in the time that the professors will establish to such effect to principle of course and that will publish in the platform of teledocencia Fatic. These tutorías are destinadas to resolve doubts and orientar to the students on the development of the contents abordados in the theoretical kinds, the practical kinds and the works that can them encomendar. In this apartado also includes the aclaración to the students of any question on the proofs realized along the course. |
|--------------------------|---|

| <b>Assessment</b>        |   |               |                               |    |                       |
|--------------------------|---|---------------|-------------------------------|----|-----------------------|
|                          | Description   | Qualification | Training and Learning Results |    |                       |
| Laboratory practical     | In accordance with the planning docente of the academic course, the student will have to develop a number determined of practices that include diverse exercises of application of the knowledges purchased in the kinds of theory to concrete situations and allow to develop diverse basic skills (capacity for the resolution of problems, initiative, work in team, etc.). These practices do not take part in the calculation of the qualification of the subject, but exige to the student obtain an exert minimum in the same for the superación of the subject. | 0             | B9                            | C6 | D1<br>D2<br>D7<br>D18 |
| Objective questions exam | Will realize , and minimum, two test type test along the course, in which will evaluate the knowledges, the destrezas and the competitions purchased by the students so much in the classrooms of theory and of practices.  | 100           | B9                            | C6 | D1<br>D2              |

### **Other comments on the Evaluation**

#### 1. Ethical commitment:

The student is expected to exhibit adequate ethical behavior. In the case of detecting unethical behavior (copy, plagiarism, use of unauthorized electronic devices, for example) it will be considered that the student does not meet the necessary requirements to pass the subject. In that case, the overall grade in the current academic year will be suspended (0.0).

#### 2. Continuous evaluation system

Following the guidelines of the degree and the agreements of the academic commission will offer students / s who study this subject a continuous assessment system.

The continuous evaluation will consist of two test type tests that will be carried out throughout the course. Each one of the test type tests will deal with the contents seen until the moment of its realization, both in theory and practical classes. Therefore, the first test will not release material for the performance of the second test. Due to this, each of these tests will have a different weight in the calculation of the grade obtained in the subject. The first 30% and the second 70%.

These tests are not recoverable, that is, if a student can not perform them on the stipulated date, the teacher does not have to repeat them, unless justified and duly accredited by the student.

The student has the right to know the grade obtained in each test within a reasonable time after its completion and discuss the result with the teacher.

It will be understood that the student has passed the continuous evaluation when all the following requirements are met:

1. 75% of the practices of the subject have been correctly developed.
2. At least a grade of 5 out of 10 (passed) has been obtained in the last test type test (which will cover all the contents seen in the subject).
3. The weighted average of the marks obtained in the test type tests is a minimum of 5 out of 10 (passed), this being the grade obtained in the subject.

In order for the student to be able to take the evaluation tests indicated in this point, the student must meet the first requirement expressed in the previous paragraph.

If the weighted average of the marks obtained in the test type tests is greater than or equal to 5 but the grade obtained in the last test type test is less than 5, the student will not have passed the subject and his grade will be the one obtained in the second test.

It will be understood that a student has opted for continuous assessment when, fulfilling the necessary requirements regarding the completion of practices, participates in the second test type test.

The qualification obtained in the test and practice tests will only be valid for the academic year in which they take place.

### 3. Students who do not opt for continuous assessment

Students who do not opt for continuous assessment will be offered an evaluation procedure that allows them to reach the highest grade. This procedure will consist of a final exam (whose date is set by the Management of the Center), in which all the contents developed in the subject will be evaluated, both in the theory classes and in the practical classes. This final exam will consist of two parts: a theory test in a test-type format, which will represent 30% of the final grade, and another part of practice, which will be the remaining 70%, and which will consist of a series of exercises to be developed. It is an essential condition to pass the subject to obtain a minimum score of 5 out of 10 (Approved) in the test type test. In case of not passing the test type test, the final grade of the student will be the one obtained in said test evaluated on 3.

Only those students who do not perform any of the assessment tests included in this teaching guide will be considered "not submitted". Specifically, for those students who take the first test type test but then do not take the second test type test and do not show up for the final exam, their grade in the subject will be the grade obtained in the first test type test evaluated on 3.

### 4. About the July call

The call for recovery (July) will consist of a final exam that will be 100% of the final grade and in which all the contents developed in the subject will be evaluated, both in the theory classes and in the practical classes. This exam will consist of two parts: a theory test in test format, which will mean 30% of the final grade, and another practice, which will be the remaining 70%, and which will consist of a series of exercises to be developed. It is an essential condition to pass the subject to obtain a minimum score of 5 out of 10 (Approved) in the test type test. In case of not passing the test type test, the final grade of the student will be the one obtained in said test evaluated on 3.

### 5. Prohibition of the use of electronic devices

The use of any electronic device during the evaluation tests will not be allowed, unless expressly authorized. The fact of introducing an electronic device not authorized in the examination room, will be considered a reason for not passing the subject in this academic year and the overall rating will be suspended (0,0).

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#### **Sources of information**

##### **Basic Bibliography**

Barroso Castro, C. (Coord.), **Economía de la empresa**, 2012,

Moyano Fuentes, J.; Bruque Cámara, S.; Maqueira Marín, J.M.; Fidalgo Bautista, F.A.; Martínez Jurado, **Administración de empresas: un enfoque teórico-práctico**, 2011,

García Márquez, F., **Dirección y Gestión Empresarial**, 2013,

Iborra Juan, M.; Dasi Coscollar, A.; Dolz Dolz, C.; Ferrer Ortega, C., **Fundamentos de dirección de empresas. Conceptos y habilidades directivas**, 2014,

