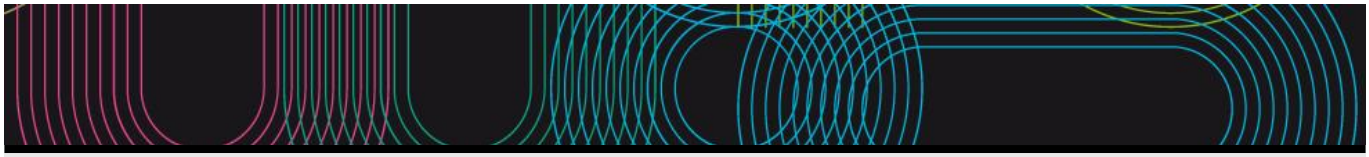

# (*)Escola de Enxeñaría Industrial

| Information |
| --- |
| For additional information about the centre and its degres visit the centre's website https://eei.uvigo.es/ |

# Grado en Ingeniería en Tecnologías Industriales

**Subjects**

**Year 1st**

| Code | Name | Quadmester | Total Cr. |
| --- | --- | --- | --- |
| V12G363V01101 | Graphic expression: Fundamentals of engineering graphics | 1st | 9 |
| V12G363V01102 | Physics: Physics 1 | 1st | 6 |
| V12G363V01103 | Mathematics: Algebra and statistics | 1st | 9 |
| V12G363V01104 | Mathematics: Calculus 1 | 1st | 6 |
| V12G363V01201 | Business: Introduction to business management | 2nd | 6 |
| V12G363V01202 | Physics: Physics 2 | 2nd | 6 |
| V12G363V01203 | Computer science: Computing for engineering | 2nd | 6 |
| V12G363V01204 | Mathematics: Calculus 2 and differential equations | 2nd | 6 |
| V12G363V01205 | Chemistry: Chemistry | 2nd | 6 |

## IDENTIFYING DATA

**Graphic expression: Fundamentals of engineering graphics**

| | | | | |
|---|---|---|---|---|
| Subject | Graphic expression: Fundamentals of engineering graphics | | | |
| Code | V12G363V01101 | | | |
| Study programme | Grado en Ingeniería en Tecnologías Industriales | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 9 | Basic education | 1st | 1st |
| Teaching language | Spanish<br>Galician<br>English | | | |
| Department | | | | |
| Coordinator | Troncoso Saracho, José Carlos<br>Fernández Álvarez, Antonio | | | |
| Lecturers | Alegre Fidalgo, Paulino<br>Comesaña Campos, Alberto<br>Fernández Álvarez, Antonio<br>Patiño Barbeito, Faustino<br>Prado Cerqueira, José Luís<br>Troncoso Saracho, José Carlos<br>Varela Alén, José Luis<br>Villar García, Marcos | | | |
| E-mail | antfdez@uvigo.gal<br>tsaracho@uvigo.es | | | |
| Web | http://moovi.uvigo.gal/ | | | |
| 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. | | | |

## Training and Learning Results

| Code | |
|---|---|
| B3 | CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations. |
| B4 | CG4 Ability to solve problems through initiative, decision-making, creativity, critical reasoning, and to communicate and transmit knowledge, skills and abilities in the field of industrial engineering. |
| B6 | CG6 Capacity for handling specifications, regulations and mandatory standards. |
| C5 | CE5 Spatial vision and knowledge of techniques for graphical representation, both through traditional methods of metric geometry and descriptive geometry, and through computer-aided design applications. |
| D2 | CT2 Problem solving. |
| D6 | CT6 Application of computer science in the field of study. |
| D9 | CT9 Application of knowledge. |

## Expected results from this subject

| Expected results from this subject | Training and Learning Results | | |
|---|---|---|---|
|  Know, understand, and apply a body of knowledge on the fundamentals and normalisation of industrial engineering drawing, in its broadest concept, while at the same time fostering the development of the spatial skills. | B3<br>B4 | C5 | D6 |
|  Acquire the capacity for abstract reasoning and for the establishment of strategies and efficient procedures in the resolution of graphic problems within the context of engineering works and projects. | B3<br>B4 | C5 | D2 |
|  Use new technologies to develop graphic communication skills, including the creation and interpretation of engineering drawings which are compliant with the Technical Drawing Standards. | B6 | C5 | D6<br>D9 |
|  Adopt a positive attitude towards lifelong learning, being proactive, participative and with a spirit of self-improvement. | B4 | | D9 |

## Contents

| Topic |
|---|

| | |
|---|---|
| Block 0.<br>Computer-aided drawing. Sketching and application of standards. | - Introduction to Computer-aided Drawing. CAD.<br>- Working environment. Coordinate systems.<br>- Drawing commands. Graphical entities. Drawing aids. Object snapping.<br>- Modify tools. Visualization options. Inquiry commands.<br>- Plotting scaled drawings.<br>- Sketching and application of standards. |
| Block 1. 2D geometry. | - Review of fundamental geometry concepts.<br>- Conics: definitions, focal and major circles, drawing a tangent to a conic curve.<br>- Constructing tangencies through loci, expansion/contraction and inversive geometry.<br>- Technical curves (roulettes): trochoids and involutes (evolvents). |
| Block 2. Projections. | - Introduction: Types of projection. Projective invariants.<br>- Topographic projection: Representation of basic elements (points, lines, planes). Elementary constructions, intersections, parallelism and perpendicularity. Roof plans. Landform drawing.<br>- 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.<br>- Pictorial representation: Axonometric projection (isometric, dimetric, trimetric). Oblique projection (cavalier and cabinet projection).<br>- Central projection: one-point perspective, two-point perspective and three-point perspective.<br>- Surfaces: Polyhedra. Curved surfaces (ruled surfaces and surfaces of revolution). Intersection between two surfaces. |
| Block 3. Standardisation. | - 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.).<br>- Introduction to standardisation: Benefi□ts of standardization. Specifications, regulations and technical standards.<br>- Basic standards for Technical Drawing: Drawing sheets. Title blocks. Types of lines. Lettering. Scales. Folding of drawing sheets.<br>- 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).<br>- 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.).<br>- Threads. Elements of a thread. Types of threads. Standard representation of threads. Threads in assembly. Thread specification. Simplified representation.<br>- Working drawings: Assembly drawings (definition and types). General rules and conventions for assembly drawings. Parts list. Part drawings. Drawing numbering system. Examples.<br>- 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. Microtolerances. |

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Lecturing | 38 | 76 | 114 |
| Problem solving | 34 | 15 | 49 |
| Seminars | 3.5 | 0 | 3.5 |
| Project based learning | 0 | 22 | 22 |
| Problem and/or exercise solving | 3 | 0 | 3 |
| Problem and/or exercise solving | 3 | 0 | 3 |
| Laboratory practice | 1 | 10 | 11 |

| | | | |
|---|---|---|---|
| Laboratory practice | 3.5 | 16 | 19.5 |

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

## Methodologies

| | Description |
|---|---|
| Lecturing | 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. |

