



(*)Escola de Enxeñaría Industrial

Information

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Degree in Industrial Technologies Engineering

Subjects

Year 1st

Code	Name	Quadmester	Total Cr.
V12G363V01101	Expresión gráfica: Expresión gráfica	1st	9
V12G363V01102	Física: Física I	1st	6
V12G363V01103	Matemáticas: Álgebra e estatística	1st	9
V12G363V01104	Matemáticas: Cálculo I	1st	6
V12G363V01201	Empresa: Introducción á xestión empresarial	2nd	6
V12G363V01202	Física: Física II	2nd	6
V12G363V01203	Informática: Informática para a enxeñaría	2nd	6
V12G363V01204	Matemáticas: Cálculo II e ecuacións diferenciais	2nd	6
V12G363V01205	Química: Química	2nd	6

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

Subject	Graphic expression: Fundamentals of engineering graphics			
Code	V12G363V01101			
Study programme	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Basic education	1st	1st
Teaching language				
Department				
Coordinator	López Figueroa, Concepto Esteban Fernández Álvarez, Antonio			
Lecturers	Adán Gómez, Manuel Alegre Fidalgo, Paulino Corralo Domonte, Francisco Javier Fernández Álvarez, Antonio González Rodríguez, Elena López Figueroa, Concepto Esteban Patiño Barbeito, Faustino Roa Corral, Ernesto Troncoso Saracho, José Carlos			
E-mail	antfdez@uvigo.es esteban@uvigo.es			
Web	http://fatic.uvigo.es			
General description	The aim that pursues with this subject is to form to the student in the thematic relative to the Graphic Expression, so as to prepare for the handle and interpretation of the systems of representation more employed in the industrial reality and his basic technicians, enter him to the knowledge of the forms, generation and properties of the geometrical entities more frequent in the technician, including the acquisition of vision and space understanding, initiate him in the study of the appearances of technological character that influence in the Graphic Expression of the Engineering and enter him rationally in the knowledge and application of the Normalisation, so much in his basic appearances as in the specific. The subject will develop so that prepare to the student for the indifferent employment of traditional technicians and of new technologies of the information and communications.			

Competencies

Code	
CG3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.
CG4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG6	CG6 Capacity for handling specifications, regulations and mandatory standards.
CE5	CE5 Capacity for spatial vision and knowledge of the techniques of graphic representation, using traditional methods of metric geometry and descriptive geometry, and through the application of computer-aided design.
CT2	CT2 Problems resolution.
CT5	CT5 Information Management.
CT6	CT6 Application of computer science in the field of study.
CT9	CT9 Apply knowledge.
CT13	CT13 Adaptability to new situations.
CT16	CT16 Critical thinking.

Learning outcomes

Learning outcomes	Competences
- Know, understand, and apply a body of knowledge about the basics of drawing and standardization of industrial engineering, in its broadest sense, while promoting the development of space capacity.	CG1 CE2 CT4 CG2 CE3 CT5 CG3 CE4 CT6 CG3 CE5 CT8 CG4 CG10 CG11

Purchase the capacity for the abstract reasoning and the establishment of strategies and efficient procedures in the resolution of the graphic problems inside the context of the works and own projects of the engineering.	CB2 CB4	CG3 CG4	CT2 CT16
Use the graphic communication between technicians, by means of the realisation and interpretation of planes in accordance with the Norms of Technical Drawing, involving the use of the new technologies.	CB2 CB3 CB5	CG2 CG5 CG6 CG9	CE1 CE5 CE12 CE21 CE22 CT4 CT5 CT6 CT7 CT9 CT13 CT16
Assume a favourable attitude to the permanent learning in the profession, showing proactive, participatory and with spirit of improvement.		CG1 CG3 CG4 CG4 CG5	CT1 CT2 CT3 CT5 CT5 CT7 CT8 CT9 CT9 CT10 CT13 CT15 CT16 CT16 CT17 CT19 CT20

Contents

Topic	
Block 0. Computer-aided drawing 2D. Sketching, and application of Norms.	Introduction to the Computer-aided Drawing. Surroundings of work. Systems of Coordinates. You order of Drawing. Graphic entities. Helps to the drawing. References to entities. You order of Modification. You order of Visualisation. You order of Query. Impression and scales.
Block I 2D. Flat geometry.	0.2. Sketching, and application of Norms I review of previous knowledges. Conical: definitions, focal and main circumferences, tangent line and normal in a point, tangent lines from an external point, own and improper. Tangencies between straight and circumferences and between circumferences (26 cases). Tools of resolution: geometrical places, operations of dilatation and investment and power. Technical curves: Trochoids: definition, traced and tangent line in a point. Other technical curves.

Block II 3D. Systems of representation.

Introduction: Types of projections. Invariants *proyectivos.

System *Diédrico:

Foundations.

Belonging and Incidence.

Parallelism and *Perpendicularidad.

Distances, Angles.

Operations: Twists, Changes flatly and *Abatimientos.

Surfaces: Polyhedral, Irradiated and of Revolution,

Surfaces: Flat Sections, Development.

Intersection of Surfaces. Foundations.

System of Bounded Planes:

Foundations.

Belonging and Incidence.

Parallelism and *Perpendicularidad.

Distances, Angles.

*Abatimientos.

Axonometric system:

Foundations.

Axonometric scales.

Types of *axonometrias: *trimétrica, *dimétrica and isometric.

System of Cavalier Perspective: Foundations.

System of Conical Perspective: Foundation.

Block III. Normalisation.

Generalities on the drawing:

- The drawing like language.
- Types of drawings: technicians and artistic.
- Technical drawings: architectural, topographical and industrial.
- Industrial drawing: *Croquis, conjoint diagrams, *despieces and geometrical drawing.

Normalisation of the drawing:

- Advantages of the normalisation.
- Difference between regulation, specification and norm.

Basic normalisation: formats, writing, types of line, scales, etc.

Representation normalised:

- basic Principles of representation. Methods of projection
- Seen. Seen particular: auxiliaries, interrupted, partial, local, turned, etc.
- Courts, Sections and Breaks: Specifications, types of cut, sections (knocked down, displaced), etc.
- *Rayado of courts: types of line, orientation, etc.
- Conventionalisms: symmetrical pieces, repetitive elements, details, intersections, parts *contiguas, etc.

*Acotación:

- General principles of dimensioning.
- Types of *acotación. Classification of the heights.
- Principles of *acotación.
- Elements of *acotación: Lines, extremes of lines, *inscripciones, etc.
- Forms of *acotación: series, parallel, by coordinates, etc.
- *Acotación of particular elements: radios, diameters, spheres, arches, symmetries, chamfers, etc.
- Threads and threaded unions. Elements of a thread. Threaded elements. Classification of the threads. Representation of the threads. Threads normalised.
- *Acotación Of threaded elements.
- Designation of the threads.

Drawings of group and *despiece:

- Rules and agreements: reference to elements, material, numbering of planes, examples.
- *Acotación Of groups. List of *despiece.