##### **Complementary Bibliography**

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#### **Recommendations**

##### **Subjects that continue the syllabus**

Basics of operations management/V12G320V01605

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| <b>IDENTIFYING DATA</b>     |   |                 |      |            |
|-----------------------------|---|-----------------|------|------------|
| <b>(*)Física: Física II</b> |   |                 |      |            |
| Subject                     | (*)Física: Física II  |                 |      |            |
| Code                        | V12G350V01202   |                 |      |            |
| Study programme             | Grado en Ingeniería en Química Industrial   |                 |      |            |
| 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                         | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>   |                 |      |            |
| General description         | This undergraduate course is the second quarter of introductory physics. The focus is on electricity, magnetism and thermodynamics  |                 |      |            |

| <b>Skills</b> |   |
|---------------|---|
| 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.  |

| <b>Learning outcomes</b>  |                               |    |                 |
|---|-------------------------------|----|-----------------|
| 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<br>D10       |
| Ability to develop practical solutions to basic technical problems in engineering, within the framework of electromagnetism and thermodynamics. | B3                            | C2 | D2<br>D9<br>D10 |

| <b>Contents</b>                        |  |
|--|--|
| 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. |

|  |   |
|--|---|
| 2.- GAUSS'S LAW                                  | <ul style="list-style-type: none"> <li>2.1.- Charge and Electric Flux.</li> <li>2.2.- Calculating Electric Flux.</li> <li>2.3.- Gauss's Law.</li> <li>2.4.- Applications of Gauss's Law.</li> <li>2.5.- Conductors in Electrostatic Equilibrium.</li> </ul>   |
| 3.- ELECTRIC POTENTIAL                           | <ul style="list-style-type: none"> <li>3.1.- Electric Potential Energy.</li> <li>3.2.- Electric Potential.</li> <li>3.3.- Calculating Electric Potential.</li> <li>3.4.- Equipotential Surfaces.</li> <li>3.5.- Potential Gradient.</li> </ul>  |
| 4.- CAPACITANCE AND DIELECTRICS                  | <ul style="list-style-type: none"> <li>4.1.- Capacitors and Capacitance.</li> <li>4.2.- Capacitors in Series and Parallel.</li> <li>4.3.- Energy Storage in Capacitors and Electric-Field Energy.</li> <li>4.4.- Dielectrics, Molecular Model of Induced Charge, and Polarization Vector.</li> <li>4.5.- Gauss's Law in Dielectrics.</li> <li>4.6.- Dielectric Constant and Permittivity.</li> </ul>                          |
| 5.- CURRENT, RESISTANCE, AND ELECTROMOTIVE FORCE | <ul style="list-style-type: none"> <li>5.1.- Electric Current.</li> <li>5.2.- Current and Current Density.</li> <li>5.3.- Ohm's Law and Resistance.</li> <li>5.4.- Electromotive Force and Circuits.</li> <li>5.5.- Energy and Power in Electrical Circuits.</li> <li>5.6.- Basic Theory of Electrical Conduction.</li> </ul>   |
| 6.- MAGNETIC FIELD                               | <ul style="list-style-type: none"> <li>6.1.- Magnetic Field.</li> <li>6.2.- Motion of Charged Particles in a Magnetic Field.</li> <li>6.3.- Magnetic Force on a Current-Carrying Conductor.</li> <li>6.4.- Force and Torque on a Current Loop.</li> <li>6.5.- Biot-Savart's Law.</li> <li>6.6.- Magnetic Field Lines and Magnetic Flux.</li> <li>6.7.- Ampère's Law.</li> </ul>   |
| 7.- MAGNETIC FIELD IN MATTER                     | <ul style="list-style-type: none"> <li>7.1.- Magnetic Substances and Magnetization Vector.</li> <li>7.2.- Ampère's Law in Magnetic Media.</li> <li>7.3.- Magnetic Susceptibility and Permeability.</li> <li>7.4.- Paramagnetism and Diamagnetism.</li> <li>7.5.- Ferromagnetism.</li> </ul>   |
| 8.- ELECTROMAGNETIC INDUCTION                    | <ul style="list-style-type: none"> <li>8.1.- Induction Experiments.</li> <li>8.2.- Faraday-Lenz's Law.</li> <li>8.3.- Induced Electric Fields.</li> <li>8.4.- Eddy Currents.</li> <li>8.5.- Mutual Inductance.</li> <li>8.6.- Self-Inductance and Inductors.</li> <li>8.7.- Magnetic-Field Energy.</li> </ul>   |
| 9.- THERMODYNAMIC SYSTEMS                        | <ul style="list-style-type: none"> <li>9.1.- Classical Thermodynamics.</li> <li>9.2.- Thermodynamic Systems and Classification.</li> <li>9.3.- State Variables and State of a System.</li> <li>9.4.- Equations of State.</li> <li>9.5.- Thermodynamic Equilibrium.</li> <li>9.6.- Change of State, Transformation or Process.</li> <li>9.7.- Quasi-static Processes.</li> <li>9.8.- State and Process Functions.</li> </ul>   |
| 10.- TEMPERATURE AND HEAT                        | <ul style="list-style-type: none"> <li>10.1.- Thermal Equilibrium, The Zeroth Law of Thermodynamics, and Temperature.</li> <li>10.2.- Thermometers and Temperature Scales.</li> <li>10.3.- Ideal Gas Thermometers and the Kelvin Scale.</li> <li>10.4.- Heat.</li> <li>10.5.- Calorimetry and Heat Capacities.</li> </ul>   |
| 11.- THE FIRST LAW OF THERMODYNAMICS             | <ul style="list-style-type: none"> <li>11.1.- Work.</li> <li>11.2.- Work Done During Volume Changes.</li> <li>11.3.- Internal Energy.</li> <li>11.4.- The First Law of Thermodynamics.</li> <li>11.5.- Internal Energy of an Ideal Gas.</li> <li>11.6.- Molar Heat Capacities of an Ideal Gas.</li> <li>11.7.- Adiabatic, Isothermal, Isobaric and Isochoric Processes for an Ideal Gas.</li> <li>11.8.- Enthalpy.</li> </ul> |

|   |   |
|---|---|
| 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                              | 10            | B3 C2                         |
| Problem and/or exercise solving                       | 40            | B3 C2 D2                      |
| Essay questions exam                                  | 40            | B3 C2                         |
| Report of practices, practicum and external practices | 10            | B3 C2 D9 D10                  |

### 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):

$$G = ECL \text{ (or RECL)} + ECA \text{ (or RECA)} + T + P.$$

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 "suspense" (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 "suspense" (0.0).