## Personalized assistance

| Methodologies | Description |
|---|---|
| Seminars | |

## Assessment

| | Description | Qualification | Training and Learning Results |
|---|---|---|---|
| Problem and/or exercise solving | It will make a first partial examination (eliminatory of matter) of the first contents of the matter, that will be able to include test type test, questions of reasoning, resolution of problems and development of practical cases.<br><br>It demands reach a minimum qualification of 4,0 points on 10 possible to be able to surpass the subject. | 20-30 | B3 C5 D2<br>B6 D9 |
| Problem and/or exercise solving | It will make a second partial examination (eliminatory of matter) of the remaining contents of the matter, that will be able to include test type test, questions of reasoning, resolution of problems and development of practical cases.<br><br>It demands reach a minimum qualification of 4,0 points on 10 possible to be able to surpass the subject. | 30-40 | B4 C5 D2<br>B6 D9 |
| Laboratory practice | It will make a proof of practise of CAD, in which it will verify the capacity of the student in the handle of systems of drawing by computer.<br><br>It demands reach a minimum qualification of 5,0 points on 10 possible to be able to surpass the subject | 20 | B4 C5 D2<br>D6<br>D9 |
| Laboratory practice | Along the course, in determinate sessions will pose problems or exercises for his resolution by the students and back delivery to the professor, that will evaluate them in accordance with the criteria that previously will have communicated to the students. These tasks will be so much in format paper as of CAD.<br><br>It demands reach a minimum qualification of 5,0 points on 10 possible to be able to surpass the subject. | 20 | B4 C5 D2<br>D6<br>D9 |

## Other comments on the Evaluation

**MODALITY OF CONTINUOUS EVALUATION:**

There will be two eliminatory partial tests (with an approximate weight of 25% and 35%) in which a minimum mark of 4.0 out of a possible 10 points must be obtained in each of the tests (as well as an overall 5.0) in order to pass the subject. The parts not passed can be passed later in the final exam of the subject.

In addition to the two partial tests, the practical work will also be assessed by means of a CAD test and the different sheet, exercises and practical work that will be carried out throughout the whole four-month period (with a weight of 20% and 20% respectively for each of these two parts). In order to pass the subject, a minimum mark of 5.0/10 points must be achieved in each of these parts.

In the final exam, a theoretical-practical test will be carried out to assess the degree of acquisition of competences, in which a minimum grade of 5.0/10 will be required to pass the course.

In the second call, there will be a theoretical-practical test in order to pass the course, it will be necessary to achieve a minimum grade of 5.0/10. This exam is open to all students who have not passed the subject in any of the previous tests.

**MODALITY OF NON CONTINUOUS EVALUATION:**

Students who waive continuous assessment must sit the final exam with all the material and must also take a practical test in order to pass the subject. This practical test, which will complete the overall final exam, will consist of two parts, one of CAD and the other of graphic tracings (in addition, in order to take this practical test, students may be required to present a series of tasks previously carried out by the student).

In the second call, there will be a theoretical-practical test with similar characteristics to the final exam, in which, in order to pass the course, it will be necessary to achieve a minimum grade of 5.0/10. This exam is open to all students who have not passed the subject in any of the previous tests.

**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


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Auria, José M.; Ibáñez Carabantes, Pedro; Ubieto Artur, Pedro, **DIBUJO INDUSTRIAL. CONJUNTOS Y DESPIECES**, 2ª Edición, ISBN: 84-9732-390-4,

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### Complementary Bibliography


López Poza, Ramón y otros, **Sistemas de Representacion I**, ISBN 84-400-2331--6,

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Guirado Fernández, Juan José, **INICIACIÓN Á EXPRESIÓN GRÁFICA NA ENXEÑERÍA**, ISBN: 84-95046-27-X,

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David A. Madsen, David P. Madsen, **Engineering Drawing Design**, 5ª, Delmar Cengage Learning, 2012

Casasola Fernández, Mª Isabel y otros, **Sistemas de representación I, Teoría y problemas**, ISBN 978-84-615-3553-8, ISBN 978-84-615-3553-8, Ed. Asociación de Investigación, 2011

González García,V.; López Poza, R.; Nieto Oñate, M., **Sistemas de Represntación I**, ISBN: 84-400-2331-6,

Bertoline, Wiebe, Miller, Mohler, **Dibujo en Ingeniería y Comunicación Gráfica**, 9701019474, 9789701019474, 2ª, McGraw-Hill, 1999


## 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.

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Physics: Physics 1** | | | | |
| Subject | Physics: Physics 1 | | | |
| Code | V12G363V01102 | | | |
| Study programme | Grado en Ingeniería en Tecnologías Industriales | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Basic education | 1st | 1st |
| Teaching language | Spanish<br>Galician | | | |
| Department | | | | |
| Coordinator | Lusquiños Rodríguez, Fernando | | | |
| Lecturers | Añel Cabanelas, Juan Antonio<br>Barro Guizán, Óscar<br>Blanco García, Jesús<br>Boutinguiza Larosi, Mohamed<br>Fernández Arias, Mónica<br>Lusquiños Rodríguez, Fernando<br>Pou Álvarez, Pablo<br>Ribas Pérez, Fernando Agustín<br>Serra Rodríguez, Julia Asunción<br>Soto Costas, Ramón Francisco<br>Trillo Yáñez, María Cristina<br>Varela Benvenuto, Ramiro Alberto<br>Vázquez Besteiro, Lucas | | | |
| E-mail | flusqui@uvigo.es | | | |
| Web | http://moovi.uvigo.gal/ | | | |
| General description | Physics course for 1st year bachelor degrees | | | |

| Training and Learning Results | |
|---|---|
| Code | |
| B3 | CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and 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 Problem solving. |
| D9 | CT9 Application of knowledge. |
| D10 | CT10 Self learning and work. |

| Expected results from this subject | Training and Learning Results | | |
|---|---|---|---|
| To understand the basic concepts of the general laws of mechanics, and fields and waves. | B3 | C2 | |
| To be familiar with the basic instrumentation to measure physical quantities. | | C2 | |
| To know the basic techniques for the analysis and evaluation of experimental data. | B3 | C2 | D9<br>D10 |
| To develop practical solutions to elementary technical engineering problems in the areas of mechanics and fields and waves. | B3 | C2 | D2<br>D9<br>D10 |

| Contents | |
|---|---|
| Topic | |
| 1.- UNITS, PHYSICAL QUANTITIES AND VECTORS | 1.1.- The nature of Physics.<br>1.2.- Consistency and conversions of units.<br>1.3.- Uncertainty and significant figures.<br>1.4.- Estimates and orders of magnitude.<br>1.5.- Vectors and sum of vectors.<br>1.6.- Vector components.<br>1.7.- Unitary vectors.<br>1.8.- Vector products.<br>1.9.- Sliding Vectors |