Systems of tolerances and superficial finishings:

- Types of tolerances: dimensional and geometrical.
- Dimensional tolerances: linear and angular.
- Tolerances ISO: qualities, positions, types of adjust, etc.
- Systems of adjust. Examples.
- Indication of superficial finishings.

Representation of Elements Normalised. Diagrams.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	38	116	154
Problem solving	34	0	34
Seminars	4	0	4
Project based learning	0	27	27
Laboratory practice	4	0	4

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

Methodologies	
	Description
Lecturing	Active master Session. Each thematic unit will be presented by the professor, complemented with the comments of the students with base in the bibliography assigned or another pertinent.
Problem solving	They will pose exercises and/or problems that will resolve of individual way or *grupal.

Seminars	Realisation of activities of reinforcement to the learning by means of the resolution *tutelada of way *grupal of practical suppositions linked to the theoretical contents of the subject.
Project based learning	Realisation of activities that require the active participation and the collaboration between the students.

Personalized assistance

Methodologies	Description
Seminars	

Assessment

Description	Qualification	Evaluated Competences
Laboratory practice	35	CG4 CE5 CT2 CT5 CT6 CT9 CT13

Other comments on the Evaluation

 In second announcement will realise to the student a theoretical proof-practical to evaluate his degree of acquisition of competitions, of analogous characteristics to the final examination, in which to surpass the *asignatura will be necessary to reach a minimum qualification of 5,0 points on 10 possible.

Ethical commitment: It is expected an adequate ethical behaviour of the student. In case of detecting unethical behaviour (copying, plagiarism, unauthorized use of electronic devices, etc.) shall be deemed that the student does not meet the requirements for passing the subject. In this case, the overall rating in the current academic year will be Fail (0.0).

Responsible professors of groups:

Group To: Javier *Corralo *Domonte.

Group *B: Carlos *Troncoso *Saracho.

Group C: Antonio Fernández Álvarez.

Group D: Carlos *Troncoso *Saracho.

Group G: Ernesto *Roa Farmyard.

Group *H: Esteban López *Figueroa.

Group I: Faustino *Patiño *Barbeito.

Group *J: Ernesto *Roa Farmyard.

Group *K: Manuel Adán Gómez.

Group L: Faustino *Patiño *Barbeito.

Sources of information

Basic Bibliography

Complementary Bibliography

Corbella Barros, David, **Trazados de Dibujo Geométrico 1**, Madrid 1970,

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

Izquierdo Asensi, Fernando, **Geometría Descriptiva**, 24ª Edición. ISBN 84-922109-5-8,

Ladero Lorente, Ricardo, **Teoría do Debuxo Técnico**, Vigo 2012,

Asociación Española de Normalización (AENOR), **Normas UNE de Dibujo Técnico**, Versión en vigor,

Félez, Jesús; Martínez, Mª Luisa, **DIBUJO INDUSTRIAL**, 3ª Edición, ISBN: 84-7738-331-6,

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

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

Ramos Barbero, Basilio; García Maté, Esteban, **DIBUJO TÉCNICO**, 2ª Edición, ISBN: 84-8143-261-X,

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

Giesecke, Mitchell, Spencer, Hill, Dygdon, Novak, Lockhart, □ **Technical Drawing with Engineering Graphics**, 14ª,

David A. Madsen, David P. Madsen, □ **Engineering Drawing & Design**, 5ª,

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

Recommendations

Other comments

It is recommended for a suitable follow-up of the subject have of previous knowledges of drawing, to the level of the studies *cursados in the *Bachillerato of the Scientific Option-Technological.

In case of discrepancies between versions shall prevail spanish version of this guide.

IDENTIFYING DATA				
Physics: Physics 1				
Subject	Physics: Physics 1			
Code	V12G363V01102			
Study programme	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Lusquiños Rodríguez, Fernando			
Lecturers	Álvarez Fernández, María Inés Blanco García, Jesús Boutinguiza Larosi, Mohamed Iglesias Prado, Jose Ignacio Legido Soto, José Luís Lusquiños Rodríguez, Fernando Quintero Martínez, Félix Ramos Docampo, Miguel Alexandre Ribas Pérez, Fernando Agustín Serra Rodríguez, Julia Asunción Soto Costas, Ramón Francisco Trillo Yáñez, María Cristina Wallerstein Figueirôa, Daniel			
E-mail	flusqui@uvigo.es			
Web	http://faitic.uvigo.es			
General description	(*)Física do primeiro curso das Enxeñarías da rama Industrial			

Competencies	
Code	
CG3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.
CE2	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.
CT2	CT2 Problems resolution.
CT9	CT9 Apply knowledge.
CT10	CT10 Self learning and work.

Learning outcomes			
Learning outcomes	Competences		
(*)FB2a. Comprensión y dominio de los conceptos básicos sobre las leyes generales de la mecánica y campos y ondas y su aplicación para la resolución de problemas propios de la ingeniería.	CG3	CE2	
(*)CG3. Conocimiento en materias básicas y tecnológicas, que les capacite para el aprendizaje de nuevos métodos y teorías, y les dote de versatilidad para adaptarse a nuevas situaciones.		CE2	
(*)CS2. Aprendizaje y trabajo autónomos.	CG3	CE2	CT9 CT10
New	CG3	CE2	CT2 CT9 CT10

Contents	
Topic	

1.- UNITS, PHYSICAL AMOUNTS AND VECTORS	<ul style="list-style-type: none"> 1.1.- The nature of Physics. 1.2.- Consistency and conversions of units. 1.3.- Uncertainty and significant figures. 1.4.- Estimates and orders of magnitude. 1.5.- Vectors and sum of vectors. 1.6.- Vector components. 1.7.- Unitary vectors. 1.8.- Vector products. 1.9.- Sliding Vectors
2.- CINEMATIC OF THE POINT	<ul style="list-style-type: none"> 2.1.- Vectors of position, speed and acceleration. Half and instantaneous values 2.2.- Vectors angular speed and angular acceleration. Half and instantaneous values. 2.3.- Relation between linear cinematic magnitudes and angular 2.4.- Intrinsic components. 2.5.- Study of simple movements: *mov. Rectilinear, *mov. Circulate, shot *oblicuo 2.6.- Expressions of cinematic magnitudes in coordinates *cartesianas and polar
3.- LAWS OF THE MOVEMENT OF NEWTON	<ul style="list-style-type: none"> 3.1.- Strength and interactions. 3.2.- First law of Newton. Systems of inertial and non inertial references 3.3.- Second law of Newton. 3.4.- Mass and weight. 3.5.- Third law of Newton. 3.6.- Quantity of movement. Mechanical impulse. Angular moment. 3.7.- Strengths of contact: active, of *ligadura.
4.- WORK AND KINETIC ENERGY	<ul style="list-style-type: none"> 4.1.- Work realized by a Force. Power. 4.2.- Kinetic Energy. 4.3.- Conservative Forces 4.4.- Elastic potential energy. 4.5.- Potential energy in the gravitatory field. 4.6.- Mechanical energy. 4.7.- Strength and potential energy. 4.8.- Principle of conservation of the mechanical energy.
5.- KINEMATICS OF SYSTEM OF POINTS	<ul style="list-style-type: none"> 5.1.- Points system. 5.2.- Rigid solid. 5.3.- Translation movement. 5.4.- Movement of rotation around a fixed axis. 5.5.- General movement. 5.6.- Instant center of rotation. 5.7.- Rolling motion. 5.8.- Relative movement.
6.- DYNAMICS OF THE SYSTEMS OF PARTICLES	<ul style="list-style-type: none"> 6.1.- Systems of particles. Inner and exterior strengths. 6.2.- Center of masses of the system. Movement of the c.o.m. 6.3.- Equations of the movement of a system of particles. 6.4.- Linear moment. Theorem Of conservation. 6.5.- Angular moment of a system of particles. Theorem Of conservation. 6.6.- Work and power. 6.7.- Potential energy and kinetics of a system of particles. 6.8.- Theorem Of the energy of a system of particles. 6.9.- Crashes.
7.- DYNAMICS OF THE RIGID SOLID	<ul style="list-style-type: none"> 7.1.- Rotation of a rigid solid around a fixed axis. 7.2.- Moments and products of inertia. 7.3.- Calculation of moments of inertia. 7.4.- Steiner's theorem. 7.5.- Moment of a force and pair of forces. 7.6.- Equations of the general movement of the rigid solid. 7.7.- Kinetic energy in the general movement of the rigid solid. 7.8.- Work in the general movement of the rigid solid. 7.9.- Angular moment of a rigid solid. Conservation theorem.
8.- STATIC	<ul style="list-style-type: none"> 8.1.- Balance of rigid solids. 8.2.- Center of gravity. 8.3.- Stability. 8.4.- Degrees of freedom and ligatures