### Sources of information

#### Basic Bibliography

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

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## 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.

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**IDENTIFYING DATA****Computer science: Computing for engineering**

|                     |   |                 |      |            |
|---------------------|---|-----------------|------|------------|
| Subject             | Computer science:<br>Computing for<br>engineering   |                 |      |            |
| Code                | V12G350V01203   |                 |      |            |
| Study programme     | Grado en<br>Ingeniería en<br>Química Industrial   |                 |      |            |
| Descriptors         | ECTS Credits  | Choose          | Year | Quadmester |
|                     | 6   | Basic education | 1st  | 2nd        |
| Teaching language   | Spanish<br>Galician<br>English  |                 |      |            |
| Department          |   |                 |      |            |
| Coordinator         | Rodríguez Damian, María<br>Sáez López, Juan   |                 |      |            |
| Lecturers           | Ibáñez Paz, Regina<br>Manzanedo García, Antonio<br>Pérez Cota, Manuel<br>Rodríguez Damian, Amparo<br>Rodríguez Damian, María<br>Rodríguez Diéguez, Amador<br>Sáez López, Juan<br>Vázquez Núñez, Fernando Antonio                    |                 |      |            |
| E-mail              | mrdamian@uvigo.es<br>juansaez@uvigo.es  |                 |      |            |
| Web                 | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>   |                 |      |            |
| General description | They treat the following contents:<br>Methods and basic algorithms of programming<br>Programming of computers by means of a language of high level<br>Architecture of computers<br>Operating systems<br>basic Concepts of databases |                 |      |            |

**Skills**

|      |   |
|------|---|
| 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.   |
| B4   | CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering specializing in Industrial Chemistry. |
| C3   | CE3 Basic knowledge on the use and programming of computers, operating systems, databases and software applications in engineering.   |
| D1   | CT1 Analysis and synthesis.   |
| D2   | CT2 Problems resolution.  |
| D5   | CT5 Information Management.   |
| D6   | CT6 Application of computer science in the field of study.  |
| D7   | CT7 Ability to organize and plan.   |
| D17  | CT17 Working as a team.   |

**Learning outcomes**

| Expected results from this subject                         | Training and Learning Results |    |                       |
|--|-------------------------------|----|-----------------------|
| Computer and operating system skills.                      | B3                            | C3 | D5<br>D6<br>D7        |
| Basic understanding of how computers work                  | B3                            | C3 | D1<br>D5              |
| Skills regarding the use of computer tools for engineering | B3                            | C3 | D5<br>D6<br>D7<br>D17 |
| Database fundamentals                                      | B3                            | C3 | D1<br>D5<br>D6<br>D7  |

|  |          |    |                 |
|--|----------|----|-----------------|
| Capability to implement simple algorithms using a programming language | B3<br>B4 | C3 | D2<br>D7<br>D17 |
| Structured and modular programming fundamentals                        | B3<br>B4 | C3 | D2<br>D5<br>D17 |

## Contents

| Topic   |   |
|---|---|
| Concepts and basic techniques of programming applied to the engineering | Paradigms of programming<br>Programming structured<br>Programming languages<br>Python features  |
| Foundations of Python   | Types of variables<br>data and operators<br>Comments<br>Functions and standard Modules.<br>Import and use of modules.<br>Input-Output and control of errors   |
| Structures of control   | Decision if-else<br>Iterative: while<br>Boolean algebra   |
| Sequences and iterative   | Working with sequences: lists, tuples and string<br>Types of data mutable and no mutable<br>Concepts of reference and value<br>Indexes of the sequences<br>Cycle for- in<br>Operators and sequences<br>Functions and methods of sequences |
| Lists and List of lists   | Operators and methods<br>Characteristics of the lists<br>Working with lists<br>Indexes and iterate lists  |
| Functions and own Modules   | Definition and creation of functions<br>Types of parameters and return values<br>Concepts of value and reference in the parameters<br>Scope of the variables<br>Creation and invocation of modules  |
| Persistence   | Files, definitions and characteristics<br>Basic operations with the files   |
| Graphic interface   | Creation of windows and widgets<br>Manipulation of graphic elements<br>Utilisation of variable control  |
| Basic concepts of Computing   | Computer Architecture<br>Components: hardware, software<br>Operating systems<br>Databases   |

## Planning

|                                 | Class hours | Hours outside the classroom | Total hours |
|---------------------------------|-------------|-----------------------------|-------------|
| Introductory activities         | 1           | 1                           | 2           |
| Practices through ICT           | 22          | 24                          | 46          |
| Problem solving                 | 11          | 18                          | 29          |
| Previous studies                | 1           | 5                           | 6           |
| Autonomous problem solving      | 6           | 20                          | 26          |
| Lecturing                       | 10          | 0                           | 10          |
| Objective questions exam        | 4           | 7                           | 11          |
| Problem and/or exercise solving | 8           | 12                          | 20          |