| | |
|---|---|
| 2.- KINEMATICS | 2.1.- Position, speed and acceleration vectors. Average and instantaneous values.<br>2.2.- Angular speed and angular acceleration. Average and instantaneous values.<br>2.3.- Relation between linear kinematic magnitudes and angular magnitudes.<br>2.4.- Intrinsic components.<br>2.5.- Study of simple movements: linear motion in 1D, circular motion, projectile motion.<br>2.6.- Expression of kinematic magnitudes in cartesian and polar coordinates |
| 3.- NEWTON'S LAWS OF MOTION | 3.1.- Force and interactions.<br>3.2.- Newton's first law. Inertial and non-inertial reference systems.<br>3.3.- Newton's second law.<br>3.4.- Mass and weight.<br>3.5.- Newton's third law.<br>3.6.- Momentum. Mechanical impulse. Angular momentum.<br>3.7.- Contact forces. |
| 4.- WORK AND KINETIC ENERGY | 4.1.- Work done by a force. Power.<br>4.2.- Kinetic energy.<br>4.3.- Conservative Forces<br>4.4.- Elastic potential energy.<br>4.5.- Potential energy in the gravitatory field.<br>4.6.- Mechanical energy.<br>4.7.- Force and potential energy.<br>4.8.- Principle of conservation of mechanical energy. |
| 5.- KINEMATICS OF SYSTEM OF PARTICLES | 5.1.- System of particles.<br>5.2.- Rigid body.<br>5.3.- Translation movement.<br>5.4.- Movement of rotation around a fixed axis.<br>5.5.- General movement.<br>5.6.- Instantaneus center of rotation.<br>5.7.- Rolling motion.<br>5.8.- Relative movement. |
| 6.- DYNAMICS OF SYSTEMS OF PARTICLES | 6.1.- Systems of particles. Internal and external forces.<br>6.2.- Centre of mass. Movement of the centre of mass.<br>6.3.- Equations of the movement of a system of particles.<br>6.4.- Linear momentum. Conservation of linear momentum.<br>6.5.- Angular moment of a system of particles. Conservation of angular momentum.<br>6.6.- Work and power.<br>6.7.- Potential energy and kinetics of a system of particles.<br>6.8.- Conservation of energy of a system of particles.<br>6.9.- Collisions. |
| 7.- RIGID BODY DYNAMICS | 7.1.- Rotation of a rigid body around a fixed axis.<br>7.2.- Moments and products of inertia.<br>7.3.- Calculation of moments of inertia.<br>7.4.- Steiner's theorem.<br>7.5.- Moment of a force and pair of forces.<br>7.6.- Equations of the general movement of a rigid body.<br>7.7.- Kinetic energy in the general movement of a rigid body.<br>7.8.-Work in the general movement of a rigid body.<br>7.9.- Angular momentum of a rigid body. Conservation theorem. |
| 8.- STATICS | 8.1.- Equilibrium of rigid bodies.<br>8.2.- Center of gravity.<br>8.3.- Stability.<br>8.4.- Degrees of freedom and links |
| 9.- PERIODIC MOTION | 9.1.- Description of the oscillation.<br>9.2.- Simple harmonic motion.<br>9.3.- Energy in the simple harmonic motion.<br>9.4.- Applications of simple harmonic motion.<br>9.5.- The simple pendulum.<br>9.6.- The physical pendulum.<br>9.7.- Damped oscillations.<br>9.8.- Forced oscillations and resonance. |

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

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Lecturing | 24.5 | 45 | 69.5 |
| Problem solving | 8 | 20 | 28 |
| Laboratory practical | 18 | 18 | 36 |
| Objective questions exam | 1 | 0 | 1 |
| Problem and/or exercise solving | 3.5 | 0 | 3.5 |
| Essay questions exam | 3 | 0 | 3 |
| Report of practices, practicum and external practices | 0 | 9 | 9 |
| *The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. | | | |

**Methodologies**

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

**Personalized assistance**

| **Methodologies** | **Description** |
|---|---|
| Lecturing | In office hours |
| Laboratory practical | in office hours |
| Problem solving | In office hours |
| **Tests** | **Description** |
| Objective questions exam | In office hours |
| Problem and/or exercise solving | In office hours |
| Essay questions exam | In office hours |

| | |
|---|---|
| Report of practices, practicum and external practices | In office hours |

| Assessment | | | |
|---|---|---|---|
| | Description | Qualification | Training and Learning Results |
| Objective questions exam | Tests for evaluating the acquired competences that include closed questions with different answer alternatives (true / false, multiple choice, pairing of elements ...). Students select an answer from a limited number of possibilities. | 10 | B3 C2 |
| Problem and/or exercise solving | Test in which the student must solve a series of problems and / or exercises in a time / condition established by the teacher. In this way, the student must apply the knowledge they have acquired. | 50 | B3 C2 D2 |
| Essay questions exam | Competency assessment tests that include open-ended questions on a topic. Students must develop, relate, organize and present the knowledge they have on the subject in an extensive answer. | 30 | B3 C2 |
| Report of practices, practicum and external practices | Preparation of a document by the student that reflects the characteristics of the work carried out. Students must describe the tasks and procedures developed, show the results obtained or observations made, as well as the analysis and treatment of data. | 10 | B3 C2 D9 D10 |

**Other comments on the Evaluation**

1. CONTINUOUS ASSESSMENT (EC)

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

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

The mark ECL will be evaluated by means of practices reports, with a weight of 10% in the final mark (mark ECLI), and tests, with a weight of 10% in the final mark (mark ECLE). It is mandatory

the attendance to all lab sessions to obtain the mark ECL, otherwise, the mark ECL will be 0.0.

Final mark EC for the continuous assessment modality:

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

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

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

2. GLOBAL ASSESSMENT (EG)

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

Final mark EG for the global assessment modality:

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

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

In the extraordinary exam, a student who has previously obtained marks EGA1 or EGL1 (or both) can choose between: a)

answering the exam(s) corresponding to mark EGA2 and/or mark EGL2, in such a way that the new mark EGA2 replaces EGA1 and/or the new mark EGL2 replaces EGL1, and b) maintaining mark EGA1 and/or mark EGL1 instead of taking the exam(s) corresponding to mark EGA2 and/or mark EGL2, respectively.

3. END-OF-PROGRAM EXAM (FC)

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

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

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

4. GENERAL RULES

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

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

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

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

1. CONTINUOUS ASSESSMENT (EC)

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

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

The mark ECL will be evaluated by means of practices reports, with a weight of 10% in the final mark (mark ECLI), and tests, with a weight of 10% in the final mark (mark ECLE). It is mandatory

the attendance to all lab sessions to obtain the mark ECL, otherwise, the mark ECL will be 0.0.

Final mark EC for the continuous assessment modality:

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

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

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

2. GLOBAL ASSESSMENT (EG)

Those students who have been granted the waiver of the continuous assessment have the possibility of taking a written

global test to obtain a mark EG with a weight of 100% of the final mark. This test will include the following parts: a test on topics covered in the lectures, with a weight of 80% in the final mark (mark denoted EGA1 in the ordinary exam and EGA2 in the extraordinary exam), and a test on laboratory topics, with a weight of 20% in the final mark (mark denoted EGL1 in the ordinary exam and EGL2 in the extraordinary exam).