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

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
Practices report	0	9	9

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

Methodologies

	Description
Lecturing	Exhibition by part of the professor of the contents on the subject object of study, theoretical bases and/or guidelines of a work, exercise or project to develop by the student.
Problem solving	Activity in which formulate problem and/or exercises related with the asignatura. The student has to develop the felicitous or correct solutions by means of the ejercitación of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. suele Use as I complement of the lesson magistral.
Laboratory practical	Activities of application of the knowledges to concrete situations and of acquisition of basic skills and procedimentales related with the subject object of study. They develop in special spaces with equipment especializado (laboratories, classrooms informáticas, etc).

Personalized assistance

Methodologies	Description
Lecturing	In office hours

Laboratory practical	in office hours
Problem solving	In office hours
Tests	Description
Objective questions exam	In office hours
Problem and/or exercise solving	In office hours
Essay questions exam	In office hours
Practices report	In office hours

Assessment			
	Description	Qualification	Evaluated Competences
Objective questions exam	Pruebas para evaluación de las competencias adquiridas que incluyen preguntas cerradas con diferentes alternativas de respuesta (verdadero/falso, elección múltiple, emparejamiento de elementos...). Los alumnos seleccionan una respuesta entre un número limitado de posibilidades.	10	CG3 CE2
Problem and/or exercise solving	Prueba en la que el alumno debe solucionar una serie de problemas y/o ejercicios en un tiempo/condiciones establecido/as por el profesor. De esta manera, el alumno debe aplicar los conocimientos que ha adquirido.	40	CG3 CE2 CT2
Essay questions exam	Pruebas para evaluación de las competencias que incluyen preguntas abiertas sobre un tema. Los alumnos deben desarrollar, relacionar, organizar y presentar los conocimientos que tienen sobre la materia en una respuesta extensa.	40	CG3 CE2
Practices report	Elaboración de un documento por parte del alumno en el que se reflejan las características del trabajo llevado a cabo. Los alumnos deben describir las tareas y procedimientos desarrollados, mostrar los resultados obtenidos u observaciones realizadas, así como el análisis y tratamiento de datos.	10	CG3 CE2 CT9 CT10

Other comments on the Evaluation

The qualification of the continuous evaluation (which we will call EC) will have a weight of 30% of the final grade and will include both the contents of the laboratory practices (weight of 20%, which we will call ECL qualification) and of the classroom (weight of 10% , which we will call ECA qualification).

The ECA grade will be obtained through justified response tests on classroom contents.

The ECL qualification will be obtained as the sum of the qualification of the Reports / memories of practices on laboratory contents. To obtain an ECL qualification, attendance will be required at least 10 of the 12 laboratory sessions scheduled.

Those students who can not follow the continuous assessment and who have been granted the rejection of the continuous assessment will have the possibility of taking a final written test to obtain a REC grade that will weigh 30% of the final grade and will include both the contents of the laboratory practices (weight of 20%, which we will call RECL rating) as classroom (weight of 10%, which we will call RECA rating).

The remaining 70% of the final grade will be obtained by completing a final exam that will consist of two parts: a theoretical part (which we will call T) that will weigh 30% of the final grade and another part of problem solving (which we will call P) that will have a weight of 40% of the final grade. The theoretical part will consist of an eliminatory test type test (that we will denominate TT) on fundamental theoretical concepts, that will have a weight of 10% of the final qualification and where a minimum qualification of 50% will be required, and another test of theoretical-practical questions of justified response (which we will call TC), which will have a weight of 20% of the final grade. Those students who do not appear for the final exam will obtain a grade of not presented.

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

the final grade.

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

$G = ECL + ECA + TT + TC + P$, where TC and P are added only if TT is exceeded.

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

$G = ECL$ (or RECL) + ECA (or RECA) + TT + TC + P, where TC and P are added only if TT is exceeded.

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

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

Sources of information

Basic Bibliography

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

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	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Basic education	1st	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Pardo Fernández, Juan Carlos			
Lecturers	Castejón Lafuente, Alberto Elias Díaz de Bustamante, Jaime Fernández García, José Ramón Fiestras Janeiro, Gloria Godoy Malvar, Eduardo Gómez Rúa, María Lorenzo Picado, Leticia Luaces Pazos, Ricardo Martín Méndez, Alberto Lucio Martínez Brey, Eduardo Matías Fernández, José María Pardo Fernández, Juan Carlos Rodríguez Campos, María Celia			
E-mail	juancp@uvigo.es			
Web	http://fatic.uvigo.es			
General description	The aim of this course is to provide the student with the basic techniques in Algebra and Statistics that will be necessary in other courses of the degree.			
	English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Competencies

Code	
CG3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.
CE1	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.
CT2	CT2 Problems resolution.
CT5	CT5 Information Management.
CT6	CT6 Application of computer science in the field of study.
CT9	CT9 Apply knowledge.

