



(\*)Escola de Enxeñaría Industrial

## Degree in Mechanical Engineering

### Subjects

#### Year 1st

Code	Name	Quadmester	Total Cr.
V12G380V01101	Graphic expression: Graphic expression	1st	9
V12G380V01102	Physics: Physics I	1st	6
V12G380V01103	Mathematics: Algebra and statistics	1st	9
V12G380V01104	Mathematics: Calculus I	1st	6
V12G380V01201	Business: Introduction to business management	2nd	6
V12G380V01202	Physics: Physics II	2nd	6
V12G380V01203	Computer science: Computing for engineering	2nd	6
V12G380V01204	Mathematics: Calculus II and differential equations	2nd	6
V12G380V01205	Chemistry: Chemistry	2nd	6

**IDENTIFYING DATA****Graphic expression: Graphic expression**

Subject	Graphic expression: Graphic expression			
Code	V12G380V01101			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Basic education	1st	1st
Teaching language				
Department	Design in Engineering			
Coordinator	López Figueroa, Concepto Esteban Alegre Fidalgo, Paulino			
Lecturers	Adán Gómez, Manuel Alegre Fidalgo, Paulino Corralo Domonte, Francisco Javier Fernández Álvarez, Antonio López Figueroa, Concepto Esteban Patiño Barbeito, Faustino Roa Corral, Ernesto Troncoso Saracho, José Carlos			
E-mail	alegre@uvigo.es esteban@uvigo.es			
Web	<a href="http://faitic.uvigo.es">http://faitic.uvigo.es</a>			
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	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
B6	CG6 Capacity for handling specifications, regulations and mandatory standards.
C5	CE5 Capacity for spatial vision and knowledge of the techniques of graphic representation, using traditional methods of metric geometry and descriptive geometry, and through the application of computer-aided design.
D2	CT2 Problems resolution.
D6	CT6 Application of computer science in the field of study.
D9	CT9 Apply knowledge.

**Learning outcomes**

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

**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
Group tutoring	4	0	4
Problem based learning	0	27	27
Essay questions exam	2	0	2
Laboratory practice	4	0	4

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

**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.
Group tutoring	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.
Problem based learning	Realisation of activities that require the active participation and the collaboration between the students.

### Personalized attention

Methodologies	Description
Group tutoring	

### Assessment

Description		Qualification	Training and Learning Results		
Essay questions exam	It will realise a final examination that will cover the whole of the contents of the subject, so many theorists like practical, and that they will be able to include test type test, questions of reasoning, resolution of problems and development of practical cases. It demands reach a minimum qualification of 4,0 points on 10 possible to be able to surpass the subject.	65	B3 B4	C5	D2 D9
Laboratory practice	Along the triannual, in determinate sessions of resolution of problems and exercises will pose problems or exercises for his resolution by the students and back delivery to the professor, that will evaluate them in accordance with the criteria that previously will have communicated to the students.	35	B4	C5	D2 D6 D9

### 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

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

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

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

Félez, Jesús; Martínez, M<sup>a</sup> Luisa, **DIBUJO INDUSTRIAL**, 3<sup>a</sup> Edición, ISBN: 84-7738-331-6,

Casasola Fernández, M<sup>a</sup> Isabel y otros, **Sistemas de representación I, Teoría y problemas**, ISBN 978-84-615-3553-8, Ed. Asociación de Investigación, 2011

### **Complementary Bibliography**

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

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

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

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

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

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

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Giesecke, Mitchell, Spencer, Hill, Dygdon, Novak, Lockhart, □ **Technical Drawing with Engineering Graphics**, 14ª, Prentice Hall, 2012

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

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### **Recommendations**

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### **Other comments**

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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.

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

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<b>IDENTIFYING DATA</b>				
<b>Física: Física I</b>				
Subject	Física: Física I			
Code	V12G380V01102			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1	1c
Teaching language	Castelán Galego			
Department	Física aplicada			
Coordinator	Lusquiños Rodríguez, Fernando			
Lecturers	Álvarez Fernández, María Inés Blanco García, Jesús Boutinguiza Larosi, Mohamed Legido Soto, José Luís Lugo Latas, Luis Lusquiños Rodríguez, Fernando Pérez Vallejo, Javier Ribas Pérez, Fernando Agustín Serra Rodríguez, Julia Asunción Soto Costas, Ramón Francisco Trillo Yáñez, María Cristina Val García, Jesús del Wallerstein Figueirôa, Daniel			
E-mail	flusqui@uvigo.es			
Web	<a href="http://faitic.uvigo.es">http://faitic.uvigo.es</a>			
General description	Física do primeiro curso das Enxeñarías da rama Industrial			

### Competencias

Code	
B3	CG3 Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
C2	CE2 Comprensión e dominio dos conceptos básicos sobre as leis xerais da mecánica, termodinámica, campos e ondas e electromagnetismo, así como a súa aplicación para a resolución de problemas propios da enxeñaría.
D2	CT2 Resolución de problemas.
D9	CT9 Aplicar coñecementos.
D10	CT10 Aprendizaxe e traballo autónomos.

### Resultados de aprendizaxe

Expected results from this subject	Training and Learning Results		
Comprender os conceptos básicos sobre as leis xerais de a mecánica e campos e ondas.	B3	C2	
Coñecer a instrumentación básica para medir magnitudes físicas.		C2	
Coñecer as técnicas básicas de avaliación de datos experimentais.	B3	C2	D9 D10
Desenvolver solucións prácticas a problemas técnicos elementais de a ingeniería en os ámbitos de a mecánica e de campos e ondas.	B3	C2	D2 D9 D10

### Contidos

Topic	
1.- UNIDADES, CANTIDADES FÍSICAS E VECTORES	1.1.- A natureza da Física. 1.2.- Consistencia e conversións de unidades. 1.3.- Incerteza e cifras significativas. 1.4.- Estimacións e ordes de magnitude. 1.5.- Vectores e suma de vectores. 1.6.- Compoñentes de vectores. 1.7.- Vectores unitarios. 1.8.- Produtos de vectores. 1.9.- Vectores deslizantes
2.-CINEMÁTICA DO PUNTO	2.1.- Vectores de posición e velocidade. Traxectoria. 2.2.- O vector aceleración: Compoñentes intrínsecas. 2.3.- Velocidade media.