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

## Methodologies

|                         | Description   |
|-------------------------|---|
| Introductory activities | Activities directed to take contact, gather information on the students, creation of groups, tasks of organisation, as well as present the subject. |

|                            |   |
|----------------------------|---|
| Practices through ICT      | Activities of application of the knowledges to concrete situations and of acquisition of basic skills and process related with the matter object of study. They develop in special spaces with equipment facilitated by the School, and expects that each student have his own laptop or the facilitated by the School. |
| Problem solving            | Analysis of a fact, problem or real event with the purpose to know it, interpret it, resolve it, generate hypothesis, contrast data, complete knowledges, diagnose it and train in alternative procedures of solution.  |
| Previous studies           | Reading and understanding by part of the student of some subjects or parts of subjects to deepen in the knowledge of the same in class.   |
| Autonomous problem solving | Resolution by part of the student of the different type of problems posed, being able to identify the efficiency of each method of resolution proposed.   |
| Lecturing                  | Exhibition by part of the professor of the contents on the matter object of study, theoretical bases and/or guidelines of a work, exercise or project to develop by the student.  |

### Personalized assistance

| Methodologies         | Description  |
|-----------------------|--|
| Problem solving       | They will resolve the doubts posed by the students. Teachers' tutoring in the agreed format.   |
| Practices through ICT | Attention in the laboratory to the doubts that present or will indicate him the way to be followed so that the person find the solution. Teachers' tutoring in the schedule and format stipulated. |

### Assessment

|                                 | Description  | Qualification | Training and Learning Results |    |    |
|---------------------------------|--|---------------|-------------------------------|----|----|
| Practices through ICT           | Group of proofs that include the solution of problems, exercises of practical type, and activities to resolve.   | 70            |                               |    |    |
| Objective questions exam        | Proofs for the evaluation of the competitions purchased that include questions with different alternative of answer (true/false, multiple election, ...) | 15            | B3                            | C3 | D5 |
| Problem and/or exercise solving | Resolution of practical exercises  | 15            |                               |    |    |

### Other comments on the Evaluation

Ethical commitment:

Students are expected to behave ethically. If unethical behaviour is detected (copying, plagiarism, use of unauthorized electronic devices and others), then it will be considered that the student does not meet the minimum requirements to pass the course. In this case, the final grade for the current academic year will be failed (0.0).

In addition to the ethical commitment, the following is underlined:

In the first place, a person registered in the course is by default subject to the continuous assessment system; if the student does not want to be in this system, the he/she must expressly renounce to it within the established deadlines.

### CONTINUOUS ASSESSMENT OPERATION

In the present course, the continuous assessment will collect all the evidence of learning from the person enrolled and will be grouped into three assessments. The first two will take place preferably in the laboratories: Test 1 and Test 2. The third evaluation may be written: Test 3. If the student does not renounce to the continuous evaluation system, tests that are not attended will be considered as qualified as zero (0.0). A minimum score of 30% out of 10 (3.0 points) must be obtained in the last two evaluations: Test 2 and Test 3, in order to be eligible to have the final average calculated. If this requirement is not met and the final average is equal to or greater than 5, the final grade will be 4:

$$\text{Test 1} * 0.3 + (\text{Test 2} \geq 3) * 0.4 + (\text{Test 3} \geq 3) * 0.3 \geq 5$$

A student is considered passed if he/she obtains a five or more in compliance with all the requirements.

### First call (May/June):

The following must be met to pass the subject under continuous assessment:

$$\text{Test 1} * 0.3 + (\text{Test 2} \geq 3) * 0.4 + (\text{Test 3} \geq 3) * 0.3 \geq 5$$

Once the first evaluation: Test 1, has been carried out, the person enrolled may request to abandon the continuous evaluation system (within the period and by the means established by the teaching staff). In this way, the person enrolled will be able to follow the non-continuous assessment system.

### **Second call (June/July):**

If a person does not reach the passing level in the first exam (May/June) but has passed the minimum mark in the second exam: Test 2, in the second call (June/July) he/she can choose to keep the grades of the first two tests, and take a 4-points exam, or take a 100% exam in the subject (10 points). If the person takes the 3-points test, he/she will be asked for a minimum score of 30% out of 10 (3.0 points) in order to calculate the final grade. If this requirement is not met and the final average is equal to or greater than 5, the final grade will be 4.

### **NON-CONTINUOUS EVALUATION OPERATION**

An exam that allows students to obtain 100% of the grade. The exam may be divided into sections, minimums can be required.

### **First call (May/June):**

Registered students who have expressly renounced to the continuous assessment system may take the May/June exam (on the date and at the time proposed by the School) and take an exam that allows them to obtain 100% of the grade. This exam is not open to those who have failed the continuous assessment.

### **Second call (June/July):**

An exam will be proposed to evaluate 100% of the subject, for those who have not achieved the minimum mark in the first call.

The version of the guide was made in Spanish. For any doubt or contradiction, the Spanish guide will be mandatory.

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### **Sources of information**

#### **Basic Bibliography**

Eric Matthes, **Python Crash Course, 3rd Edition: A Hands-On, Project-Based Introduction to Programming**, 3, No Starch Press, 2022

Silvia Guardati Buemo y Osvaldo Cairó Battistutti, **De cero al infinito. Aprende a programar en Python**, Cairó, 2020

Juan Diego Pérez Villa, **Introducción a la informática. Guía visual**, Anaya Multimedia, 2022

#### **Complementary Bibliography**

Jane Holcombe y Charles Holcombe, **ISE Survey of Operating Systems**, 7, McGraw Hill, 2022