Learning outcomes

Learning outcomes	Competences			
Acquire the basic knowledge on matrices, vector spaces and linear maps.	CB2	CG1 CG2 CG3	CE1 CE20 CE22	
Handle the operations of the matrix calculation and use it to solve problems to systems of linear equations.	CB4	CG1 CG2 CG3	CE1 CE22	CT2 CT5 CT8

Understand the basic concepts on eigenvalues and eigenvectors, vector spaces with scalar product and quadratic forms used in other courses and solve basic problems related to these subjects.	CG2 CG3 CG9 CG14 CG15	CE1 CE1 CE2 CE3 CE4	CT1 CT2 CT2 CT3 CT4 CT5 CT6 CT9
Perform basic exploratory analysis of databases.	CG1 CG2 CG3 CG9 CG10 CG11 CG12 CG13 CG14	CE1 CE1 CE5 CE6 CE7 CE9 CE10 CE13 CE14 CE15 CE16	CT1 CT2 CT3 CT4 CT5 CT5
Model situations under uncertainty by means of probability.	CB1 CG3	CG3 CE1	CE1 CT2 CT2
Know basic statistical models and their application to industry and perform inferences from data samples.	CB1 CB2 CG6	CG3 CG4 CE8	CE1 CE7 CE8 CT2 CT2 CT9
Use computer tools to solve problems of the contents of the course.	CB2 CB3 CG4	CG3 CG3 CE13 CE14 CE16 CE17 CE18	CE1 CE7 CE13 CE14 CE16 CE17 CT1 CT2 CT3 CT4 CT6 CT10

Contents

Topic	
Preliminaries	The field of complex numbers.
Matrices, determinants and systems of linear equations.	Definition and types of matrices. Matrices operations. Elementary transformations, row echelon forms, rank of a matrix. Inverse and determinant of a square matrix. Consistency of systems of linear equations and their solutions.
Vector spaces and linear maps.	Vector space. Subspaces. Linear independence, basis and dimension. Coordinates, change of basis. Basic notions on linear maps.
Eigenvalues and eigenvectors.	Definition of eigenvalue and eigenvector of a square matrix. Diagonalization of matrices by similarity transformation. Applications of eigenvalues and eigenvectors.
Vector spaces with scalar product and quadratic forms.	Vectorial spaces with scalar product. Associated norm and properties. Orthogonality. Gram-Schmidt orthonormalization process. Orthogonal diagonalization of a real and symmetric matrix. Quadratic forms.
Descriptive statistics and regression.	Concept and uses of the statistics. Variables and attributes. Types of variables. Tables of frequencies and graphical representations. Position and dispersion measures. Analysis of bivariate data. Linear regression. Correlation.
Probability.	Concept and properties. Conditional probability and independence of events. Bayes Theorem.
Discrete random variables and continuous random variables.	Definition of random variable. Types of random variables. Distribution function. Discrete random variables. Continuous random variables. Characteristics of a random variable. Main distributions: Binomial, Geometric, Poisson, Hypergeometric, Uniform, Exponential, Normal. Central Limit Theorem.

Statistical inference.

General concepts.
Sampling distributions.
Point estimation.
Confidence intervals.
Tests of hypotheses.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	40	81	121
Problem solving	12	12	24
Laboratory practical	24	12	36
Autonomous problem solving	0	40	40

*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.
Laboratory practical	Computer tools will be used to solve problems related to the contents of the course.
Autonomous problem solving	Student will have to solve problems and exercises by their own.

Personalized assistance

Methodologies	Description
Laboratory practical	
Lecturing	
Problem solving	
Autonomous problem solving	

Assessment

	Description	Qualification	Evaluated Competences
Problem solving	Students will make several mid-term exams of Algebra and Statistics during the course.	40 por cento en Álgebra; 20 por cento en Estadística	CG3 CE1 CT2 CT5 CT6 CT9

Other comments on the Evaluation

At the end of the first quarter, once the mid-term exams and the final exams have been done, the student will have a grade out of 10 points in Algebra (A) and a grade out of 10 points in Statistics (S). The final qualification of the subject will be calculated as follows: - If both grades, A and S, are greater or equal to 3.5, then the final grade will be $(A+S)/2$. - Any of the grades A or S is less than 3.5, then the final qualification will be the minimum of the quantities $(A+S)/2$ and 4.5. The students who are exempted by the School from taking the mid-term exams will be evaluated through a final exam of Algebra (100% of the grade of this part) and a final exam of Statistics (100% of the grade of this part). The final grade will be calculated according to procedure described above. A student will be assigned to NP ("absent") if he/she is absent in both final exams (i.e. Algebra and Statistics); otherwise he/she will be graded according to the procedure described above. The assessment in the second call (June/July) will be done by means of a final exam of Algebra and a final exam of Statistics (100% of the grade of each part). The final grade will be calculated according to procedure described above. If at the end of the first quarter a student obtains a grade equal to or greater than 5 out of 10 in any of the parts of the subject (Algebra or Statistics) then he/she will keep this grade in the second call (June/July) without retaking the corresponding exam.

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

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

Responsible lecturers by group:
Group A: Eduardo Godoy Malvar / Gloria Fiestras Janeiro
Group B: Alberto Martín Méndez / José María Matías Fernández
Group C: Alberto Castejón Lafuente / José María Matías Fernández
Group D: Cecilio Fonseca Bon / Celia Rodríguez Campos
Group G: José Ramón Fernández García / María Gómez Rúa
Group H: José Ramón Fernández García / Ricardo Luaces Pazos
Group I: Cecilio Fonseca

Bon / Juan Carlos Pardo Fernández
Pazos
Group J: Eduardo Martínez Brey / Ricardo Luaces
Group K: Cecilio Fonseca Bon / José María Matías Fernández
Group L: Alberto Castejón Lafuente / Leticia Lorenzo Picado

Sources of information

Basic Bibliography

Complementary Bibliography

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

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

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

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

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

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

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	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Galician			
Department				
Coordinator	Martínez Martínez, Antonio			
Lecturers	Bajo Palacio, Ignacio Cordeiro Alonso, José María Díaz de Bustamante, Jaime González Rodríguez, Ramón Loureiro García, Marcos Martínez Martínez, Antonio Vidal Vázquez, Ricardo			
E-mail	antonmar@uvigo.es			
Web	http://fatic.uvigo.es			
General description	The aim of this matter is that the student purchase the command of the basic technicians of differential calculation in one and in several variables and of integral calculation in a variable that are necessary for other matters that has to *cursar in the degree.			

Competencies

Code	
CG3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.
CG4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CE1	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.
CT1	CT1 Analysis and synthesis.
CT2	CT2 Problems resolution.
CT6	CT6 Application of computer science in the field of study.
CT9	CT9 Apply knowledge.
CT14	CT14 Creativity.
CT16	CT16 Critical thinking.

Learning outcomes

Learning outcomes	Competences			
Understanding of the basic knowledges of differential calculation of one and of several variables.	CB2	CG1	CE1	CT1
	CB3	CG2	CE1	CT2
	CB4	CG3	CE2	CT3
		CG3	CE3	CT4
		CG5	CE4	CT5
		CG6	CE5	CT6
		CG7	CE6	CT7
			CE7	CT8
				CT10
Understanding of the basic knowledges of integral calculation of functions of a variable.	CB4	CG3	CE1	CT1
		CG6	CE6	CT1
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.		CG3	CE1	CT2
		CG3	CE2	CT2
		CG4		CT9
				CT10
				CT14
				CT16

I handle of the technicians of integral calculation for the calculation of areas, volumes and surfaces.

CG3 CE1 CT1
CG3 CE1 CT1
CG4 CT2
CT9
CT14
CT16

Utilisation of computer tools to resolve problems of differential calculation and of integral calculation.