3.- LEIS DO MOVEMENTO DE NEWTON	<p>3.1.- Forza e interaccións.</p> <p>3.2.- Primeira lei de Newton.Sistemas de referencia inerciais e non inerciais.</p> <p>3.3.- Segunda lei de Newton.</p> <p>3.4.- Masa e peso.</p> <p>3.5.- Terceira lei de Newton.</p> <p>3.6.- Momento lineal. Impulso mecánico. Momento angular.</p> <p>3.7.- Rozamento.</p>
4.- TRABALLO E ENERXÍA CINÉTICA	<p>4.1.- Traballo realizado por unha forza. Potencia.</p> <p>4.2.- Enerxía cinética.</p> <p>4.3.- Forzas conservativas e non conservativas.</p> <p>4.4.- Enerxía potencial elástica.</p> <p>4.5.- Enerxía potencial no campo gravitatorio.</p> <p>4.6.- Enerxía mecánica.</p> <p>4.7.- Forza e enerxía potencial.</p> <p>4.8.- Principio de conservación da enerxía mecánica.</p>
5.- CINEMÁTICA DOS SISTEMAS DE PUNTOS	<p>5.1.- Sistema de puntos.</p> <p>5.2.- Sólido ríxido.</p> <p>5.3.- Movemento de traslación.</p> <p>5.4.- Movemento de rotación arredor dun eixo fixo.</p> <p>5.5.- Movimiento xeral ou rototraslatorio.</p> <p>5.6.- Centro instantáneo de rotación.</p> <p>5.7.- Rodadura.</p> <p>5.8.- Movemento relativo.</p>
6.- DINÁMICA DOS SISTEMAS DE PARTÍCULAS	<p>6.1.- Sistemas de partículas. Forzas interiores e exteriores.</p> <p>6.2.- Centro de masas do sistema. Movemento do c.d.m.</p> <p>6.3.- Ecuacións do movemento dun sistema de partículas.</p> <p>6.4.- Momento lineal. Teorema de conservación.</p> <p>6.5.- Momento angular dun sistema de partículas. Teorema de conservación.</p> <p>6.6.- Traballo e potencia.</p> <p>6.7.- Enerxía potencial e cinética dun sistema de partículas.</p> <p>6.8.- Teorema da enerxía dun sistema de partículas.</p> <p>6.9.- Choques.</p>
7.- DINÁMICA DO SÓLIDO RÍXIDO	<p>7.1.- Rotación dun sólido ríxido en torno a un eixo fixo.</p> <p>7.2.- Momentos e produtos de inercia.</p> <p>7.3.- Cálculo de momentos de inercia.</p> <p>7.4.- Teorema de Steiner.</p> <p>7.5.- Momento dunha forza e par de forzas.</p> <p>7.6.- Ecuacións do movemento xeral do sólido ríxido.</p> <p>7.7.- Enerxía cinética no movemento xeral do sólido ríxido.</p> <p>7.8.-Traballo no movemento xeral do sólido ríxido.</p> <p>7.9.- Momento angular dun sólido ríxido. Teorema de conservación.</p>
8.- ESTÁTICA	<p>8.1.- Equilibrio de sólidos ríxidos.</p> <p>8.2.- Centro de gravidade.</p> <p>8.3.- Estabilidade.</p> <p>8.4.- Grados de liberdade e ligaduras</p>
9.- MOVEMENTO PERIÓDICO	<p>9.1.- Descrición da oscilación.</p> <p>9.2.- Movemento armónico simple.</p> <p>9.3.- Enerxía no movemento armónico simple.</p> <p>9.4.- Aplicacións do movemento armónico simple.</p> <p>9.5.- O péndulo simple.</p> <p>9.6.- O péndulo físico.</p> <p>9.7.- Oscilacións amortecidas.</p> <p>9.8.- Oscilacións forzadas e resonancia.</p>
10.- MECÁNICA DE FLUÍDOS	<p>10.1.- Densidade.</p> <p>10.2.- Presión nun fluido.</p> <p>10.3.- Principios fundamentais da Fluidostática.</p> <p>10.4.- Ecuación de continuidade.</p> <p>10.5.- Ecuación de Bernoulli.</p>
11.- ONDAS MECÁNICAS	<p>11.1.- Tipos de ondas mecánicas.</p> <p>11.2.- Ondas periódicas.</p> <p>11.3.- Descrición matemática dunha onda.</p> <p>11.4.- Rapidez dunha onda transversal.</p> <p>11.5.- Enerxía do movemento ondulatorio.</p> <p>11.6.- Interferencia de ondas, condicións de fronteira e superposición.</p> <p>11.7.- Ondas estacionarias nunha corda.</p> <p>11.8.- Modos normais dunha corda.</p>



LABORATORIO

- 1.- Teoría de Medidas, Erros, Gráficos e Axustes. Exemplos.
- 2.- Tempo de Reacción.
- 3.- Determinación da densidade dun corpo.
- 4.- Movemento Relativo.
- 5.- Velocidade instantánea.
- 6.- Estudo do péndulo simple.
- 7.- Experiencias cun resorte helicoidal.
- 8.- Oscilacións amortecidas e forzadas.
- 9.- Momentos de inercia. Determinación do radio de xiro dun corpo.
- 10.- Ondas estacionarias.