Final mark EG for the global assessment modality:

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

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

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

3. END-OF-PROGRAM EXAM (FC)

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

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

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

4. GENERAL RULES

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

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

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

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

## Sources of information

### Basic Bibliography

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

### Complementary Bibliography

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

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

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

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

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

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

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

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,

## Recommendations

**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.

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Mathematics: Algebra and statistics** | | | | |
| Subject | Mathematics: Algebra and statistics | | | |
| Code | V12G363V01103 | | | |
| Study programme | Grado en Ingeniería en Tecnologías Industriales | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 9 | Basic education | 1st | 1st |
| Teaching language | Spanish<br>Galician<br>English | | | |
| Department | | | | |
| Coordinator | Matías Fernández, José María | | | |
| Lecturers | Bajo Palacio, Ignacio<br>Bazarra García, Noelia<br>Castejón Lafuente, Alberto Elias<br>Fiestras Janeiro, Gloria<br>Gómez Rúa, María<br>Luaces Pazos, Ricardo<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 | | | |
| Web | http://moovi.uvigo.gal/ | | | |
| General description | (*) The objective of this course is that the student acquires the mastery of the basic techniques of Linear Algebra and Statistics that are necessary in other subjects that must be taken later in the degree. | | | |

| Training and Learning Results | |
|---|---|
| Code | |
| B3 | CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and 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 Problem solving. |
| D5 | CT5 Information Management. |
| D6 | CT6 Application of computer science in the field of study. |
| D9 | CT9 Application of knowledge. |

| Expected results from this subject | Training and Learning Results | | | |
|---|---|---|---|---|
| Acquire the basic knowledge on matrices, vector spaces and linear maps. | A2 | B1<br>B2<br>B3 | C1<br>C20<br>C22 | |
| Handle the operations of the matrix calculation and use it to solve problems to systems of linear equations. | A4 | B1<br>B2<br>B3 | C1<br>C22 | D2<br>D5<br>D8 |
| Understand the basic concepts on eigenvalues and eigenvectors, vector spaces with scalar product and quadratic forms used in other courses and sove basic problems related to these subjects. | | B2<br>B3<br>B9<br>B14<br>B15 | C1<br>C1<br>C2<br>C3<br>C4 | D1<br>D2<br>D2<br>D3<br>D4<br>D5<br>D6<br>D9 |

| | | | | |
|---|---|---|---|---|
| Perform basic exploratory analysis of databases. | | B1<br>B2<br>B3<br>B9<br>B10<br>B11<br>B12<br>B13<br>B14 | C1<br>C1<br>C5<br>C6<br>C7<br>C9<br>C10<br>C13<br>C14<br>C15<br>C16 | D1<br>D2<br>D3<br>D4<br>D5<br>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. | A2<br>A3 | B3<br>B3<br>B4 | C1<br>C7<br>C13<br>C14<br>C16<br>C17<br>C18 | D1<br>D2<br>D3<br>D4<br>D6<br>D10 |

| **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 |
| Problem and/or exercise solving | 4.5 | 0 | 4.5 |

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

| Methodologies | |
|---|---|
| | Description |
| Lecturing | 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 and/or exercise solving | CONTINUOUS ASSESSMENT (CA). Students who wish to take part in continuous assessment will have continuous assessment tests throughout the term.<br>*** In Algebra, there will be three CA tests with the weights on the final grade of Algebra indicated: 2 partial exam(15% each test) to be held in the weeks scheduled by the Centre for the practices of the first term, and a third global exam (all subject contents) that will take place on the date of the exam of the global assessment option. In addition, 10% of the final mark in Algebra will correspond to class work and exercises.<br>*** In Statistics, there will be two CA tests with the weights on the final Statistics grade indicated: the first one for topics 1 and 2 (20%) to be taken upon completion of these topics, and the second one will be global (80%) and will take place on the date of the exam of the global assessment option.<br><br>GLOBAL ASSESSMENT (GA). Students who wish to take the GA will only have a final exam in Algebra and another in Statistics at the end of the term, which will include the whole subject. | 100 | B3 | C1 | D2<br>D5<br>D6<br>D9 |

**Other comments on the Evaluation**

**Continuous Evaluation vs. Global Assessment**. Students must choose between the Continuous Assessment (CA) and Global Assessment (GA) systems before the deadline established by the School.

**Assessment 1st Opportunity**. At the end of the term, once the continuous or global assessment exams have been completed, the student will have a grade out of 10 points for Algebra (A) and a grade out of 10 points for Statistics (S), which will represent 100% of the grade for each part. The final grade of the subject will be calculated as follows:

- If both grades A and S are greater 0 equal to 3.5, then the final grade will be (A+S)/2.
- If either grade A or S is less than 3.5, then the final grade will be the minimum of the amounts (A+S)/2 and 4.5.

A student will be given the grade of no-show if he/she does not sit for any of the CA or GA exams of the two parts of the subject after the deadline established by the center to decide between CA or GA; if, after that deadline, he/she sits for any test that corresponds to him/her according to that decision, he/she will be considered to have sat for it.

**Assessment 2nd Opportunity**. The evaluation of the students in the second edition of the minutes will be carried out by means of an exam of Algebra and another one of Statistics that will suppose 100% of the final grade of each part. To calculate the final grade of the subject the procedure described above will be applied. If at the end of the term (first edition of minutes) a student obtains a grade higher or equal to 5 points (out of 10) in one of the parts (Algebra or Statistics) then, in the second edition, he/she will be able to skip the final exam of that part and keep the grade obtained in the first edition.

**Ethical commitment**: The student is expected to present an appropriate ethical behaviour. In the case of detecting unethical behaviour (copying, plagiarism, use of unauthorized electronic devices, and others) it will be considered that the student does not meet the necessary requirements to pass the subject. In this case the overall grade for the current academic year will be a failing grade (0.0).

The use of any electronic device will not be allowed during the evaluation tests unless expressly authorized.

The fact of introducing an unauthorized electronic device in the exam room will be considered a reason for not passing the subject in the current academic year and the overall grade will be a fail (0.0).

## 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,

Jay L. Devore, **Probability and Statistics for Engineering and the Sciences**, 8th edition,

Douglas C. Montgomery & George C. Runger, **Applied Statistics and Probability for Engineers**, 5th edition,

Openstax College (Internet), **Introductory Statistics**,

William Navidi, **Statistics for Engineers and Scientists**, 3rd edition,


### Complementary Bibliography

## Recommendations

### Subjects that are recommended to be taken simultaneously

Mathematics: Calculus I/V12G380V01104

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Mathematics: Calculus 1** | | | | |
| Subject | Mathematics: Calculus 1 | | | |
| Code | V12G363V01104 | | | |
| Study programme | Grado en Ingeniería en Tecnologías Industriales | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Basic education | 1st | 1st |
| Teaching language | Spanish<br>Galician | | | |
| Department | | | | |
| Coordinator | Martínez Martínez, Antonio | | | |
| Lecturers | Busto Ulloa, Saray<br>Díaz de Bustamante, Jaime<br>Estévez Martínez, Emilio<br>Martínez Martínez, Antonio<br>Meniño Cotón, Carlos<br>Prieto Gómez, Cristina Magdalena<br>Rodal Vila, Jaime Alberto<br>Vidal Vázquez, Ricardo | | | |
| E-mail | antonmar@uvigo.es | | | |
| Web | http://moovi.uvigo.gal/ | | | |
| 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. | | | |