CG3 CE1 CT2
CG4 CE1 CT2
CT6
CT9
CT16

Contents

Topic

Convergence and continuity	Introduction to the real numbers. Absolute value. The space \mathbb{R}^n . Successions. Series. Limits and continuity of functions of one and of several variables.
Differential calculation of functions of one and of several variables	Differential calculation of functions of a real variable. Differential calculation of functions of several real variables.
Integral calculation of functions of a variable	The integral of Riemann. Calculation of primitive. Improper integrals. 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

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

Methodologies

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

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	Evaluated	Competences
Problem and/or exercise solving	They will make proofs written and/or works.	40	CG3 CE1 CG4	CT1 CT2 CT6 CT9 CT14 CT16

Other comments on the Evaluation

The continuous evaluation will carry out on the previously exposed criteria. Those students that do not receive to the continuous evaluation will be evaluated with a final examination on the contents of the whole of the matter, that will suppose 100% of the note.
The evaluation of the students in second announcement will consist in an examination on the contents of the whole of the matter, that will suppose 100% of the note.

Ethical commitment: it expects that the present student a suitable ethical behaviour. In case to detect a no ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices, and others) will consider that the student does not gather the necessary requirements to surpass the matter. In this case the global qualification in the present academic course will be of suspense (0.0).

Sources of information

Basic Bibliography

Complementary Bibliography

Burgos, J., **Cálculo Infinitesimal de una variable**, 2ª,

Burgos, J., **Cálculo Infinitesimal de varias variables**, 2ª,

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

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

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

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

Larson, R. y otros, **Cálculo 1**, 9ª,

Larson, R. y otros, **Cálculo 2**, 9ª,

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

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

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

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

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

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	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Fernández Arias, M ^a Jesús Álvarez Llorente, Gema			
Lecturers	Álvarez Llorente, Gema Arevalo Tomé, Raquel Fernández Arias, M ^a Jesús Fernández Vázquez-Noguerol, Mar González-Portela Garrido, Alicia Trinidad López Miguens, María Jesús Pérez Pereira, Santos Silva França Santos, Alexandra Maria Sinde Cantorna, Ana Isabel Urgal González, Begoña			
E-mail	jarias@uvigo.es galvarez@uvigo.es			
Web	http://faitic@uvigo.es			
General description	(*)Esta materia ten como obxectivo fundamental ofrecer ao alumno unha visión preliminar ou introdutoria, de carácter teórico-práctico, encol a natureza e o funcionamento das organizacións empresariais e a súa relación coa contorna na que operan, así como as actividades que levan a cabo. Para iso, entre outras cousas, definiremos o termo empresa dende un punto de vista multidimensional que abrangue a complexidade do seu funcionamento como sistema aberto. Posteriormente, analizaremos as relacións da empresa coa súa contorna, e entraremos no estudo das súas principais áreas funcionais que contribúen ao correcto desenvolvemento da súa actividade.			

Competencies

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

Learning outcomes

Learning outcomes	Competences		
Know the role of the company in the field of economic activity.	CE6	CT18	
Understand the basic aspects that characterize the different types of companies.	CE6	CT1	CT18
Know the legal framework of the different types of companies.	CE6	CT1	
Know the most relevant aspects of the organization and management in the company.	CG9	CE6	CT1 CT18
Acquire skills on the processes that affect business management.	CG9	CE6	CT2 CT7 CT18

Contents

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

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	45.5	78
Laboratory practical	18	45	63
Objective questions exam	3	6	9

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

Methodologies

	Description
Lecturing	Explanation of the main contents of the course.
Laboratory practical	Application to specific problems of the knowledge acquired in theoretical classes.

Personalized assistance

Tests	Description
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Objective questions exam	The students will have occasion of acudir to tutorías in the dispatch of the professor in the time that the professors will establish to such effect to principle of course and that will publish in the platform of teledocencia Fatic. These tutorías are destinadas to resolve doubts and orientar to the students on the development of the contents abordados in the theoretical kinds, the practical kinds and the works that can them encomendar. In this apartado also includes the aclaración to the students of any question on the proofs realized along the course.
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Assessment					
	Description	Qualification	Evaluated Competences		
Laboratory practical	In accordance with the planning docente of the academic course, the student will have to develop a number determined of practices that include diverse exercises of application of the knowledges purchased in the kinds of theory to concrete situations and allow to develop diverse basic skills (capacity for the resolution of problems, initiative, work in team, etc.). These practices do not take part in the calculation of the qualification of the subject, but exige to the student obtain an exert minimum in the same for the superación of the subject.	0	CG9	CE6	CT1 CT2 CT7 CT18
Objective questions exam	Will realize , and minimum, two test type test along the course, in which will evaluate the knowledges, the destrezas and the competitions purchased by the students so much in the classrooms of theory and of practices.	100	CG9	CE6	CT1 CT2

Other comments on the Evaluation

1. Ethical commitment:

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

2. Continuous evaluation system

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

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

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

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

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

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

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

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

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

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

3. Students who do not opt for continuous assessment

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

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

4. About the July call

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

5. Prohibition of the use of electronic devices

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

Sources of information

Basic Bibliography

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

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

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

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

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Basics of operations management/V12G320V01605

IDENTIFYING DATA				
Physics: Physics 2				
Subject	Physics: Physics 2			
Code	V12G363V01202			
Study programme	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	English			
Department				
Coordinator	Fernández Fernández, José Luís			
Lecturers	Álvarez Fernández, María Inés Blanco García, Jesús Fernández Fernández, José Luís Iglesias Prado, Jose Ignacio Legido Soto, José Luís Lusquiños Rodríguez, Fernando Paredes Galán, Ángel Quintero Martínez, Félix Ribas Pérez, Fernando Agustín Riveiro Rodríguez, Antonio Soto Costas, Ramón Francisco Testa Anta, Martín			
E-mail	jlfdez@uvigo.es			
Web	http://faiatic.uvigo.es			
General description	This undergraduate course is the second quarter of introductory physics. The focus is on electricity, magnetism and thermodynamics			

Competencies	
Code	
CG3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.
CE2	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.
CT2	CT2 Problems resolution.
CT9	CT9 Apply knowledge.
CT10	CT10 Self learning and work.

Learning outcomes			
Learning outcomes		Competences	
Understanding the basic concepts of electromagnetism and thermodynamics.	CG3	CE2	
Knowing the basic instruments for the measurement of physical quantities.		CE2	
Knowing the basic techniques for experimental data evaluation.	CG3	CE2	CT9 CT10
Ability to develop practical solutions to basic technical problems in engineering, within the framework of electromagnetism and thermodynamics.	CG3	CE2	CT2 CT9 CT10

Contents	
Topic	
1.- ELECTRIC CHARGE AND ELECTRIC FIELD	1.1.- Electric Charge. 1.2.- Conductors, Insulators and Induced Charges. 1.3.- Coulomb's Law. 1.4.- Electric Field and Electric Forces. 1.5.- Electric Field Calculations. 1.6.- Electric Field Lines. 1.7.- Electric Dipoles.
2.- GAUSS'S LAW	2.1.- Charge and Electric Flux. 2.2.- Calculating Electric Flux. 2.3.- Gauss's Law. 2.4.- Applications of Gauss's Law. 2.5.- Conductors in Electrostatic Equilibrium.