LABORATORIO NON ESTRUCTURADO

1. Sesións con actividades non estruturadas (práctica aberta) que abarcan os contidos teóricos de as prácticas enumeradas arriba. Os grupos de alumnos deben resolver un problema práctico proposto por o profesor, seleccionando o marco teórico e ferramentas experimentais para obter a solución; para iso, dispoñerán de información básica e guía de o profesor

**Planificación**

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	24.5	45	69.5
Resolución de problemas	8	20	28
Prácticas de laboratorio	18	18	36
Exame de preguntas obxectivas	1	0	1
Resolución de problemas	3.5	0	3.5
Exame de preguntas de desenvolvemento	3	0	3
Informe de prácticas	0	9	9

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

**Metodoloxía docente**

	Description
Lección maxistral	Exposición por parte do profesor dos contidos sobre a materia obxecto de estudo, bases teóricas e/ou directrices dun traballo, exercicio ou proxecto a desenvolver polo estudante.
Resolución de problemas	Actividade en a que se formulan problema e/ou exercicios relacionados con a asignatura. O alumno debe desenvolver as solucións adecuadas ou correctas mediante a exercitación de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación de a información dispoñible e a interpretación de os resultados. Adóitase utilizar como complemento de a lección magistral.
Prácticas de laboratorio	Actividades de aplicación de os coñecementos a situacións concretas e de adquisición de habilidades básicas e procedimentales relacionadas con a materia obxecto de estudo. Desenvólvense en espazos especiais con equipamiento especializado (laboratorios, aulas informáticas, etc).

**Atención personalizada**

Methodologies	Description
Lección maxistral	Levarase a cabo fundamentalmente nas titorías.
Prácticas de laboratorio	Levarase a cabo fundamentalmente nas titorías.
Resolución de problemas	Levarase a cabo fundamentalmente nas titorías.
Tests	Description
Exame de preguntas obxectivas	Levarase a cabo fundamentalmente nas titorías.
Resolución de problemas	Levarase a cabo fundamentalmente nas titorías.
Exame de preguntas de desenvolvemento	Levarase a cabo fundamentalmente nas titorías.
Informe de prácticas	Levarase a cabo fundamentalmente nas titorías.

**Avaliación**

Description	Qualification Training and Learning Results

Exame de preguntas obxectivas	Probas para avaliación de as competencias adquiridas que inclúen preguntas pechas con diferentes alternativas de resposta (verdadeiro/falso, elección múltiple, emparejamiento de elementos...). Os alumnos seleccionan unha resposta entre un número limitado de posibilidades.	10	B3 C2
Resolución de problemas	Proba en a que o alumno debe solucionar unha serie de problemas e/ou exercicios en un tempo/condicións establecido/as por o profesor. De este xeito, o alumno debe aplicar os coñecementos que adquiriu.	40	B3 C2 D2
Exame de preguntas de desenvolvemento	Probas para avaliación de as competencias que inclúen preguntas abertas sobre un tema. Os alumnos deben desenvolver, relacionar, organizar e presentar os coñecementos que teñen sobre a materia en unha resposta extensa.	40	B3 C2
Informe de prácticas	Elaboración de un documento por parte de o alumno en o que se reflicten as características de o traballo levado a cabo. Os alumnos deben describir as tarefas e procedementos desenvolvidos, mostrar os resultados obtidos ou observacións realizadas, así como a análise e tratamento de datos.	10	B3 C2 D9 D10

### Other comments on the Evaluation

A cualificación de a avaliación continua (que denominaremos *EC*) terá un peso de o 30% de a cualificación final e incluírá tanto os contidos de as prácticas de laboratorio (peso de o 20%, que denominaremos cualificación *ECL*) como de aula (peso de o 10%, que denominaremos cualificación *ECA*).

A cualificación *ECA* obterase mediante probas de resposta xustificada sobre contidos de aula.

A cualificación *ECL* obterase como a suma de a cualificación de os Informes/memorias de prácticas sobre contidos de laboratorio. Para obter unha cualificación *ECL* será necesaria a asistencia polo menos de 10 de as 12 sesións de laboratorio programadas.

Aqueles alumnos que non poidan seguir a avaliación continua e teñan concedida a renuncia a a avaliación continua terán a posibilidade de realizar unha proba final escrita para obter unha cualificación *REC* que terá un peso de o 30% de a cualificación final e incluírá tanto os contidos de as prácticas de laboratorio (peso de o 20%, que denominaremos cualificación *RECL*) como de aula (peso de o 10%, que denominaremos cualificación *RECA*).

O 70% restante de a cualificación final obterase mediante a realización de un exame final que constará de dous partes: unha parte teórica (que denominaremos *T*) que terá un peso de o 30% de a cualificación final e outra parte de resolución de problemas (que denominaremos *P*) que terá un peso de o 40% de a cualificación final. A parte teórica constará de unha proba eliminatoria tipo test (que denominaremos *TT*) sobre conceptos teóricos fundamentais, que terá un peso de o 10% de a cualificación final e onde se esixirá unha cualificación mínima de o 50%, e outra proba de cuestións teórico-prácticas de resposta xustificada (que denominaremos *TC*), que terá un peso de o 20% de a cualificación final. Aqueles alumnos que non se presenten a o exame final obterán unha cualificación de non presentado.

Tanto os exames de a convocatoria fin de carreira como os que se realicen en datas e/ou horarios distintos a os fixados oficialmente por o centro, poderán ter un formato de exame distinto a o detallado anteriormente, aínda que as partes de o exame conserven o mesmo valor en a cualificación final.

Cualificación final *G* de a asignatura para a modalidade de avaliación continua:

$$G = ECL + ECA + TT + TC + P, \text{ onde } TC \text{ e } P \text{ súmanse só si supérase } TT.$$

Cualificación final *G* de a asignatura para a modalidade de avaliación ao final de o cuatrimestre e xullo (as opcións *RECL* e *RECA* unicamente para alumnado con renuncia concedida) :

$$G = ECL \text{ (ou } RECL) + ECA \text{ (ou } RECA) + TT + TC + P, \text{ onde } TC \text{ e } P \text{ súmanse só si supérase } TT.$$

Profesores responsables de grupos:

Grupo A: Mohamed Boutinguiza Larosi

Grupo B: María Cristina Trillo Yáñez

Grupo C: Mohamed Boutinguiza Larosi

Grupo D: María Cristina Trillo Yáñez

Grupo G: Jesús Branco García

Grupo H: Jesús Branco García

Grupo I: Fernando Lusquiños Rodríguez

Grupo J: Fernando Lusquiños Rodríguez

Grupo K: Fernando Ribas Pérez

Grupo L: Fernando Ribas Pérez

Compromiso ético: Espérase que o alumno presente un comportamento ético adecuado. En o caso de detectar un comportamento non ético (copia, plagio, utilización de aparellos electrónicos non autorizado, etc.) considerarase que o alumno non reúne os requisitos necesarios para superar a materia. En este caso a cualificación global en o actual curso académico será de suspenso (0,0).