| Training and Learning Results | |
|---|---|
| Code | |
| B3 | CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations. |
| B4 | CG4 Ability to solve problems through initiative, decision-making, creativity, critical reasoning, and to communicate and transmit knowledge, skills and abilities in the field of industrial engineering. |
| 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 Problem solving. |
| D6 | CT6 Application of computer science in the field of study. |
| D9 | CT9 Application of knowledge. |
| D14 | CT14 Creativity. |
| D16 | CT16 Critical thinking. |

| Expected results from this subject | Training and Learning Results | | |
|---|---|---|---|
| Understanding of the basic knowledges of differential calculation of one and of several variables. | B3 | C1 | D1 |
| Understanding of the basic knowledges of integral calculation of functions of a variable. | B3 | C1 | D1 |
| I handle of the technicians of differential calculation for the location of extremes, the local approximation of functions and the numerical resolution of systems of equations. | B3<br>B3<br>B4 | C1<br>C2 | D2<br>D2<br>D9<br>D10<br>D14<br>D16 |
| I handle of the technicians of integral calculation for the calculation of areas, volumes and surfaces. | B3<br>B3<br>B4 | C1<br>C1 | D1<br>D1<br>D2<br>D9<br>D14<br>D16 |

| | | | |
|---|---|---|---|
| Utilisation of computer tools to resolve problems of differential calculation and of integral calculation. | B3<br>B4 | C1<br>C1 | D2<br>D2<br>D6<br>D9<br>D16 |

| Contents | |
|---|---|
| Topic | |
| Convergence and continuity | Introduction to real numbers. Absolute value. Euclidean space R^n.<br>Successions. Series.<br>Limits and continuity of functions of one and several variables. |
| Differential calculus of functions of one and several variables | Differential calculus of real functions of one real variable<br>Differential calculus of functions of several real variables |
| Integral calculus of functions of one variable | The Riemann integral. Calculus of primitives.<br>Improper integrals.<br>Applications of the 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 | The professor will resolve problems and exercises type and the student will have to resolve similar exercises. |
| Laboratory practical | They will employ computer tools to resolve exercises and apply the knowledges obtained in the classes of theory. |
| Lecturing | The professor will expose in the theoretical classes the contents gives the matter. |

| Personalized assistance | |
|---|---|
| **Methodologies** | **Description** |
| Problem solving | The professor will attend personally the doubts and queries of the students. |
| Laboratory practical | The professor will attend personally the doubts and queries of the students. |

| Assessment | | | | | |
|---|---|---|---|---|---|
| | Description | Qualification | Training and Learning Results | | |
| Problem and/or exercise solving | They will make controls written and/or works.<br>The weight of each one of them will not surpass 30% of the continuous evaluation. | 60 | B3<br>B4 | C1 | D1<br>D2<br>D6<br>D9<br>D14<br>D16 |
| Essay questions exam | It will do a final examination on the contents of the whole of the matter. | 40 | B3<br>B4 | C1 | D1<br>D2<br>D9 |

**Other comments on the Evaluation**

The continuous eval. carry to cape on the previously exposed criteria. Those students that do not receive to the continuous eval be evaluated with a final examination on the contents of the whole of the matter, that will be the 100% of the note.

The continuous eval. of the students in second announcement consist in an examination on the contents of the whole of the matter, that will be 100% of the note.

Commitment:

"It expects that the present student a behaviour ethtic o suitable. In case to detect a behaviour no-ethic o (copy, plagiarism,

use of electronical devices unauthorised, and others) consider hat the student doesnt the necessary requirements to surpass the matter. In this case the calification in the present course will be 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: Introduction to business management | | | |
| Code | V12G363V01201 | | | |
| Study programme | Grado en Ingeniería en Tecnologías Industriales | | | |
| 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>Fernández Arias, María Jesús<br>González-Portela Garrido, Alicia Trinidad<br>Pérez Pereira, Santos<br>Reyes Santias, Francisco<br>Sinde Cantorna, Ana Isabel<br>Turienzo Riveiro, Javier<br>Urgal González, Begoña | | | |
| E-mail | galvarez@uvigo.es | | | |
| Web | http://moovi.uvigo.gal/ | | | |
| General description | This subject's main objective is to offer students a preliminary or introductory vision, of a theoretical-practical nature, regarding the nature and functioning of business organizations and their relationship with the environment in which they operate. For this, among other things, we will define the term company from a multidimensional point of view that covers the complexity of its operation as an open system. Subsequently, we will analyze the relations of the company with its environment, and we will enter the study of its main functional areas that contribute to the correct development of its activity. | | | |

| Training and Learning Results | |
|---|---|
| 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 Problem solving. |
| D7 | CT7 Ability to organize and plan. |
| D18 | CT18 Working in an international context. |

| 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. FINANCIAL MANAGEMENT (PART IV). FINANCING. | 5.1 Concept of financing<br>5.2 Types of financing<br>5.3 Short-term External financing<br>5.4 Long-term external financing.<br>5.5 Internal financing<br>5.6 Solvency and liquidity. |
| 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. OPERATION MANAGEMENT (PART II). PRODUCTION COSTS | 7.1 Concept of cost.<br>7.2 Classification of costs.<br>7.3 The cost of production.<br>7.4 The margins of the company.<br>7.5 The profitability threshold.<br>7.6 The production threshold. |
| 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. |
| PRACTICAL CLASSES OF THE SUBJECT *<br>(*) Practical classes schedules can undergo changes depending on the evolution of the course. | Practical class 1: The company as a system<br>Practical class 2: The business environment and business types<br>Practical class 3: The economic and financial structure of the company (I). Basic concepts<br>Practical class 4: The economic and financial structure of the company (II). The balance sheet<br>Practical class 5: Operating cycle and Cash Conversion Cycle<br>Practical class 6: The results of the company. The income statement<br>Practical class 7: Investment appraisal techniques<br>Practical class 8: Sources of business financing<br>Practical class 9: Efficiency and productivity<br>Practical class 10: Costs, margins and breakeven point<br>Practical class 11: The basics of marketing<br>Practical class 12: The management system of the company: A case study |

| **Planning** | | | |
|---|---|---|---|
| | Class hours | Hours outside the classroom | Total hours |
| Lecturing | 38.5 | 45.5 | 84 |
| Problem solving | 17.6 | 39.4 | 57 |
| 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. |
| Problem solving | Application to specific problems of the knowledge acquired in theoretical classes. |

## Personalized assistance

| Methodologies | Description |
|---|---|
| Lecturing | Students will have the opportunity to attend individualized tutorials with their teacher. The procedure for arranging these tutorials will be communicated to the students by the professor at the beginning of the course and will be published on the University's teaching platform. These tutorials are intended to resolve doubts and guide students on the development of the content covered in theoretical classes, practical classes and work that can be entrusted to them. This section also includes clarification to students of any question about the tests carried out throughout the course. |

## Assessment

| | Description | Qualification | Training and Learning Results |
|---|---|---|---|
| Problem solving | In accordance with the educational planning of the academic course, the student will have to develop a determinate number of practices that include diverse exercises of application of the knowledges purchased in the classes of theory to concrete situations. These practices do not take part in the calculation of the qualification of the subject, but the student is required to obtain a minimum performance in them to pass the subject. The practicals will be carried out in person, and the student's attendance at these classes is mandatory. | 0 | B9 C6 D1 D2 D7 D18 |
| Objective questions exam | They will make diverse proofs along the course in which they will evaluate the knowledges, the skills and the competitions purchased by the students so much in the classrooms of theory as of practices. | 100 | B9 C6 D1 D2 |

## Other comments on the Evaluation

1. Ethical commitment:

The student is expected to exhibit appropriate ethical behavior. In the case of detecting unethical behavior (copying, 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 this case, the overall qualification for this academic year will be fail (0.0).