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

12.- THE SECOND LAW OF THERMODYNAMICS

- 12.1.- Directions of Thermodynamic Processes.
- 12.2.- Heat Engines, Refrigerators, and Heat Pumps.
- 12.3.- The Second Law of Thermodynamics: Clausius and Kelvin-Planck Statements.
- 12.4.- Carnot Engine.
- 12.5.- Carnot Theorems.
- 12.6.- Thermodynamic Temperature.
- 12.7.- Entropy.
- 12.8.- Increase of Entropy Principle.
- 12.9.- Entropy Change of an Ideal Gas.

LABORATORY

- 1.- How to Use a Multimeter. Ohm's Law. Direct Current. Circuit with Resistors.
- 2.- Linear and Non-Linear Conductors.
- 3.- Charge and Discharge of a Capacitor.
- 4.- Analysis of a Parallel Plate Capacitor with Dielectrics.
- 5.- Utilization of an Oscilloscope to Analyze Charge and Discharge Processes.
- 6.- Study of the Magnetic Field. Helmholtz Coils. Magnetic Moment. Hall Effect.
- 7.- Calorimetry. Water Equivalent of Calorimeter. Latent Heat of Fusion.
- 8.- Thermodynamics of the Ideal Gas. Heat Capacity Ratio. Adiabatic Work.

LABORATORY: UNSTRUCTURED ACTIVITY (OPEN LAB) SESSIONS

Unstructured activity (open lab) sessions that cover the topics of the above cited regular laboratory sessions. A practical problem will be assigned to each team. Then, under the teacher's supervision, each team must analyse the problem, select a theoretical model and experimental means to obtain a solution.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24.5	45	69.5
Problem solving	8	20	28
Laboratory practical	18	18	36
Objective questions exam	1	0	1
Problem and/or exercise solving	3.5	0	3.5
Essay questions exam	3	0	3
Practices report	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.
Practices report	In office hours.

Assessment

Description		Qualification	Evaluated Competences		
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	CG3	CE2	
Problem and/or exercise solving	Test in which the student must solve a series of problems and / or exercises in a time / conditions set by the teacher. In this way, the student should apply the acquired knowledge.	40	CG3	CE2	CT2
Essay questions exam	Tests that include open questions on a topic. Students should develop, relate, organize and present knowledge on the subject in an argued response.	40	CG3	CE2	
Practices report	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	CG3	CE2	CT9 CT10

Other comments on the Evaluation

Continuous assessment (denoted EC) will have a weight of 30% in the final mark, and will include the lab mark (20%, denoted ECL) and the class mark (10%, denoted ECA).

The mark ECA will be evaluated by means of tests on the topics covered in the lectures.

The mark ECL will be evaluated by the lab reports and tests on the topics covered in the laboratory sessions. It is mandatory the attendance to 10 out of 12 lab sessions to obtain the mark ECL.

Those students unable to attend the continuous assessment and who have been granted with the waiver of the continuous assessment have the possibility of taking a final test to obtain REC mark with a weight of 30% of the final mark. This test will include the contents of the lab sessions (weight of 20%, denoted RECL) and the topics covered in the lectures (weight of 10%, denoted RECA).

The remaining 70% of the final mark will be obtained by taking a final exam. This will consist of two parts: a theoretical part (denoted T) with a weight of 30% of the final mark, and another part on problem solving (denoted P) with a weight of 40% of the final mark. The theoretical part will consist of: (1) a qualifying test (denoted TT) on fundamental theoretical concepts, and (2) a test with questions of development (denoted TC). The qualifying test TT will have a weight of 10% in the final mark, and it is required a minimum score of 50% in it. The test TC will have a weight of 20% in the final mark. Those students not attending the final exam will obtain a mark of non-presented.

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

Final mark G for the continuous assessment modality: $G = ECL + ECA + TT + TC + P$, where TC and P are only considered if the test TT is passed. Final mark G for the assessment at the end of the course and July (RECL and RECA only for those students granted with the waiver of the continuous assessment): $G = ECL \text{ (or RECL)} + ECA \text{ (or RECA)} + TT + TC + P$, where TC and P are only considered if the test TT is passed. Lecturers assigned to each group:

Ethical commitment: Every student is expected to follow an appropriate ethical behaviour. In the case that unethical conduct is detected (copy, plagiarism, utilisation of unauthorised electronic devices, or others), it will be considered that the student does not fulfil the necessary requirements to pass the subject. In this case, the final mark in the present academic year will be "suspenso" (0.0). Students should not possess or use any electronic device during the tests and exams, unless specifically authorised to do so. The mere fact that a student carries an unauthorised electronic device into the examination room will result in failing the subject in the present academic year and the final mark will be "suspenso" (0.0).

Sources of information

Basic Bibliography

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

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

Complementary Bibliography

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

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

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

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

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

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

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

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

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

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

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

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

Recommendations

Other comments

Basic recommendations:

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

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

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

Subject	Computer science: Computing for engineering			
Code	V12G363V01203			
Study programme	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Rodríguez Diéguez, Amador Rodríguez Damian, María			
Lecturers	Ibáñez Paz, Regina Pérez Cota, Manuel Rodríguez Damian, Amparo Rodríguez Damian, María Rodríguez Diéguez, Amador Sáez López, Juan Sanz Dominguez, Rafael Vázquez Núñez, Fernando Antonio			
E-mail	mrdamian@uvigo.es amador@uvigo.es			
Web	http://fatic.uvigo.es			
General description	They treat the following contents: Methods and basic algorithms of programming Programming of computers by means of a language of high level Architecture of computers Operating systems basic Concepts of databases			
	English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Competencies

Code	
CG3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.
CG4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CE3	CE3 Basic knowledge on the use and programming of computers, operating systems, databases and software applications in engineering.
CT1	CT1 Analysis and synthesis.
CT2	CT2 Problems resolution.
CT5	CT5 Information Management.
CT6	CT6 Application of computer science in the field of study.
CT7	CT7 Ability to organize and plan.
CT17	CT17 Working as a team.