Non se permitirá a utilización de ningún dispositivo electrónico durante as probas de avaliación salvo autorización expresa. O feito de introducir un dispositivo electrónico non autorizado en o aula de exame será considerado motivo de non superación de a materia en o presente curso académico e a cualificación global será de suspenso (0,0).

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### **Bibliografía. Fontes de información**

#### **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,

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### **Recomendacións**

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#### **Other comments**

Recomendacións:

1. Nocións básicas adquiridas nas materias de Física e Matemáticas en cursos previos.
2. Capacidade de comprensión escrita e oral.
3. Capacidade de abstracción, cálculo básico e síntese da información.
4. Destrezas para o traballo en grupo e para a comunicación grupal.

En caso de discrepancia entre versións, prevalecerá a versión en castelán desta guía.

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**IDENTIFYING DATA****Mathematics: Algebra and statistics**

Subject	Mathematics: Algebra and statistics			
Code	V12G380V01103			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Basic education	1st	1st
Teaching language	Spanish Galician English			
Department	Statistics and Operational Research Applied Mathematics I Applied Mathematics II			
Coordinator	Pardo Fernández, Juan Carlos Castejón Lafuente, Alberto Elías			
Lecturers	Castejón Lafuente, Alberto Elías Díaz de Bustamante, Jaime Fernández García, José Ramón Fiestras Janeiro, Gloria Godoy Malvar, Eduardo Gómez Rúa, María Luaces Pazos, Ricardo Martín Méndez, Alberto Lucio Matías Fernández, José María Pardo Fernández, Juan Carlos Rodríguez Campos, María Celia Suárez Rodríguez, María Carmen			
E-mail	juancp@uvigo.es acaste@uvigo.es			
Web	<a href="http://fatic.uvigo.es">http://fatic.uvigo.es</a>			
General description	The aim of this course is to provide the student with the basic techniques in Algebra and Statistics that will be necessary in other courses of the degree.			

**Competencies**

Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
C1	CE1 Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differential equations, numerical methods, numerical algorithms, statistics and optimization.
D2	CT2 Problems resolution.
D5	CT5 Information Management.
D6	CT6 Application of computer science in the field of study.
D9	CT9 Apply knowledge.

**Learning outcomes**

Expected results from this subject	Training and Learning Results
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1. Define, look for, organize and elaborate works with information of the subject
2. Cooperatively workout exercise resolution
3. Use of telematic tools and other sources for autonomous learning

#### CELL BIOLOGY

4. Recognize the diversity and organisation of cells and tissues
5. Establish relations between cell compartments and cell functions
6. Differentiate clearly vegetal and animal cell and tissue organisation
7. Establish relationships between cell organisation and cell function
8. Optical microscope utilization
9. Knowing staining techniques
10. Identification of cell organelles by electron microscopy and tissues by optical microscopy

#### GENETICS

11. Importance of DNA in biology
12. Apply the scientific method and basic research technologies in Genetics
13. Learn how to establish genetic hypotheses and strategies to refute them
14. Manage the basic mechanisms for the transmission of the hereditary material
15. Know the molecular structure, the regulation and the expression of the hereditary material
16. Know the basic genomic principles and their biotechnological applications.
17. Know the origin of the biological diversity and the evolutionary history of the species

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

#### 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.
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.

Regression.

Scatterplot. Correlation.  
Linear regression: regression line.  
Inference about the parameters of the regression line.

### Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	40	81	121
Problem solving	12	12	24
Laboratory practices	24	12	36
Autonomous problem solving	0	40	40
Essay questions exam	4	0	4

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

### Methodologies

	Description
Lecturing	The lecturer will explain the contents of the course.
Problem solving	Problems and exercises will be solved during the classes. Students will also solve similar problems and exercises.
Laboratory practices	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 attention

Methodologies	Description
Laboratory practices	
Lecturing	
Problem solving	
Autonomous problem solving	

### Assessment

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

### Other comments on the Evaluation

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

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

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

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

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### Sources of information

#### Basic Bibliography

Lay, David C., **Álgebra lineal y sus aplicaciones**, 4<sup>a</sup>,

Nakos, George; Joyner, David, **Álgebra lineal con aplicaciones**, 1<sup>a</sup>,

de la Villa, A., **Problemas de álgebra**, 4<sup>a</sup>,

Cao, Ricardo et al., **Introducción a la Estadística y sus aplicaciones**, 1<sup>a</sup>,

Devore, Jay L., **Probabilidad y estadística para ingeniería y ciencias.**, 8<sup>a</sup>,

Devore, Jay L., **Probability and statistics for engineering and sciences**, 8<sup>a</sup>,

#### Complementary Bibliography

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### Recommendations

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

Mathematics: Calculus I/V12G380V01104

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<b>IDENTIFYING DATA</b>				
<b>Matemáticas: Cálculo I</b>				
Subject	Matemáticas: Cálculo I			
Code	V12G380V01104			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1	1c
Teaching language	Castelán Galego			
Department	Matemática aplicada I Matemática aplicada II			
Coordinator	Martínez Martínez, Antonio			
Lecturers	Bajo Palacio, Ignacio Calvo Ruibal, Natividad Cordeiro Alonso, Jose María Díaz de Bustamante, Jaime González Rodríguez, Ramón Martínez Martínez, Antonio Vidal Vázquez, Ricardo			
E-mail	antonmar@uvigo.es			
Web	http://fatic.uvigo.es			
General description	O obxectivo desta materia é que o estudante adquira o dominio das técnicas básicas de cálculo diferencial nunha e en varias variables e de cálculo integral nunha variable que son necesarias para outras materias que debe cursar na titulación.			