2. Continuous evaluation system:

Following the guidelines of the degree and the agreements of the academic committee, students who take this subject will be offered a continuous assessment system. This system will be applicable to all students who have not expressly waived this evaluation criterion following the official channels established by the Center.

The continuous evaluation system will consist of two multiple choice tests and a final exam.

Each of the multiple choice tests will deal with the contents seen up to the moment of its completion, both in theory and practical classes. Therefore, the first test will not release material for the second test. Due to this, each one of these tests will have a different weight in the calculation of the qualification obtained in the subject. The first 20% and the second 40%.

These tests are not recoverable, that is, if a student cannot take them on the stipulated date, the teacher has no obligation to repeat them, except for justified cause and duly accredited by the student.

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

To take the second multiple choice test, it will be a necessary condition to have passed 70% of the practices. For students who do not meet this condition, the qualification that will appear in the first edition of the act will be 20% of the qualification obtained in the first multiple choice test.

In addition, to pass the subject it will be a necessary condition, although not sufficient, to obtain a minimum score of 4 on a scale of 0 to 10 in the second multiple choice test. For students who do not meet this condition, the qualification that will appear on the first edition of the act will be 20% of the qualification obtained in the first multiple choice test, plus 40% of the qualification obtained in the second multiple choice test.

The final exam will be held on the date and time set by the Center Management and will consist of the development of several problems similar to those carried out in the practices, and will have a weight of 40% in the final qualification. In this case, the qualification that will appear in the first edition of the act will be 20% of the qualification obtained in the first multiple choice test, plus 40% of the qualification obtained in the second multiple choice test, plus 40% of the qualification obtained in the final exam.

The qualification obtained in multiple choice tests, practices and the final exam will only be valid for the academic year in

which they are taken.

3. Global evaluation system:

Students who have expressly waived continuous assessment following the official channels established by the Center will be offered an assessment procedure that allows them to achieve the highest qualification.

This procedure will consist of a global evaluation exam, which will be carried out on the date and time set by the Center Management, and in which all the contents developed in the subject will be evaluated, both in theory classes and in practices. This global assessment exam will consist of two parts: a theory test in multiple choice format, which will account for 30% of the final qualification, and a practice test, which will account for 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 in the multiple choice test. In case of not passing the multiple choice test, the student's final qualification will be the one obtained in the test evaluated out of 3.

Only those students who do not take any of the assessment tests included in this teaching guide will be considered as Not Present.

4. About the July call:

The recovery call (July) will consist of a global evaluation exam that will mean 100% of the final qualification and in which all the contents developed in the subject will be evaluated, both in theory classes and in practical classes. This exam will consist of two parts: a theory test in multiple choice format, which will account for 30% of the final qualification, and a practice test, which will account for 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 in the multiple choice test. In case of not passing the multiple choice test, the student's final qualification will be the one obtained in the test evaluated out of 3.

5. Prohibition of use of electronic devices:

The use of any electronic device will not be allowed during the evaluation tests, unless authorized express. The fact of introducing an unauthorized electronic device into the exam room will be considered a reason for failing the subject in this academic year and the overall qualification will be failed (0.0).

| **Sources of information** |
|---|
| **Basic Bibliography** |
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| 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** |

| **Recommendations** |
|---|
| **Subjects that continue the syllabus** |
| Basics of operations management/V12G320V01605 |

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Physics: Physics 2** | | | | |
| Subject | Physics: Physics 2 | | | |
| Code | V12G363V01202 | | | |
| Study programme | Grado en Ingeniería en Tecnologías Industriales | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Basic education | 1st | 2nd |
| Teaching language | English | | | |
| 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>Iglesias Prado, José Ignacio<br>Lusquiños Rodríguez, Fernando<br>Paredes Galán, Ángel<br>Pou Álvarez, Pablo<br>Quintero Martínez, Félix<br>Ribas Pérez, Fernando Agustín<br>Salgueiriño Maceira, Verónica<br>Soto Costas, Ramón Francisco<br>Varela Benvenuto, Ramiro Alberto<br>Vázquez Besteiro, Lucas | | | |
| E-mail | jlfdez@uvigo.es | | | |
| Web | http://moovi.uvigo.gal/ | | | |
| General description | This undergraduate course is the second quarter of introductory physics. The focus is on electricity, magnetism and thermodynamics | | | |

| Training and Learning Results | |
|---|---|
| Code | |
| B3 | CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and 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 Problem solving. |
| D9 | CT9 Application of knowledge. |
| D10 | CT10 Self learning and work. |

| Expected results from this subject | Training and Learning Results | | |
|---|---|---|---|
| Understanding the basic concepts of electromagnetism and thermodynamics. | B3 | C2 | |
| Knowing the basic instruments for the measurement of physical quantities. | | C2 | |
| Knowing the basic techniques for experimental data evaluation. | B3 | C2 | D9<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 |

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

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

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

**Planning**

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

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

**Methodologies**

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

**Personalized assistance**

| **Methodologies** | **Description** |
|---|---|
| Lecturing | In office hours. |
| Laboratory practical | In office hours. |
| Problem solving | In office hours. |
| **Tests** | **Description** |
| Objective questions exam | In office hours. |
| Problem and/or exercise solving | In office hours. |
| Essay questions exam | In office hours. |
| Report of practices, practicum and external practices | In office hours. |

**Assessment**

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

**Other comments on the Evaluation**

1. CONTINUOUS ASSESSMENT (EC)

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

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

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

Final mark EC for the continuous assessment modality:

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

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

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

2. GLOBAL ASSESSMENT (EG)

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

Final mark EG for the global assessment modality:

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

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

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

3. END-OF-PROGRAM EXAM (FC)

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

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

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

4. GENERAL RULES

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

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

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

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

## Sources of information

### Basic Bibliography


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

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


### Complementary Bibliography


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

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

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

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

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

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

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

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

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

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

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

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


## Recommendations

### Other comments

Basic recommendations:

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

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

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Computer science: Computing for engineering** | | | | |
| Subject | Computer science: Computing for engineering | | | |
| Code | V12G363V01203 | | | |
| Study programme | Grado en Ingeniería en Tecnologías Industriales | | | |
| 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 | Castro Rascado, Enrique<br>Diéguez González, Luis<br>Díez Sánchez, Ana Isabel<br>Fernández Fernández, María Sila<br>Ibáñez Paz, Regina<br>López Fernández, Joaquín<br>Pérez Cota, Manuel<br>Rodríguez Damian, Amparo<br>Rodríguez Damian, María<br>Rodríguez Diéguez, Amador<br>Sáez López, Juan | | | |
| E-mail | mrdamian@uvigo.es<br>juansaez@uvigo.es | | | |
| Web | http://moovi.uvigo.gal/ | | | |
| 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 | | | |

| Training and Learning Results | |
|---|---|
| Code | |
| B3 | CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations. |
| B4 | CG4 Ability to solve problems through initiative, decision-making, creativity, critical reasoning, and to communicate and transmit knowledge, skills and abilities in the field of industrial engineering. |
| 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 Problem solving. |
| 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. |

| 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 algorythims 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 technicians 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 thecourse. In this case, the final grade for the current academic year will befailed (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 oflearning from the person enrolled and will be grouped into three assessments.The first two will take place preferably in the laboratories: Test 1 and Test2. The third evaluation may be written: Test 3. If the student does notrenounce 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 (3.0points) must be obtained in the last two evaluations: Test 2 and Test 3, inorder to be eligible to have the final average calculated. If this requirementis not met and the final average is equal to or greater than 5, the final grade will be 4:

Test 1 * 0.3 + (Test 2>=3) * 0. 4 + (Test 3>=3) * 0. 3 >=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:

Test 1 * 0.3 + (Test 2>=3) * 0. 4 + (Test 3>=3) * 0.3 >= 5

Once thefirst evaluation: Test 1, has been carried out, the person enrolled may requestto abandon the continuous evaluation system (within the period and by the meansestablished by the teaching staff). In this way, the person enrolled will beable 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, minimuns 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.

## 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


## Recommendations

## IDENTIFYING DATA

**Mathematics: Calculus 2 and differential equations**

| | | | | |
|---|---|---|---|---|
| Subject | Mathematics: Calculus 2 and differential equations | | | |
| Code | V12G363V01204 | | | |
| Study programme | Grado en Ingeniería en Tecnologías Industriales | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Basic education | 1st | 2nd |
| Teaching language | Spanish<br>Galician<br>English | | | |
| Department | | | | |
| 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>Martínez Brey, Eduardo<br>Meniño Cotón, Carlos | | | |
| E-mail | acachafe@uvigo.es | | | |
| Web | http://moovi.uvigo.gal/ | | | |
| General description | The aim of the matter is making the student know the basic techniques of integral calculus in several variables, vector calculus, differential ordinary equations and its applications. | | | |

## Training and Learning Results

| Code | |
|---|---|
| B3 | CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations. |
| B4 | CG4 Ability to solve problems through initiative, decision-making, creativity, critical reasoning, and to communicate and transmit knowledge, skills and abilities in the field of industrial engineering. |
| 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 Problem solving. |
| D3 | CT3 Oral and written proficiency in the own language. |
| D6 | CT6 Application of computer science in the field of study. |
| D9 | CT9 Application of knowledge. |
| D15 | CT15 Objectification, identification and organization. |
| D16 | CT16 Critical thinking. |

## Expected results from this subject

| Expected results from this subject | Training and Learning Results | | |
|---|---|---|---|
| Understanding of the basic concepts of integral calculus in several variables. | B3 | C1 | D1 |
| Knowledge of the main techniques of integration of functions of several variables. | B3<br>B4 | C1 | D1<br>D2<br>D9 |
| Knowledge of the main results of vector calculation and applications. | B3<br>B4 | C1 | D1<br>D2<br>D9 |
| Acquisition of the basic knowledge for solving equations and linear differential systems. | B3<br>B4 | C1 | D1<br>D2<br>D9 |
| Understanding of the importance of integral calculus, vector calculus and differential equations for the study of the physical world. | | C1 | D9<br>D16 |

| | | |
|---|---|---|
| Application of the knowledge of integral calculus, vector calculus and differential equations. | C1 | D2<br>D6<br>D9<br>D16 |
| Acquisition of the necessary capacity to use this knowledge in the manual and computer resolution of issues, exercises and problems. | C1 | D1<br>D2<br>D3<br>D6<br>D9<br>D15<br>D16 |

**Contents**

| Topic | |
|---|---|
| Integral calculus in several variables. | The double integral on rectangles. Cavalieri's Principle. Reduction to iterate integrals. Double integral on elementary regions. Properties. Fubini's theorem. The change of variables' theorem. The particular case of polar coordinates.<br>Triple integrals on a box and elementary regions. Fubini's theorem. The change of variables' theorem. Particular cases: cylindrical and spherical coordinates. Geometric and physical applications of multiple integration: computation of volumes, mass centers and inertia momentums. |
| Vector calculus. | Curves in the plane and in three-dimensional space. Arc length. Change of parameter. Line or trajectory integrals with respect to the arc length of scalar fields. Line integral or circulation of vector fields. Properties. Fundamental theorem of line integrals. Green's theorem on the plane. Regular surfaces. Tangent plane. Normal vector. Area of a Surface. Surface integral of scalar fields. Flux or surface integral of vector fields. Divergence and curl operators. Characterization of conservative fields. Stokes' theorem. Gauss' theorem. |
| Differential equations. | Ordinary differential equations. Concept of solution of an ordinary differential equation. Theorems of existence and uniqueness for problems with initial conditions. Methods of solution of first order differential equations: equations in separable variables, equations reducible to separable variables, homogeneuous equations, linear and linear reduced equations. Exact differential equations. Integrating factors. Differential equation of a uniparametric family of plane curves. Orthogonal trajectories. Linear differential equations of order two and greater. Initial condition problems. Fundamental sets. Method of variation of parameters . Method of undetermined coefficients. Order reduction. Euler's equation. Systems of linear differential equations. |
| Numerical methods for initial value problems. | Introduction to numerical methods. Euler's and improved Euler's method. Runge-Kutta's fourth order method. |

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Lecturing | 32 | 60 | 92 |
| Problem solving | 22 | 24 | 46 |
| Laboratory practical | 9 | 0 | 9 |
| Essay questions exam | 3 | 0 | 3 |

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

**Methodologies**

| | Description |
|---|---|
| Lecturing | In theory clases the profesor will explain the basic contents of the matter. The students will have basic reference texts to follow the matter. |
| Problem solving | The professor will solve problems and exercises and the student will have to solve similar exercises to acquire the necesssary skills. |
| Laboratory practical | The professor will solve problems and exercises by hand or by use of informatic tools and the student will have to solve similar exercises to acquire the necessary skills. |

**Personalized assistance**

| Methodologies | Description |
|---|---|

| | |
|---|---|
| Problem solving | The profesor will personally help solving doubts and requirements from the students, especially in problem and laboratory clases and in office hours. |
| Laboratory practical | The profesor will personally help solving doubts and requirements from the students, especially in problem and laboratory clases and in office hours. |

**Assessment**

| | Description | Qualification | Training and Learning Results | | |
|---|---|---|---|---|---|
| Problem solving | Written andor homework tests will be done. | 60 | B3<br>B4 | C1 | D1<br>D2<br>D3<br>D6<br>D9<br>D15<br>D16 |
| Essay questions exam | A final test will be done on the contents of the whole matter. | 40 | B3<br>B4 | C1 | D1<br>D2<br>D3<br>D9<br>D15<br>D16 |

**Other comments on the Evaluation**

The continuous assessment will be done based on the former exposed criteria.