Antonio Postigo Palacios, **Bases de datos**, Ediciones Paraninfo, 2021

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### **Recommendations**

**IDENTIFYING DATA****Matemáticas: Cálculo II e ecuacións diferenciais**

|                     |   |                           |           |                  |
|---------------------|---|---------------------------|-----------|------------------|
| Subject             | Matemáticas:<br>Cálculo II e<br>ecuacións<br>diferenciais   |                           |           |                  |
| Code                | V12G350V01204   |                           |           |                  |
| Study programme     | Grao en Enxeñaría<br>en Química<br>Industrial   |                           |           |                  |
| Descriptors         | ECTS Credits<br>6   | Choose<br>Basic education | Year<br>1 | Quadmester<br>2c |
| Teaching language   | Castelán<br>Galego<br>Inglés  |                           |           |                  |
| Department          | Matemática aplicada I<br>Matemática aplicada II   |                           |           |                  |
| Coordinator         | Cachafeiro López, María Alicia  |                           |           |                  |
| Lecturers           | Bazarra García, Noelia<br>Busto Ulloa, Saray<br>Cachafeiro López, María Alicia<br>Calvo Ruibal, Natividad<br>Castejón Lafuente, Alberto Elias<br>Durany Castrillo, José<br>Estévez Martínez, Emilio<br>Fernández García, José Ramón<br>Godoy Malvar, Eduardo<br>Martínez Brey, Eduardo<br>Martínez Torres, Javier<br>Prieto Gómez, Cristina Magdalena |                           |           |                  |
| E-mail              | acachafe@uvigo.es   |                           |           |                  |
| Web                 | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>   |                           |           |                  |
| General description | U obxectivo que se persegue con esta asignatura é que o alumno coñeza as técnicas básicas de o cálculo integral en varias variables, cálculo vectorial, ecuaciones diferenciales ordinarias e as súas aplicacións.  |                           |           |                  |

**Competencias**

|      |   |
|------|---|
| Code |   |
| B3   | CG3 Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.   |
| B4   | CG4 Capacidade para resolver problemas con iniciativa, toma de decisións, creatividade, razoamento crítico e capacidade para comunicar e transmitir coñecementos, habilidades e destrezas no campo da enxeñaría industrial na mención de Química Industrial.  |
| C1   | CE1 Capacidade para a resolución dos problemas matemáticos que poidan presentarse na enxeñaría. Aptitude para aplicar os coñecementos sobre: álgebra lineal; xeometría; xeometría diferencial; cálculo diferencial e integral; ecuacións diferenciais e en derivadas parciais; métodos numéricos; algorítmica numérica; estatística e optimización. |
| D1   | CT1 Análise e síntese.  |
| D2   | CT2 Resolución de problemas.  |
| D3   | CT3 Comunicación oral e escrita de coñecementos.  |
| D6   | CT6 Aplicación da informática no ámbito de estudo.  |
| D9   | CT9 Aplicar coñecementos.   |
| D15  | CT15 Obxectivación, identificación e organización.  |
| D16  | CT16 Razoamento crítico.  |

**Resultados de aprendizaxe**

| Expected results from this subject  | Training and Learning Results |    |                |
|---|-------------------------------|----|----------------|
| Comprensión de os conceptos básicos de o cálculo integral en varias variables.                          | B3                            | C1 | D1             |
| Coñecemento de as principais técnicas de integración de funcións de varias variables.                   | B3<br>B4                      | C1 | D1<br>D2<br>D9 |
| Coñecemento de os principais resultados de o cálculo vectorial e aplicacións.                           | B3<br>B4                      | C1 | D1<br>D2<br>D9 |
| Adquisición de os coñecementos básicos para a resolución de ecuaciones e sistemas diferenciais lineais. | B3<br>B4                      | C1 | D1<br>D2<br>D9 |

|   |    |  |
|---|----|--|
| Comprensión de a importancia de o cálculo integral, cálculo vectorial e de as ecuaciones diferenciales para o estudo de o mundo físico.           | C1 | D9<br>D16                                |
| Aplicación de os coñecementos de cálculo integral, cálculo vectorial e de ecuaciones diferenciales.   | C1 | D2<br>D6<br>D9<br>D16                    |
| Adquisición de a capacidade necesaria para utilizar estes coñecementos en a resolución manual e informática de cuestións, exercicios e problemas. | C1 | D1<br>D2<br>D3<br>D6<br>D9<br>D15<br>D16 |

## Contidos

| Topic   |   |
|---|---|
| Integración en varias variables.                  | Integral dobre sobre rectángulos. Principio de Cavalieri. Redución a integrales iteradas. Integral dobre sobre rexións elementais. Propiedades. Teorema de Fubini. Teorema de o cambio de variable. Caso particular de coordenadas polares.<br>Integral triplo sobre unha caixa e sobre rexións elementais. Teorema de Fubini. Teorema de o cambio de variable. Casos particulares: coordenadas cilíndricas e esféricas. Aplicacións geométricas e físicas de a integral múltiple: cálculo de volumes, centros de masa e momentos de inercia.   |
| Cálculo vectorial                                 | Curvas no plano e no espazo. Lonxitude de arco. Cambio de parámetro. Integral curvilínea ou de traxectoria con respecto á lonxitude de arco de campos escalares. Integral curvilínea ou circulación de campos vectoriales. Propiedades. Teorema fundamental das integrais de liña. Teorema de Green no plano.<br>Superficies regulares. Plano tangente. Vector normal. Área dunha superficie. Integral de superficie de campos escalares. Fluxo ou integral de superficie de campos vectoriales. Operadores diverxencia e rotacional. Caracterización de campos conservativos. Teorema de Stokes. Teorema de Gauss.   |
| Ecuacións diferenciais                            | Ecuacións diferenciais ordinarias. Concepto de solución. Teoremas de existencia e unicidade para problemas de condición inicial. Métodos de resolución de ecuacións diferenciais ordinarias de primeira orde: en variables separables, reducibles a variables separables, homoxéneas, lineais e reducibles a lineais. Ecuacións diferenciais exactas. Factores integrantes. Ecuación diferencial dunha familia uniparamétrica de curvas planas. Traxectorias ortogonales. Ecuacións diferenciais lineais de orde 2 e de orde superior. Problemas de condición inicial. Conxuntos fundamentais. Método de variación de parámetros. Método de coeficientes indeterminados. Redución de orde. Ecuación de Euler. Sistemas de ecuacións diferenciais lineais. |
| Métodos numéricos para problemas de valor inicial | Introdución aos métodos numéricos. Métodos de Euler e Euler mellorado. Método de Runge-Kutta de orde 4.   |