### Competencias

Code	
B3	CG3 Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
B4	CG4 Capacidade para resolver problemas con iniciativa, toma de decisións, creatividade, razoamento crítico e capacidade para comunicar e transmitir coñecementos, habilidades e destrezas no campo da enxeñaría industrial na especialidade de Mecánica.
C1	CE1 Capacidade para a resolución dos problemas matemáticos que poidan presentarse na enxeñaría. Aptitude para aplicar os coñecementos sobre: álgebra lineal; xeometría; xeometría diferencial; cálculo diferencial e integral; ecuacións diferenciais e en derivadas parciais; métodos numéricos; algorítmica numérica; estatística e optimización.
D1	CT1 Análise e síntese.
D2	CT2 Resolución de problemas.
D6	CT6 Aplicación da informática no ámbito de estudo.
D9	CT9 Aplicar coñecementos.
D14	CT14 Creatividade.
D16	CT16 Razoamento crítico.

### Resultados de aprendizaxe

Expected results from this subject	Training and Learning Results		
Comprensión dos coñecementos básicos de cálculo diferencial dunha e de varias variables.	B3	C1	D1
Comprensión dos coñecementos básicos de cálculo integral de funcións dunha variable.	B3	C1	D1
Manexo das técnicas de cálculo diferencial para a localización de extremos, a aproximación local de funcións e a resolución numérica de sistemas de ecuacións.	B3	C1	D2
	B4		D9
			D14 D16
Manexo das técnicas de cálculo integral para o cálculo de áreas, volumes e superficies.	B3	C1	D1
	B4		D2
			D9
			D14 D16
4. Comprender os fundamentos da diversidade e a historia evolutiva das especies animais.			
Utilización de ferramentas informáticas para resolver problemas de cálculo diferencial e de cálculo integral.	B4	C1	D2 D6 D9 D16

### Contidos



## Topic

Converxencia e continuidade	Introdución aos números reais. Valor absoluto. O espazo euclídeo $R^n$ . Sucesións. Series. Límites e continuidade de funcións dunha e de varias variables.
Cálculo diferencial de funcións dunha e de varias variables	Cálculo diferencial de funcións dunha variable real. Cálculo diferencial de funcións de varias variables reais.
Cálculo integral de funcións dunha variable	A integral de Riemann. Cálculo de primitivas. Integrais impropias. Aplicacións da integral.

## Planificación

	Class hours	Hours outside the classroom	Total hours
Resolución de problemas	20.5	30	50.5
Prácticas de laboratorio	12.5	5	17.5
Lección maxistral	32	39	71
Resolución de problemas	3	3	6
Exame de preguntas de desenvolvemento	2	3	5

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

## Metodoloxía docente

	Description
Resolución de problemas	O profesor resolverá problemas e exercicios tipo e o alumno terá que resolver exercicios similares.
Prácticas de laboratorio	Empregaranse ferramentas informáticas para resolver exercicios e aplicar os coñecementos obtidos nas clases de teoría.
Lección maxistral	O profesor exporá nas clases teóricas os contidos da materia.

## Atención personalizada

Methodologies	Description
Resolución de problemas	O profesor atenderá persoalmente as dúbidas e consultas do alumnado.
Prácticas de laboratorio	O profesor atenderá persoalmente as dúbidas e consultas do alumnado.

## Avaliación

	Description	Qualification	Training and Learning Results		
Resolución de problemas	Realizaranse probas escritas e/ou traballos.	40	B3 B4	C1	D1 D2 D6 D9 D14 D16
Exame de preguntas de desenvolvemento	Farase un exame final sobre os contidos da totalidade da materia.	60	B3 B4	C1	D1 D2 D9

## Other comments on the Evaluation

A avaliación continua levaráse a cabo sobre os criterios anteriormente expostos. Aqueles alumnos que non se acollan á avaliación continua serán avaliados cun exame final sobre os contidos da totalidade da materia, que suporá o 100% da nota.

A avaliación dos alumnos en segunda convocatoria consistirá nun exame sobre os contidos da totalidade da materia, que suporá o 100% da nota.

Compromiso ético:

"Espérase que o alumno presente un comportamento ético adecuado. En caso de detectar un comportamento non ético (copia, plaxio, utilización de aparellos electrónicos non autorizados, e outros) considerarase que o alumno non reúne os requisitos necesarios para superar a materia. Neste caso a cualificación global no presente curso académico será de suspenso (0.0)."

## Bibliografía. Fontes de información

### Basic Bibliography

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

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

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

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

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

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

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

### **Complementary Bibliography**

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

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

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

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

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

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

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### **Recomendaciones**

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

Matemáticas: Cálculo II e ecuaciones diferenciais/V12G330V01204

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

Matemáticas: Álgebra e estadística/V12G330V01103

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

Subject	Business: Introduction to business management			
Code	V12G380V01201			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician			
Department	Business Organisation and Marketing			
Coordinator	Fernández Arias, M <sup>a</sup> Jesús Álvarez Llorente, Gema			
Lecturers	Álvarez Llorente, Gema Fernández Arias, M <sup>a</sup> Jesús González-Portela Garrido, Alicia Trinidad Pérez Pereira, Santos Sinde Cantorna, Ana Isabel Urgal González, Begoña			
E-mail	jarias@uvigo.es galvarez@uvigo.es			
Web	<a href="http://faitic@uvigo.es">http://faitic@uvigo.es</a>			
General description	(*)Esta materia ten como obxectivo fundamental ofrecer ao alumno unha visión preliminar ou introdutoria, de carácter teórico-práctico, encol a natureza e o funcionamento das organizacións empresariais e a súa relación coa contorna na que operan, así como as actividades que levan a cabo. Para iso, entre outras cousas, definiremos o termo empresa dende un punto de vista multidimensional que abrangue a complexidade do seu funcionamento como sistema aberto. Posteriormente, analizaremos as relacións da empresa coa súa contorna, e entraremos no estudo das súas principais áreas funcionais que contribúen ao correcto desenvolvemento da súa actividade.			