Those students rejecting the continuous assessment will be evaluated with a final test based on the contents of the matter, which will be the 100% of their grade.

In the second call, the assessment will consist of a test based on the contents of the matter, which will be the 100% of the grade.

Ethical commitment:

The student is expected to have an adequate ethical behaviour. In case of detection of a non ethic behaviour (for example cheating or use of non-authorized electronic devices), the student will be considered not to have reached the necessary skills to pass the matter. In this case the student will fail with numerical grade 0.

**Sources of information**

**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**

**Recommendations**

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

Mathematics: Algebra and statistics/V12G320V01103
Mathematics: Calculus 1/V12G320V01104

**Other comments**

In case of discrepancies, the Spanish version of this guide will prevail

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Chemistry: Chemistry** | | | | |
| Subject | Chemistry: Chemistry | | | |
| Code | V12G363V01205 | | | |
| Study programme | Grado en Ingeniería en Tecnologías Industriales | | | |
| 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 | Bolaño García, Sandra<br>Cruz Freire, José Manuel<br>Estévez Guiance, Laura<br>González Ballesteros, Noelia<br>González Sas, Olalla<br>Mandado Alonso, Marcos<br>Martínez Arcos, Andrea<br>Moldes Moreira, Diego<br>Morandeira Conde, Lois<br>Mosquera Castro, Ricardo Antonio<br>Nieto Faza, Olalla<br>Novoa Carballal, Ramón<br>Nóvoa Rodríguez, Ramón<br>Peña Gallego, María de los Ángeles<br>Pérez Juste, Jorge<br>Rey Losada, Francisco Jesús<br>Salgado Seara, José Manuel<br>Sánchez Bermúdez, Ángel Manuel<br>Sánchez Vázquez, Pablo Breogán<br>Silva López, Carlos<br>Vecino Bello, Xanel | | | |
| E-mail | jmcruz@uvigo.es | | | |
| Web | http://moovi.uvigo.gal/ | | | |
| 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. | | | |

| Training and Learning Results | |
|---|---|
| Code | |
| B3 | CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and 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 Problem solving. |
| D3 | CT3 Oral and written proficiency in the own language. |
| D10 | CT10 Self learning and work. |
| D17 | CT17 Working as a team. |

| 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>D3<br>D10<br>D17 |

| Contents |
|---|
| Topic |

| | |
|---|---|
| 1. Atomic theory and chemical bonding | 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.<br>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. |
| 2. States of aggregation: Solids, gases, pure liquids and solutions | 2.1. Solid state:<br>Introduction. Classification of solids: amorphous solids, molecular crystals and liquid crystals, Covalent crystals and ionic crystals.<br>2.2. Gaseous state:<br>Characteristics of the gas phase. Ideal gases: Equation of state. Real gases: Equation of state. Properties of gases.<br>2.3. Liquid state:<br>Characteristics of the liquid phase: physical properties (density, surface tension, viscosity). Changes of state. Phase diagram. Solutions: colligative properties |
| 4.Chemical equilibrium: in gas phase, acid-base-base, redox, solubility | (4.1. Chemical equilibrium:<br>Concept of Equilibrium. Equilibrium Constant. Types of equilibrium. The Le Chatelier Principe.<br>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.<br>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.<br>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. |
| 5. Chemical kinetics | 5.1. Basic Concepts:<br>Reaction Rate. Reaction Order. Kinetic Constant. Rate Equation.<br>5.2. Determination of the Rate Equation:<br>Initial rate method. Integrated Rate Laws.<br>5.3. Factors affecting the Reaction Rate. |
| 6. Basic principles of Organic Chemistry | 6.1. Fundamentals of Organic formulation and functional groups:<br>6.1.1. ºStructure 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. |
| 7. Basic principles of Inorganic Chemistry. | 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.<br>7.2. Non-metallic elements and their compounds:<br>General properties. Hydrogen. Carbon. Nitrogen and phosphorous. Oxygen and sulphur. Halogens. |
| 8. Applied Electrochemistry | 8.1. Applications of the Nernst equation: Determination of pH, Equilibrium constant, solubility product.<br>8.2. Electrochemical cells: types of cells. Concentration Cells. Electric Conductivity in electrolytes. Electrolysis Cells.<br>8.3. Industrial Processes of electrolysis: electrodeposition (electroplating), electrometallurgy, electrolysis chlorine□caustic soda. Fuel cells. |

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

**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.<br>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 | Students must solve independently, and periodically submit problems or exercises formulated by the faculty member. The results and the procedure followed in the execution will be evaluated.<br>According to current legislation, the final grade will be numeric and between 0 and 10. | 10 | B3 C4 D2<br>D3<br>D10 |
| Objective questions exam | The purpose of these tests, is to assess the level of theoretical knowledge acquired by students in classroom sessions. Written tests are multiple choices, multiple responses, in which students can achieve a numerical score between 0 and 10, according to current legislation. | 40 | B3 C4 D10 |
| Problem and/or exercise solving | The evaluation of the knowledge gained by students in seminars will be through a written exam, in the official announcement of examinations, in which the student must solve 4 or 5 problems related to the subject under study.<br>The exam will be graded according to the current legislation, with a numerical final grade between 0 and 10. | 40 | B3 C4 D2<br>D10 |
| Report of practices, practicum and external practices | After each laboratory session, the student should answer an oral question or prepare a detailed report including aspects such as objective and theoretical foundations, procedure followed, materials used, results and interpretation.<br>The aspects considered in the evaluation are the content of the report, the understanding of the work done, the ability of summarising, quality of presentation, and the personal contribution.<br>The final score, between 0 and 10, will be the average of the marks obtained in the various reports made and/or writing or oral test that could be done for each practice. | 10 | C4 D17 |

**Other comments on the Evaluation**

The objective questions test for theory content, and the exercises examen, will be considered for the final score weighting only when rated greater than or equal to 4. Although the average score could be equal to or greater than 5, if the qualification of the objective questions test for theory content or the exercises exam is lower than 4, the final score will be the lowest mark obtained (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.

In the second call, an objective questions test for theory content and an exercises examen will be carried out. The marks of lab experiments, autonomous problem solving, and marks of objective questions test for theory content and exercises exam higher than 5 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,

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Reboiras, M.D, **Química. La ciencia básica**, Ed. Thomsom,

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**Complementary Bibliography**


Atkins, P. y Jones, L, **Principios de Química. Los caminos del descubrimiento**, Ed. Interamericana,

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Ballester, A., Verdeja, L. y Sancho, J., **Metalurgia Extractiva I: Fundamentos**, Ed. Síntesis,
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Rayner-Canham, G., **Química Inorgánica Descriptiva**, Ed. Prentice-Hall,
Alegret, M. y Arben Merckoci, **Sensores electroquímicos**, Ediciones UAB,
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## Recommendations

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

(*)Física: Física I/V12G350V01102
(*)Matemáticas: Álxebra e estatística/V12G350V01103
(*)Matemáticas: Cálculo I/V12G350V01104

### Other comments

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