Learning outcomes

Learning outcomes	Competences		
Computer and operating system skills.	CG3	CE3	CT5 CT6 CT7
Basic understanding of how computers work	CG3	CE3	CT1 CT5
Skills regarding the use of computer tools for engineering	CG3	CE3	CT5 CT6 CT7 CT17

Database fundamentals	CG3	CE3	CT1 CT5 CT6 CT7
Capability to implement simple algorithms using a programming language	CG3 CG4	CE3	CT2 CT7 CT17
Structured and modular programming fundamentals	CG3 CG4	CE3	CT2 CT5 CT17

Contents

Topic	
Basic computer architecture	Basic components Peripheral devices Communications
Basic programming concepts and techniques applied to engineering	Data structures Control structures Structured programming Information treatment Graphical user interfaces
Operating systems	Basic principles Types
Practical exercises that support and secure the theoretical concepts	Practical exercises that will allow the students to verify the concepts learned in class and see that using them they can solve problems
Computer tools applied to engineering	Types and examples

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	1	2
Laboratory practical	22	30	52
Case studies	12	14	26
Lecturing	8	12	20
Objective questions exam	4	7	11
Laboratory practice	6	8	14
Essay questions exam	10	15	25

*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 related to establishing contact, gathering information from the students, organizing groups, as well as presenting the course.
Laboratory practical	Activities related to applying the knowledge obtained to specific situations and acquiring basic and procedural skills related with the subject being studied. Developed in specialized spaces with specialized equipment (labs, computer rooms, etc).
Case studies	Analyze a fact, problem or real event with the purpose of knowing it, interpreting it, resolving it, generating hypothesis, contrasting data, thinking about it, gaining new knowledge, diagnosing it and training alternative solutions
Lecturing	Exhibition of the contents that make up the subject being studied on behalf of the professor, theoretical principles and/or instructions regarding an assignment, exercise or project to be developed by the student.

Personalized assistance

Methodologies	Description
Laboratory practical	

Assessment

	Description	Qualification	Evaluated Competences		
Objective questions exam	Tests for evaluating acquired competencies that include questions from which the student must choose a response from a set of alternatives (true/false, multiple choice,...)	15	CG3	CE3	CT5

Laboratory practice	Tests for evaluating acquired competencies that include activities, problems or practical exercises to be solved.	70	CG3 CG4	CE3	CT1 CT2 CT5 CT6 CT7 CT17
Essay questions exam	Tests for evaluating acquired competencies that include questions regarding a subject. The students must develop, relate, organize and present their knowledge regarding the subject.	15	CG3 CG4	CE3	CT1 CT2 CT5 CT6 CT7

Other comments on the Evaluation

Ethical commitment:

Students are expected to behave ethically. If unethical behaviour is detected (copying, plagiarism, use of unauthorized electronic

devices and others), then it will be considered that the student does not meet the minimum requirements to pass the course. In this case, the final grade for the current academic year will be failed (0.0).

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

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

CONTINUOUS ASSESSMENT OPERATION

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

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

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

First call (May/June):

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

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

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

Second call (June/July):

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

NON-CONTINUOUS EVALUATION OPERATION

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

First call (May/June):

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

Second call (June/July):

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

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

Sources of information

Basic Bibliography

Eric Matthes, **Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction to Programming**, 2019

Sébastien Chazallet, **Python 3. Los fundamentos del lenguaje - 2ª edición**, 2016

Dictino Chaos García, **Introducción a la informática básica (GRADO)**, 2017

Complementary Bibliography

Tanenbaum, Andrew S., **Sistemas Operativos Modernos**, Pearson Education, 2009

Silberschatz, Abraham ,Korth Henry, Sudarshan, S., **Fundamentos de bases de datos**, McGraw-Hill,, 2014

Recommendations

IDENTIFYING DATA**Mathematics: Calculus 2 and differential equations**

Subject	Mathematics: Calculus 2 and differential equations			
Code	V12G363V01204			
Study programme	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Cachafeiro López, María Alicia			
Lecturers	Cachafeiro López, María Alicia Calvo Ruibal, Natividad Castejón Lafuente, Alberto Elias Durany Castrillo, José Fernández García, José Ramón Godoy Malvar, Eduardo Illán González, Jesús Ricardo Martínez Brey, Eduardo			
E-mail	acachafe@uvigo.es			
Web	http://faitic.es			
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.			

Competencies

Code	
CG3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.
CG4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CE1	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.
CT1	CT1 Analysis and synthesis.
CT2	CT2 Problems resolution.
CT3	CT3 Oral and written proficiency in the own language.
CT6	CT6 Application of computer science in the field of study.
CT9	CT9 Apply knowledge.
CT15	CT15 Objectification, identification and organization.
CT16	CT16 Critical thinking.

Learning outcomes

Learning outcomes	Competences		
Understanding of the basic concepts of integral calculus in several variables.	CG3	CE1	CT1
Knowledge of the main techniques of integration of functions of several variables.	CG3	CE1	CT1
	CG4		CT2 CT9
Knowledge of the main results of vector calculation and applications.	CG3	CE1	CT1
	CG4		CT2 CT9
			CT2 CT9
Acquisition of the basic knowledge for solving equations and linear differential systems.	CG3 CG4	CE1	CT1 CT2 CT9
Understanding of the importance of integral calculus, vector calculus and differential equations for the study of the physical world.		CE1	CT9 CT16
Application of the knowledge of integral calculus, vector calculus and differential equations.		CE1	CT2 CT6 CT9 CT16

Acquisition of the necessary capacity to use this knowledge in the manual and computer resolution of issues, exercises and problems.

CE1 CT1
CT2
CT3
CT6
CT9
CT15
CT16

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. 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, homogeneous 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 classes the profesor will explain the basic contents of the matter. The students will have basic reference texts to follow the matter.
Problem solving	The profesor will solve problems and exercises and the student will have to solve similar exercises to acquire the necessary skills.
Laboratory practical	The profesor 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 classes and in office hours.
Laboratory practical	The profesor will personally help solving doubts and requirements from the students, especially in problem and laboratory classes and in office hours.

Assessment					
	Description	Qualification	Evaluated	Competences	
Problem solving	Written and/or homework tests will be done.	40	CG3 CG4	CE1	CT1 CT2 CT3 CT6 CT9 CT15 CT16
Essay questions exam	A final test will be done on the contents of the whole matter.	60	CG3 CG4	CE1	CT1 CT2 CT3 CT9 CT15 CT16

Other comments on the Evaluation

The continuous assessment will be done based on the former exposed criteria. The final grade will be the best mark between that obtained in the continuous assessment and the one in the final test.

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 ethical 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	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician English			
Department				

Coordinator	Cruz Freire, José Manuel			
Lecturers	Bolaño García, Sandra Bravo Bernárdez, Jorge Cruz Freire, José Manuel Fernández Requejo, Patricia Izquierdo Pazó, Milagros Lorenzo Fernández, Paula Losada Barreiro, Sonia Moldes Menduíña, Ana Belén Moldes Moreira, Diego Nóvoa Rodríguez, Ramón Otero Martínez, Nicolás Rey Losada, Francisco Jesús Rodríguez Rodríguez, Ana María Rosales Villanueva, Emilio Sanroman Braga, María Ángeles Souto Salgado, José Antonio			
E-mail	jmcruz@uvigo.es			
Web	http://fatic.uvigo.es/			
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.			

Competencies

Code				
CG3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.			
CE4	CE4 Ability to understand and apply the basic knowledge of general chemistry, organic chemistry and inorganic chemistry, and their applications in engineering.			
CT2	CT2 Problems resolution.			
CT3	CT3 Oral and written proficiency in the own language.			
CT10	CT10 Self learning and work.			
CT17	CT17 Working as a team.			