**Competencies**

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

**Learning outcomes**

Expected results from this subject	Training and Learning Results	
	C6	D18
Know the role of the company in the field of economic activity. Detailed knowledge of the ocean equations and the dynamics of the ocean related with the solutions of those equations.	C6	D18
Understand the basic aspects that characterize the different types of companies.	C6	D1 D18
Know the legal framework of the different types of companies.	C6	D1
Know the most relevant aspects of the organization and management in the company.	B9	C6 D1 D18
Acquire skills on the processes that affect business management.	B9	C6 D2 D7 D18

**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. The Balance Sheet. 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 Income Statement: definition and main purposes. 3.2 Income Statement Structure. 3.3 The profitability of the company.
4. FINANCIAL MANAGEMENT (PART III). INVESTMENT DECISIONS.	4.1 Definition of Investment. 4.2 Types of investments. 4.3. Investment Appraisal Techniques
5. FINANCIAL MANAGEMENT (PART IV). FINANCING.	5.1 Concept of financing 5.2 Types of financing 5.3 Short-term External financing 5.4 Long-term external financing. 5.5 Internal financing 5.6 Solvency and liquidity.
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. OPERATION MANAGEMENT (PART II). PRODUCTION COSTS	7.1 Concept of cost. 7.2 Classification of costs. 7.3 The cost of production. 7.4 The income statement. 7.5 Breakeven Point.
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.
PRACTICAL CLASSES OF THE SUBJECT * (* ) Practical classes schedules can undergo changes depending on the evolution of the course.	Practical class 1: The company as a system Practical class 2: The business environment and business types Practical class 3: The economic and financial structure of the company (I). Basic concepts Practical class 4: The economic and financial structure of the company (II). The balance sheet Practical class 5: Operating cycle and Cash Conversion Cycle Practical class 6: The results of the company. The income statement Practical class 7: Investment appraisal techniques Practical class 8: Sources of business financing Practical class 9: Efficiency and productivity Practical class 10: Costs, margins and breakeven point Practical class 11: The basics of marketing Practical class 12: The management system of the company: A case study

### Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	45.5	78
Laboratory practices	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 practices	Application to specific problems of the knowledge acquired in theoretical classes.

**Personalized attention**

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

**Assessment**

Description	Qualification	Training and Learning Results
Laboratory practices	0	B9 C6 D1 D2 D7 D18
Objective questions exam	100	B9 C6 D1 D2

**Other comments on the Evaluation**

## 1. Ethical commitment

expect that the present student an ethical behaviour felicitous. In the case to detect a no ethical behaviour (copy, plagio, utilization of electronic devices no authorized, for example) will consider that the student does not gather the necessary requirements to surpass the subject. In this case, the global qualification in the present academic course will be of suspenso (0,0).

## 2. System of continuous evaluation

Following the proper guidelines of the titulación and the agreements of the academic commission will offer to the/the students/ace that cursen this subject a system of continuous evaluation.

The continuous evaluation will feature of two test type test that will realize along the course. Each one of them test type test versará on the contents seen until the moment of his realization, so much in kinds of theory and of practices. Therefore, the first proof will not free subject of face to the realization of the second proof. Because of this, each one of these proofs will have a distinct weight in the calculation of the qualification obtained in the asignatura. The first a 30% and the second a 70%.

These proofs are not recoverable, is to say, if a/to student/to can not realize them in the date stipulated, the/the professor/to does not have obligation to repeat them, except cause justified and properly accredited by the/the student/to.

The/the student/to has right to know the qualification obtained in each proof in a reasonable term after his realization and comment with the/the professor/to the result.

It will understand that the/the student/to has surpassed the continuous evaluation when they fulfil all the following requirements:

1. It have developed properly 75% of the practices of the asignatura.
2. It have obtained , at least, a qualification of 5 on 10 (Approved) in the last proof type test (that versará on all the contents seen in the asignatura).
3. The average ponderada of the qualifications obtained in them test type test was like minimum of 5 on 10 (Approved), being this the qualification obtained in the asignatura.

So that the/the student/to can present to the proofs of evaluation indicated in this point, will be precise that this/to fulfil the first requirement expressed in the previous paragraph.

It will understand that a student/to has opted by the continuous evaluation when, fulfilling with the necessary requirements

regarding the realization of the practices, takes part in the second proof type test.

The qualification obtained in them test type test and in the practices only will be valid for the academic course in which realize .

### 3. Students/ace that do not opt by the continuous evaluation

To the students/ace that do not opt by the continuous evaluation will offer them a procedure of evaluation that allow them achieve the maximum qualification. This procedure will consist in a final examination (cuya date is fixed by the Direction of the Centre), in which will evaluate all the contents developed in the asignatura, so much in the kinds of theory and in the kinds of practices. This final examination will feature of two parts: a proof of theory in format type test, that will suppose 30% of the final note, and another of practice, that will suppose 70% restante, and that will consist in a series of exercises to develop. It is indispensable condition to surpass the asignatura obtain in it tests type test a minimum punctuation of 5 on 10 (Approved).

Only will have the consideration of "No presented" that/ace students/ace that do not realize none of the proofs of evaluation collected in this guide docente. In concrete, for that/ace students/ace that realize the first tests type test but afterwards do not realize the second proof type test and neither present to the final examination, his qualification in the asignatura will be the note obtained in the first tests type test evaluated on 3.

### 4. On the announcement of July

The announcement of recovery (July) will consist in a final examination that will suppose 100% of the final qualification and in which will evaluate all the contents developed in the asignatura, so much in the kinds of theory and in the kinds of practices. Said examination will feature of two parts: a proof of theory in format type test, that will suppose 30% of the final note, and another of practice, that will suppose 70% restante, and that will consist in a series of exercises to develop. It is indispensable condition to surpass the asignatura obtain in it tests type test a minimum punctuation of 5 on 10 (Approved).