## Planificación

|                                       | Class hours | Hours outside the classroom | Total hours |
|---------------------------------------|-------------|-----------------------------|-------------|
| Lección maxistral                     | 32          | 60                          | 92          |
| Resolución de problemas               | 22          | 24                          | 46          |
| Prácticas de laboratorio              | 9           | 0                           | 9           |
| Exame de preguntas de desenvolvemento | 3           | 0                           | 3           |

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

## Metodoloxía docente

|                          | Description  |
|--------------------------|--|
| Lección maxistral        | O profesor exporá nas clases teóricas os contidos da materia. Os alumnos terán textos básicos de referencia para o seguimento da materia.  |
| Resolución de problemas  | O profesor resolverá problemas e exercicios e o alumno terá que resolver exercicios similares para adquirir as capacidades necesarias.   |
| Prácticas de laboratorio | O profesor resolverá problemas e exercicios de forma manual e/ou mediante o uso de ferramentas informáticas e o alumno terá que resolver exercicios similares para adquirir as capacidades necesarias. |

## Atención personalizada

| Methodologies            | Description  |
|--------------------------|--|
| Resolución de problemas  | O profesor atenderá persoalmente as dúbidas e consultas dos alumnos, en especial nas clases de problemas e laboratorio e en *tutorías. |
| Prácticas de laboratorio | O profesor atenderá persoalmente as dúbidas e consultas dos alumnos, en especial nas clases de problemas e laboratorio e en *tutorías. |

## Avaliación

|                                       | Description  | Qualification | Training and Learning Results |    |  |
|---------------------------------------|--|---------------|-------------------------------|----|--|
| Resolución de problemas               | Realizárase probas escritas e/ou traballos.                      | 40            | B3<br>B4                      | C1 | D1<br>D2<br>D3<br>D6<br>D9<br>D15<br>D16 |
| Exame de preguntas de desenvolvemento | Realizárase una proba final sobre os contidos de toda a materia. | 60            | B3<br>B4                      | C1 | D1<br>D2<br>D3<br>D9<br>D15<br>D16       |

## Other comments on the Evaluation

A avaliación continua levarase a cabo sobre os criterios anteriormente expostos. A cualificación final do alumno será a mellor nota entre a obtida mediante avaliación continua e a obtida na proba final.

Aqueles alumnos que non se acollan á avaliación continua serán avaliados cun exame final sobre os contidos de toda a materia que supoñerá o 100% da nota.

A avaliación dos alumnos en segunda convocatoria consistirá nun exame sobre os contidos da asignatura que supoñerá o 100% da nota.

Compromiso ético:

Espérase que o alumno presente un comportamento ético adecuado. En caso de detectar un comportamento non ético (por exemplo, copia, plagio, utilización de aparellos electrónicos non autorizados) considerarase que o alumno non reúne os requisitos necesarios para superar a materia. Neste caso a cualificación global da asignatura no presente curso académico será de suspenso con cualificación numérica de 0.

## Bibliografía. Fontes de información

### Basic Bibliography

Larson, R., Edwards, B.H., **Cálculo 2 de varias variables**, 9ª edición, McGraw-Hill, 2010

Marsden, E., Tromba, A.J., **Cálculo Vectorial**, 6ª edición, Pearson, 2018

Rogawski, J., **Cálculo: varias variables**, 2ª edición, Reverté, 2012

Thomas, G.B. Jr., **Cálculo: varias variables**, 12ª edición, Addison-Wesley-Pearson Education, 2010

García, A., López, A., Rodríguez, G., Romero, S., de la Villa, A., **Cálculo II. Teoría y problemas de funciones de varias variables**, 2ª edición, CLAGSA, 2002

Nagle, K., Saff, E.B., Snider, A.D., **Ecuaciones diferenciales y problemas con valores en la frontera**, 4ª edición, Pearson Educación, 2005

Zill, D.G., **Ecuaciones Diferenciales con aplicaciones de modelado**, 9ª edición, Cengage Learning, 2009

García, A., García, F., López, A., Rodríguez, G., de la Villa, A., **Ecuaciones Diferenciales Ordinarias**, CLAGSA, 2006

Kincaid, D., Cheney, W., **Métodos numéricos y computación**, 6ª edición, Cengage Learning, 2011

### Complementary Bibliography

## Recomendacións

### Subjects that it is recommended to have taken before

Matemáticas: Álgebra e estatística/V12G320V01103

Matemáticas: Cálculo I/V12G320V01104

### Other comments

En caso de discrepancias, prevalecerá a versión en castelán desta guía.



| <b>IDENTIFYING DATA</b>     |   |                 |      |            |
|-----------------------------|---|-----------------|------|------------|
| <b>Chemistry: Chemistry</b> |   |                 |      |            |
| Subject                     | Chemistry:<br>Chemistry                   |                 |      |            |
| Code                        | V12G350V01205                             |                 |      |            |
| Study programme             | Grado en Ingeniería en Química Industrial |                 |      |            |
| Descriptors                 | ECTS Credits                              | Choose          | Year | Quadmester |
|                             | 6   | Basic education | 1st  | 2nd        |
| Teaching language           | Spanish<br>Galician<br>English            |                 |      |            |
| Department                  |   |                 |      |            |

|                     |  |  |  |  |
|---------------------|--|--|--|--|
| Coordinator         | Cruz Freire, José Manuel   |  |  |  |
| Lecturers           | Alonso Gómez, José Lorenzo<br>Álvarez Álvarez, María Salomé<br>Bolaño García, Sandra<br>Bravo Bernárdez, Jorge<br>Cruz Freire, José Manuel<br>Gómez Costas, Elena<br>Gómez Graña, Sergio<br>Lorenzo Fernández, Paula<br>Moldes Moreira, Diego<br>Nóvoa Rodríguez, Ramón<br>Prieto Jiménez, Inmaculada<br>Rey Losada, Francisco Jesús<br>Salgado Seara, José Manuel<br>Sousa Castillo, Ana<br>Vecino Bello, Xanel |  |  |  |
| E-mail              | jmcruz@uvigo.es  |  |  |  |
| Web                 | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>  |  |  |  |
| General description | This is a basic subject, common for all levels of the industrial fields studies. At the end of the course the students will have a basic knowledge about the principles of general chemistry, organic chemistry and inorganic chemistry, and its application to Industry. This knowledge will be further applied and expanded in other areas of the studies.   |  |  |  |