Learning outcomes

Learning outcomes	Competences		
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.	CG3	CE4	CT2 CT3 CT10 CT17

Contents

Topic	
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1. Atomic theory and chemical bonding	<p>1.1 Atomic theory: Particles of the atom: Electron, proton et neutron. Characteristics of the atom: Atomic number and Atomic mass. Isotopes. Stability of the nucleus: Radioactivity (natural and artificial). Evolution of the atomic theory.</p> <p>1.2. Chemical bonding: Definition. Intramolecular bonding: Covalent bonding and ionic bonding. Polyatomic molecules: hybridization and delocalization of electrons. Intermolecular bonding: Types of intermolecular forces.</p>
2. States of aggregation: Solids, gases, pure liquids and solutions	<p>2.1. Solid state: Introduction. Classification of solids: amorphous solids, molecular crystals and liquid crystals, Covalent crystals and ionic crystals.</p> <p>2.2. Gaseous state: Characteristics of the gas phase. Ideal gases: Equation of state. Real gases: Equation of state. Properties of gases.</p> <p>2.3. Liquid state: Characteristics of the liquid phase: physical properties (density, surface tension, viscosity). Changes of state. Phase diagram. Solutions: colligative properties</p>
3. Thermochemistry	<p>3.1. Heat of reaction: Definition of Enthalpy and Internal Energy. Enthalpy of reaction. Temperature Dependence of Enthalpy Changes. Enthalpy of formation. Determination of the reaction enthalpy: direct method. State Function and Hess's Law.</p> <p>3.2. Entropy: Definition. Calculus.</p> <p>3.3. Free energy: Definition. Calculus. The Criterion of Evolution.</p>
4. Chemical equilibrium: in gas phase, acid-base-base, redox, solubility	<p>4.1. Chemical equilibrium: Concept of Equilibrium. Equilibrium Constant. Types of equilibrium. The Le Chatelier Principe.</p> <p>4.2. Acid-base Equilibrium: Definition of acid and base. Autoionization of water. Ionic Product. Concept of pH and pOH. Strength of acids and bases: Polyprotic acids. Amphoters. pH calculation. Acid-base titration. Buffer solutions.</p> <p>4.3. Redox equilibrium: Concept of oxidation, reduction, oxidising agent, reducing agent. Balance of redox reactions in acid and alkaline media. Redox titration. Electrochemical cells: basic concepts and redox potential. Thermodynamics of electrochemical reactions: Gibbs Energy and cell Potential. Nernst Equation. Faraday's Laws.</p> <p>4.4 Solubility equilibrium: Soluble salts: Hydrolysis. Sparingly soluble salts: solubility and solubility product. Factors affecting solubility. Fractional Precipitation. Complex Salts: Definition, properties, dissociation and importance.</p>
5. Chemical kinetics	<p>5.1. Basic Concepts: Reaction Rate. Reaction Order. Kinetic Constant. Rate Equation.</p> <p>5.2. Determination of the Rate Equation: Initial rate method. Integrated Rate Laws.</p> <p>5.3. Factors affecting the Reaction Rate.</p>
6. Basic principles of Organic Chemistry	<p>6.1. Fundamentals of Organic formulation and functional groups:</p> <p>6.1.1. Structure of the organic compounds: Alkanes, alkenes and alkynes. Aromatic Hydrocarbons.</p> <p>6.1.2. Alcohols and phenols.</p> <p>6.1.3. Ethers.</p> <p>6.1.4. Aldehydes and ketones.</p> <p>6.1.5. Esters.</p> <p>6.1.6. Carboxylic acids and derivatives.</p> <p>6.1.7. Amines and nitro-compounds.</p>
7. Basic principles of Inorganic Chemistry.	<p>7.1. Metallurgy and the Chemistry of Metals: Abundance of metals. Nature of the metallic bond, properties. Theory of the Conduction Band: conducting materials, semiconductors and superconductors. Metallurgical processes: iron and steel.</p> <p>7.2. Non-metallic elements and their compounds: General properties. Hydrogen. Carbon. Nitrogen and phosphorous. Oxygen and sulphur. Halogens.</p>

8. Applied Electrochemistry	8.1. Applications of the Nernst equation: Determination of pH, Equilibrium constant, solubility product. 8.2. Electrochemical cells: types of cells. Concentration Cells. Electric Conductivity in electrolytes. Electrolysis Cells. 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 corrosion cell. 9.2. Corrosion of metals. 9.3. Corrosion rate. 9.4. Types of Corrosion. 9.5. Protection against Corrosion: Design considerations for Corrosion protection. Cathodic protection: sacrificial anodes and impressed current. Organic Coatings. Metallic coatings.
10. Electrochemical sensors	10.1. Fundamentals. 10.2. Typology and function. 10.3. Conductivity Sensors. 10.4. Potentiometric Sensors. 10.5. Ion Selective electrodes. pH sensors. 10.6. Sensors for gases in solution. 10.7. Enzyme-based sensors: Biosensors. 10.8. Amperometric and voltammetric sensors. 10.9. Applications of sensors: medicine, industry, environment.
11. Petroleum and derivatives. Petrochemistry	11.1. Physicochemical characteristics of petroleum (oil). 11.2. Physicochemical characteristics of natural gas. 11.3. Conditioning and uses of natural gas. 11.4. Fractioning of oil. 11.5. Cracking of hydrocarbons. Reforming, isomerisation, oligomerisation, alkylation and esterification of hydrocarbons. 11.6. Petrochemical processes of BTX; olefins and derivatives; methanol and derivatives. 11.7. Treatment of sulphurous compounds and refining units.
12. Carbon: Carbochemistry	(12.1. Formation of carbon. 12.2. Types of carbons and their constitution. 12.3. Technological uses of carbon. 12.4. Pyrogenation of carbon. 12.5. Hydrogenation of carbon. 12.6. Direct liquefaction of carbon. Gasification.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	30	45	75
Problem solving	7.5	12	19.5
Laboratory practical	10	7.5	17.5
Autonomous problem solving	0	25.5	25.5
Objective questions exam	1	0	1
Problem and/or exercise solving	3	0	3
Practices report	1	7.5	8.5

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

Methodologies

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

Personalized assistance

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

Assessment					
	Description	Qualification	Evaluated Competences		
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. According to current legislation, the final grade will be numeric and between 0 and 10.	10	CG3	CE4	CT2 CT3 CT10
Objective questions exam	The purpose of these tests, which will be carried out in the date of the official announcement of examinations, 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	CG3	CE4	CT10
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. The exam will be graded according to the current legislation, with a numerical final grade between 0 and 10.	40	CG3	CE4	CT2 CT3 CT10
Practices report	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. 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. 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		CE4	CT3 CT17

Other comments on the Evaluation

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

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

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.

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

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Complementary Bibliography

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Pingarrón, J.M. y Sánchez Batanero, P., **Química Electroanalítica. Fundamentos y Aplicaciones**, Ed. Síntesis,

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Sánchez Coronilla, A., **Resolución de Problemas de Química**, Ed. Universidad de Sevilla,

Brown, L.S., Holme, T.A., **Chemistry for engineering students**, Brooks/Cole Cengage Learning, 3rd ed.,

Recommendations

Subjects that it is recommended to have taken before

(*)Física: Física I/V12G350V01102

(*)Matemáticas: Álgebra e estadística/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.