### 5. Prohibition of use of electronic devices

will not allow the utilization of any electronic device during the proofs of evaluation, except autorización expresas. The fact to enter an electronic device no authorized in the classroom of examination, will be considered reason of no superación of the asignatura in the present academic course and the global qualification will be of suspenso (0,0).

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## Sources of information

### Basic Bibliography

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

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

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

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

### Complementary Bibliography

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## Recommendations

### Subjects that continue the syllabus

Basics of operations management/V12G320V01605

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<b>IDENTIFYING DATA</b>				
<b>Physics: Physics II</b>				
Subject	Physics: Physics II			
Code	V12G380V01202			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department	Applied Physics			
Coordinator	Fernández Fernández, José Luís			
Lecturers	Álvarez Fernández, María Inés Blanco García, Jesús Fernández Fernández, José Luís Legido Soto, José Luís Lusquiños Rodríguez, Fernando Paredes Galán, Ángel Ramos Docampo, Miguel Alexandre Ribas Pérez, Fernando Agustín Riveiro Rodríguez, Antonio Soto Costas, Ramón Francisco			
E-mail	jlfdez@uvigo.es			
Web	<a href="http://fatic.uvigo.es">http://fatic.uvigo.es</a>			
General description	This undergraduate course is the second quarter of introductory physics. The focus is on electricity, magnetism and thermodynamics			

### Competencies

Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
C2	CE2 Understanding and mastering the basics of the general laws of mechanics, thermodynamics, waves and electromagnetic fields, as well as their application for solving engineering problems.
D2	CT2 Problems resolution.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.

### Learning outcomes

Expected results from this subject	Training and Learning Results		
Understanding the basic concepts of electromagnetism and thermodynamics.	B3	C2	
Knowing the basic instruments for the measurement of physical quantities.		C2	
Knowing the basic techniques for experimental data evaluation.	B3	C2	D9 D10
Ability to develop practical solutions to basic technical problems in engineering, within the framework of electromagnetism and thermodynamics.	B3	C2	D2 D9 D10

### 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 practices	18	18	36
Objective questions exam	1	0	1
Problem 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 practices	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 attention

Methodologies	Description
Lecturing	In office hours.
Laboratory practices	In office hours.
Problem solving	In office hours.
Tests	Description
Objective questions exam	In office hours.
Problem solving	In office hours.
Essay questions exam	In office hours.
Practices report	In office hours.

### Assessment

Description	Qualification	Training and Learning Results
Objective questions exam Tests for the assessment of acquired skills that include closed questions with different response options (true/false, multiple choice, matching of elements...). Students select a response among a limited number of choices.	10	B3 C2
Problem 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	B3 C2 D2
Essay questions exam Tests for the assessment of acquired skills that include open questions on a topic. Students should develop, relate, organize and present knowledge on the subject in an extensive response.	40	B3 C2
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	B3 C2 D9 D10

### Other comments on the Evaluation

Continuous assessment (designed EC) will have a weight of 30% in the final mark, and will include the lab mark (20%, designed ECL) and the class mark (10%, designed 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 a REC mark with a weight of 30% of the final mark. This test will include the contents of the lab sessions (weight of 20%, designed RECL) and the topics covered in the lectures (weight of 10%, designed 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 (designed T) with a weight of 30% of the final mark, and another part on problem solving (designed P) with a weight of 40% of the final mark. The theoretical part will consist of: (1) a qualifying test (designed TT) on fundamental theoretical concepts, and (2) a test with questions of development (designed 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, 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:

Group A: Ramón Francisco Soto Costas

Group B: José Luis Fernández Fernández

Group C: Antonio Riveiro Rodríguez

Group D: José Luis Fernández Fernández

Group G: Jesús Blanco García

Group H: Jesús Blanco García

Group I: Fernando Lusquiños Rodríguez

Group J: Fernando Lusquiños Rodríguez

Group K: Fernando Ribas Pérez

Group L: Fernando Ribas Pérez

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).

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### 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**, 4ª ed., MIR 1982; MIR-Rubiños 1993,

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

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

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

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

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

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

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### Recommendations

#### Other comments

Basic recommendations:

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

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

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

Subject	Computer science: Computing for engineering			
Code	V12G380V01203			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician English			
Department	Systems Engineering and Automatismos Computer Sciences			
Coordinator	Rodríguez Damian, María Sáez López, Juan			
Lecturers	Castelo Boo, Santiago 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 Vázquez Núñez, Francisco José			
E-mail	mrdamian@uvigo.es juansaez@uvigo.es			
Web	<a href="http://faiic.uvigo.es">http://faiic.uvigo.es</a>			
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			

**Competencies**

Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical speciality.
C3	CE3 Basic knowledge on the use and programming of computers, operating systems, databases and software applications in engineering.
D1	CT1 Analysis and synthesis
D2	CT2 Problems resolution.
D5	CT5 Information Management.
D6	CT6 Application of computer science in the field of study.
D7	CT7 Ability to organize and plan.
D17	CT17 Working as a team.

**Learning outcomes**

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

Database fundamentals	B3	C3	D1 D5 D6 D7
Capability to implement simple algorithms using a programming language	B3 B4	C3	D2 D7 D17
Structured and modular programming fundamentals	B3 B4	C3	D2 D5 D17

### 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 practices	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 practices	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 attention

Methodologies	Description
Laboratory practices	

### Assessment

	Description	Qualification	Training and Learning Results		
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	B3	C3	D5

Laboratory practice	Tests for evaluating acquired competencies that include activities, problems or practical exercises to be solved.	60	B3 B4	C3	D1 D2 D5 D6 D7 D17
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.	25	B3 B4	C3	D1 D2 D5 D6 D7

### 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:

$$\text{Test 1} * 0.2 + (\text{Test 2} \geq 3) * 0.4 + (\text{Test 3} \geq 3) * 0.4 \geq 5$$

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:

$$\text{Test 1} * 0.2 + (\text{Test 2} \geq 3) * 0.4 + (\text{Test 3} \geq 3) * 0.4 \geq 5$$

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

Second call (June/July):

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

### NON-CONTINUOUS EVALUATION OPERATION

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

First call (May/June):