| <b>Skills</b> |   |
|---------------|---|
| 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. |
| C4            | CE4 Ability to understand and apply the basic knowledge of general chemistry, organic chemistry and inorganic chemistry, and their applications in engineering.             |
| D2            | CT2 Problems resolution.  |
| D10           | CT10 Self learning and work.  |
| D17           | CT17 Working as a team.   |

| <b>Learning outcomes</b>  |                               |    |                  |
|---|-------------------------------|----|------------------|
| Expected results from this subject  | Training and Learning Results |    |                  |
| Knowing the chemical bases of industrial technologies. Specifically, the student will gain basic knowledge of general, organic and inorganic chemistry and their applications in engineering. This will allow the student to apply the basic concepts and fundamental laws of chemistry. Due to theoretical-practical training, the student will be able to effectively carry out lab experiments and to solve basic chemistry exercises. | B3                            | C4 | D2<br>D10<br>D17 |

| <b>Contents</b> |
|-----------------|
| Topic           |

|  |   |
|--|---|
| 1. Atomic theory and chemical bonding                                    | <p>1.1 Atomic theory:<br/>         Particles of the atom: Electron, proton et neutron. Characteristics of the atom: Atomic number and Atomic mass. Isotopes. Stability of the nucleus: Radioactivity (natural and artificial). Evolution of the atomic theory.</p> <p>1.2. Chemical bonding:<br/>         Definition. Intramolecular bonding: Covalent bonding and ionic bonding. Polyatomic molecules: hybridization and delocalization of electrons. Intermolecular bonding: Types of intermolecular forces.</p>  |
| 2. States of aggregation: Solids, gases, pure liquids and solutions      | <p>2.1. Solid state:<br/>         Introduction. Classification of solids: amorphous solids, molecular crystals and liquid crystals, Covalent crystals and ionic crystals.</p> <p>2.2. Gaseous state:<br/>         Characteristics of the gas phase. Ideal gases: Equation of state. Real gases: Equation of state. Properties of gases.</p> <p>2.3. Liquid state:<br/>         Characteristics of the liquid phase: physical properties (density, surface tension, viscosity). Changes of state. Phase diagram. Solutions: colligative properties</p>   |
| 4. Chemical equilibrium: in gas phase, acid-base-base, redox, solubility | <p>4.1. Chemical equilibrium:<br/>         Concept of Equilibrium. Equilibrium Constant. Types of equilibrium. The Le Chatelier Principe.</p> <p>4.2. Acid-base Equilibrium:<br/>         Definition of acid and base. Autoionization of water. Ionic Product. Concept of pH and pOH. Strength of acids and bases: Polyprotic acids. Amphoters. pH calculation. Acid-base titration. Buffer solutions.</p> <p>4.3. Redox equilibrium:<br/>         Concept of oxidation, reduction, oxidising agent, reducing agent. Balance of redox reactions in acid and alkaline media. Redox titration. Electrochemical cells: basic concepts and redox potential. Thermodynamics of electrochemical reactions: Gibbs Energy and cell Potential. Nernst Equation. Faraday's Laws.</p> <p>4.4 Solubility equilibrium:<br/>         Soluble salts: Hydrolysis. Sparingly soluble salts: solubility and solubility product. Factors affecting solubility. Fractional Precipitation. Complex Salts: Definition, properties, dissociation and importance.</p> |
| 5. Chemical kinetics   | <p>5.1. Basic Concepts:<br/>         Reaction Rate. Reaction Order. Kinetic Constant. Rate Equation.</p> <p>5.2. Determination of the Rate Equation:<br/>         Initial rate method. Integrated Rate Laws.</p> <p>5.3. Factors affecting the Reaction Rate.</p>   |
| 6. Basic principles of Organic Chemistry                                 | <p>6.1. Fundamentals of Organic formulation and functional groups:<br/>         6.1.1. Structure of the organic compounds: Alkanes, alkenes and alkynes. Aromatic Hydrocarbons.<br/>         6.1.2. Alcohols and phenols.<br/>         6.1.3. Ethers.<br/>         6.1.4. Aldehydes and ketones.<br/>         6.1.5. Esters.<br/>         6.1.6. Carboxylic acids and derivatives.<br/>         6.1.7. Amines and nitro-compounds.</p>  |
| 7. Basic principles of Inorganic Chemistry.                              | <p>7.1. Metallurgy and the Chemistry of Metals:<br/>         Abundance of metals. Nature of the metallic bond, properties. Theory of the Conduction Band: conducting materials, semiconductors and superconductors. Metallurgical processes: iron and steel.</p> <p>7.2. Non-metallic elements and their compounds:<br/>         General properties. Hydrogen. Carbon. Nitrogen and phosphorous. Oxygen and sulphur. Halogens.</p>  |
| 8. Applied Electrochemistry  | <p>8.1. Applications of the Nernst equation: Determination of pH, Equilibrium constant, solubility product.</p> <p>8.2. Electrochemical cells: types of cells. Concentration Cells. Electric Conductivity in electrolytes. Electrolysis Cells.</p> <p>8.3. Industrial Processes of electrolysis: electrodeposition (electroplating), electrometallurgy, electrolysis chlorine-caustic soda. Fuel cells.</p>   |

|   |  |
|---|--|
| 9. Corrosion and treatment of Surfaces        | <p>9.1. Basic principles of Corrosion: the corrosion cell.</p> <p>9.2. Corrosion of metals.</p> <p>9.3. Corrosion rate.</p> <p>9.4. Types of Corrosion.</p> <p>9.5. Protection against Corrosion:</p> <p>Design considerations for Corrosion protection. Cathodic protection: sacrificial anodes and impressed current. Organic Coatings. Metallic coatings.</p>   |
| 10. Electrochemical sensors                   | <p>10.1. Fundamentals.</p> <p>10.2. Typology and function.</p> <p>10.3. Conductivity Sensors.</p> <p>10.4. Potentiometric Sensors.</p> <p>10.5. Ion Selective electrodes. pH sensors.</p> <p>10.6. Sensors for gases in solution.</p> <p>10.7. Enzyme-based sensors: Biosensors.</p> <p>10.8. Amperometric and voltammetric sensors.</p> <p>10.9. Applications of sensors: medicine, industry, environment.</p>      |
| 11. Petroleum and derivatives. Petrochemistry | <p>11.1. Physicochemical characteristics of petroleum (oil).</p> <p>11.2. Physicochemical characteristics of natural gas.</p> <p>11.3. Conditioning and uses of natural gas.</p> <p>11.4. Drilling and crude oil extraction.</p> <p>11.5. Fractioning of oil.</p> <p>11.6. Cracking, alkylation, reforming and isomerisation of hydrocarbons.</p> <p>11.7. Treatment of sulphurous compounds and refining units.</p> |
| 12. Carbon: Carbochemistry                    | <p>(12.1. Formation of carbon.</p> <p>12.2. Types of carbons and their constitution.</p> <p>12.3. Technological uses of carbon.</p> <p>12.4. Pyrogenation of carbon.</p> <p>12.5. Hydrogenation of carbon.</p> <p>12.6. Direct liquefaction of carbon. Gasification.</p>   |

### Planning

|   | Class hours | Hours outside the classroom | Total hours |
|---|-------------|-----------------------------|-------------|
| Lecturing   | 32          | 45                          | 77          |
| Problem solving   | 10          | 12                          | 22          |
| Laboratory practical                                    | 5.4         | 7.6                         | 13          |
| Autonomous problem solving                              | 0           | 25.5                        | 25.5        |
| Objective questions exam                                | 1           | 0                           | 1           |
| Problem and/or exercise solving                         | 3           | 0                           | 3           |
| Report of practices, practicum and external practices 1 |             | 7.5                         | 8.5         |

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

### Methodologies

|                            | Description  |
|----------------------------|--|
| Lecturing                  | Presentation by the faculty member of the theoretical content of the subject using audiovisual media.  |
| Problem solving            | Activity in which problems and/or exercises related to the subject will be formulated. Students should develop appropriate solutions by applying formulas or algorithms to manage the available information and interpret the results.   |
| Laboratory practical       | Activities of application of the theoretical background to specific situations, aimed to the acquisition of basic skills related to the subject. Will be developed in the laboratories or computer rooms of the center in which subject is given. Those rooms will be equipped with the necessary specialized equipment. |
| Autonomous problem solving | Activity in which the teacher formulates problems and/or exercises related to the subject, and the student must develop the analysis and resolution in an autonomous way.  |

### Personalized assistance

| Methodologies        | Description  |
|----------------------|--|
| Lecturing            | Any doubt related with the contents given in the mater sessions will be clarified.         |
| Problem solving      | Any doubt related with the problems resolved in the seminars of problems will be answered. |
| Laboratory practical | Any doubt related with the laboratory practices will be answered.                          |

### Assessment

| Description   | Qualification | Training and Learning Results |
|---|---------------|-------------------------------|
| Autonomous problem solving                            | 10            | B3 C4 D2 D10                  |
| Objective questions exam                              | 40            | B3 C4 D10                     |
| Problem and/or exercise solving                       | 40            | B3 C4 D2 D10                  |
| Report of practices, practicum and external practices | 10            | C4 D17                        |

### Other comments on the Evaluation

The final exam, consisting of two different parts, a test-type quiz for theory content and a set of exercises, will be considered for the final score weighting only when they were rated greater than or equal to 4. Although the average score could be equal or greater than 5, if the qualification of any of the parts of the final exam be lower than 4, the final score will be the lowest mark obtained in the final exam (which is the one that does not permit to calculate the average mark). The attendance to any lab session or any seminar test means that the student is being evaluated and therefore a qualification of [not presented] is no longer possible.

Those students that obtain officially the renunciation to the continuous evaluation will be evaluated by the final exam, to be held in the official date for the two calls. The final qualification will consist of a 50% of exercises and a 50% of theory (test-type) exam. A rate equal to or greater than 4 in both parts is necessary in order to pass the exam.

The marks of continuous evaluation (seminars test and lab experiments) and the marks of final exam higher than 5 (test quiz or exercises) obtained in the first call will be kept for the second call.

Ethical commitment:

The student is expected to present an adequate ethical behavior. If an unethical behavior is detected (copying, plagiarism, unauthorized use of electronic devices, and others) it is considered that the student does not meet the requirements for passing the subject. In this case, the final grade in the current academic year will be FAIL (0.0 points).

The use of electronic devices during the assessment tests will be not permitted. Introducing an unauthorized electronic device into the examination room, will be considered as a FAIL (0.0 points) in the current academic year.

### Sources of information

#### Basic Bibliography

Chang, R., **Química**, Ed. McGraw Hill,

Petrucci, R. H., Herring, F.G., Madura, J.D., Bissonnette, C., **Química General**, Ed. Prentice-Hall,

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## Recommendations

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### Subjects that it is recommended to have taken before

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(\*)Física: Física I/V12G350V01102

(\*)Matemáticas: Álgebra e estadística/V12G350V01103

(\*)Matemáticas: Cálculo I/V12G350V01104

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### Other comments

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It is recommended that students have taken and passed the subject of ""Chemistry"" in second baccaulaureate or, alternatively, passed a specific test of access to the Degree.

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