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

Second call (June/July):

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

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

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### **Sources of information**

#### **Basic Bibliography**

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Ceballos Sierra, F. Javier, **Microsoft Visual Basic.Net**, Rama, 2007

Alberto Prieto Espinosa, **Introducción a la informática**, McGraww Hill, 2006

#### **Complementary Bibliography**

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

Balena, Francesco, **Programación avanzada con Microsoft Visual Basic .NET**, McGraw-Hill, 2003

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

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### **Recommendations**

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

Subject	Mathematics: Calculus II and differential equations			
Code	V12G380V01204			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician English			
Department	Applied Mathematics I Applied Mathematics II			
Coordinator	Cachafeiro López, María Alicia			
Lecturers	Bajo Palacio, Ignacio Cachafeiro López, María Alicia Castejón Lafuente, Alberto Elias Durany Castrillo, José Godoy Malvar, Eduardo Illán González, Jesús Ricardo Martínez Brey, Eduardo Suárez Rodríguez, María Carmen			
E-mail	acachafe@uvigo.es			
Web	<a href="http://faitic.es">http://faitic.es</a>			
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	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
C1	CE1 Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differential equations, numerical methods, numerical algorithms, statistics and optimization.
D1	CT1 Analysis and synthesis
D2	CT2 Problems resolution.
D3	CT3 Oral and written proficiency.
D6	CT6 Application of computer science in the field of study.
D9	CT9 Apply knowledge.
D15	CT15 Objectification, identification and organization.
D16	CT16 Critical thinking.

**Learning outcomes**

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



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

## Contents

Topic	
Integral calculus in several variables.	The double integral on rectangles. Cavalieri's Principle. Reduction to iterate integrals. Double integral on elementary regions. Properties. Fubini's theorem. The change of variables' theorem. The particular case of polar coordinates. 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 practices	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 professor will explain the basic contents of the matter. The students will have basic reference texts to follow the matter.
Problem solving	The professor will solve problems and exercises and the student will have to solve similar exercises to acquire the necessary skills.
Laboratory practices	The professor will solve problems and exercises by hand or by use of informatic tools and the student will have to solve similar exercises to acquire the necessary skills.

## Personalized attention

Methodologies	Description

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

### Assessment

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

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

### Sources of information

#### Basic Bibliography

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

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

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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

<b>IDENTIFYING DATA</b>				
<b>Chemistry: Chemistry</b>				
Subject	Chemistry: Chemistry			
Code	V12G380V01205			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician English			
Department	Chemical Engineering Physical Chemistry Inorganic Chemistry Organic Chemistry			
Coordinator	Cruz Freire, José Manuel			
Lecturers	Alonso Gómez, José Lorenzo Bolaño García, Sandra Bravo Bernárdez, Jorge Cruz Freire, José Manuel Fernández Nóvoa, Alejandro Graña Rodríguez, Ana María Izquierdo Pazó, Milagros Lorenzo Fernández, Paula Moldes Menduíña, Ana Belén Moldes Moreira, Diego Nóvoa Rodríguez, Ramón Peña Gallego, María de los Ángeles Pérez Juste, Jorge Prieto Jiménez, Inmaculada Rey Losada, Francisco Jesús Rodríguez Rodríguez, Ana María Sanroman Braga, María Ángeles Valencia Matarranz, Laura María Yañez Díaz, Maria Remedios			
E-mail	jmcruz@uvigo.es			
Web	<a href="http://fatic.uvigo.es/">http://fatic.uvigo.es/</a>			
General description	This is a basic subject, common for all levels of the industrial fields studies. At the end of the course the students will have a basic knowledge about the principles of general chemistry, organic chemistry and inorganic chemistry, and its application to Industry. This knowledge will be further applied and expanded in other areas of the studies.			

<b>Competencies</b>	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
C4	CE4 Ability to understand and apply the basic knowledge of general chemistry, organic chemistry and inorganic chemistry, and their applications in engineering.
D2	CT2 Problems resolution.
D10	CT10 Self learning and work.
D17	CT17 Working as a team.

<b>Learning outcomes</b>	
Expected results from this subject	Training and Learning Results
1. Understand the need of a reference system to describe a movement. Understand the movement and his causes. Identify the different types of movements. Know how graph any observation to.	
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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.

The student will be able to comprise like the cinematic, the dynamics and the fluid mechanics are the foundation of the \*biomecánica

## Contents

### Topic

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.	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. 7.2. Non-metallic elements and their compounds: General properties. Hydrogen. Carbon. Nitrogen and phosphorous. Oxygen and sulphur. Halogens.
8. Applied Electrochemistry	8.1. Applications of the Nernst equation: Determination of pH, Equilibrium constant, solubility product. 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 practices	10	7.5	17.5
Autonomous problem solving	0	25.5	25.5
Objective questions exam	1	0	1
Problem 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 practices	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 attention

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 practices	Any doubt related with the laboratory practices will be answered.

### Assessment

	Description	Qualification Training and Learning Results			
Autonomous problem solving	Students must solve independently, and periodically submit problems or exercises formulated by the faculty member. The results and the procedure followed in the execution will be evaluated. According to current legislation, the final grade will be numeric and between 0 and 10.	10	B3	C4	D2 D10
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	B3	C4	D10
Problem 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	B3	C4	D2 D10
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		C4	D17

### Other comments on the Evaluation

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

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.

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## Sources of information

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

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

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Rayner-Canham, G., **Química Inorgánica Descriptiva**, Ed. Prentice-Hall,

Alegret, M. y Arben Merckoci, **Sensores electroquímicos**, Ediciones UAB,

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Ramos Carpio, M. A., **Refino de Petróleo, Gas Natural y Petroquímica**, Ediciones UPM,

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Llorens Molina, J.A., **Ejercicios para la introducción a la Química Orgánica**, Ed Tébar,

Herrero Villén, M.A., Atienza Boronat, J.A., Nogera Murray, P. y Tortajada Genaro, L.A., **La Química en problemas. Un enfoque práctico**, Ediciones UPV,

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.,

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## 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.