

(*)Escola de Enxeñaría Industrial

Information
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Grado en Ingeniería Mecánica

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

Skills	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering 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. Sketching and application of standards.	- Introduction to Computer-aided Drawing. - Working environment. Coordinate systems. - Drawing commands. Graphical entities. Drawing aids. Object snapping. - Modify tools. Visualization options. Inquiry commands. - Plotting scaled drawings. - Sketching and application of standards.
Block 1. 2D geometry.	- Review of fundamental geometry concepts. - Conics: definitions, focal and major circles, drawing a tangent to a conic curve. - Constructing tangencies through loci, expansion/contraction and inversive geometry. - Technical curves (roulettes): trochoids and involutes (evolvents).
Block 2. Projections.	- Introduction: Types of projection. Projective invariants. - Topographic projection: Representation of basic elements (points, lines, planes). Elementary constructions, intersections, parallelism and perpendicularity. Roof plans. Landform drawing. - Multiview projection: Representation of basic elements (points, lines, planes). Parallelism and perpendicularity, true length of a segment, true size of a planar figure, planar sections. - Pictorial representation: Axonometric projection (isometric, dimetric, trimetric). Oblique projection (cavalier and cabinet projection). - Central projection: one-point perspective, two-point perspective and three-point perspective. - Surfaces: Polyhedra. Curved surfaces (ruled surfaces and surfaces of revolution). Intersection between two surfaces.
Block 3. Standardisation.	- Technical Drawing: Generalities. The graphic language of engineering. Major fields of application (architectural, topographical and engineering). Different forms of technical drawings (sketch, diagram, assembly drawing, part drawing, etc.). - Introduction to standardisation: Benefi□ts of standardization. Specifications, regulations and technical standards. - Basic standards for Technical Drawing: Drawing sheets. Title blocks. Types of lines. Lettering. Scales. Folding of drawing sheets. - General principles of representation: Basic conventions for views. Standard arrangements of the 6 principal orthographic views (first-angle and third-angle methods). Views (auxiliary, partial, local, symmetric, enlarged features). Sectional views (cuts and sections) and variations (offset sections, aligned sections, sections revolved in the relevant view, removed sections, half sections, local cuts, auxiliary sections). General conventions for hatching. Conventional representation (repeated features, simplified intersections, runouts, initial outlines). - Dimensioning: Principles of dimensioning. Types of dimensioning. Types of dimensions. Elements of dimensioning (dimension line, nominal dimension value, terminator, etc.). Arrangement of dimensions (chain, parallel and running dimensioning). Dimensioning of common manufactured features (radii, diameters, spheres, chamfers, counterbores, countersinks, etc.). - Threads. Elements of a thread. Types of threads. Standard representation of threads. Threads in assembly. Thread specification. Simplified representation. - Working drawings: Assembly drawings (definition and types). General rules and conventions for assembly drawings. Parts list. Part drawings. Drawing numbering system. Examples. - Tolerancing: Types of tolerances (dimensional and geometrical). Specifying dimensional tolerances (linear and angular). ISO system of tolerances ISO (tolerance grades, fundamental deviations, symbols). Fits. Examples.

Planning

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

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

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

Personalized assistance	
Methodologies	**Description**
Seminars	

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

Other comments on the Evaluation

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

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

Sources of information

Basic Bibliography

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

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

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

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

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

Complementary Bibliography

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

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

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

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

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

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

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

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

Recommendations

Other comments

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

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

IDENTIFYING DATA				
Physics: Physics I				
Subject	Physics: Physics I			
Code	V12G380V01102			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Lusquiños Rodríguez, Fernando			
Lecturers	Blanco García, Jesús Boutinguiza Larosi, Mohamed Lusquiños Rodríguez, Fernando Paredes Galán, Ángel Pérez Rodríguez, Martín Ribas Pérez, Fernando Agustín Roson Porto, Gabriel Serra Rodríguez, Julia Asunción Soto Costas, Ramón Francisco Souto Torres, Carlos Alberto Trillo Yáñez, María Cristina Varela Benvenuto, Ramiro Alberto			
E-mail	flusqui@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	Physics course for 1st year bachelor degrees			

Skills	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
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		
(*)FB2a. Comprensión y dominio de los conceptos básicos sobre las leyes generales de la mecánica y campos y ondas y su aplicación para la resolución de problemas propios de la ingeniería.	B3	C2	
(*)CG3. Conocimiento en materias básicas y tecnológicas, que les capacite para el aprendizaje de nuevos métodos y teorías, y les dote de versatilidad para adaptarse a nuevas situaciones.		C2	
(*)CS2. Aprendizaje y trabajo autónomos.	B3	C2	D9 D10
New	B3	C2	D2 D9 D10

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

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

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

Planning

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

Methodologies

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

Personalized assistance

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

Report of practices, practicum and external practices	In office hours

Assessment					
	Description	Qualification	Training and Learning Results		
Objective questions exam	Tests for evaluating the acquired competences that include closed questions with different answer alternatives (true / false, multiple choice, pairing of elements ...). Students select an answer from a limited number of possibilities.	10	B3	C2	
Problem and/or exercise solving	Test in which the student must solve a series of problems and / or exercises in a time / condition established by the teacher. In this way, the student must apply the knowledge they have acquired.	40	B3	C2	D2
Essay questions exam	Competency assessment tests that include open-ended questions on a topic. Students must develop, relate, organize and present the knowledge they have on the subject in an extensive answer.	40	B3	C2	
Report of practices, practicum and external practices	Preparation of a document by the student that reflects the characteristics of the work carried out. Students must describe the tasks and procedures developed, show the results obtained or observations made, as well as the analysis and treatment of data.	10	B3	C2	D9 D10

Other comments on the Evaluation

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

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

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

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

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

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

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

G = ECL + ECA + T + P

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

G = ECL (or RECL) + ECA (or RECA) + T + P.

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

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

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

Sources of information

Basic Bibliography

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

Complementary Bibliography

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

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

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

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

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

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

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

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

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

Recommendations

Other comments

Recommendations:

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

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

IDENTIFYING DATA				
Mathematics: Algebra and statistics				
Subject	Mathematics: Algebra and statistics			
Code	V12G380V01103			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Basic education	1st	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Matías Fernández, José María Castejón Lafuente, Alberto Elias			
Lecturers	Bazarra García, Noelia Castejón Lafuente, Alberto Elias Godoy Malvar, Eduardo Gómez Rúa, María Luaces Pazos, Ricardo Martín Méndez, Alberto Lucio Matías Fernández, José María Meniño Cotón, Carlos Rodal Vila, Jaime Alberto Rodríguez Campos, María Celia Sestelo Pérez, Marta			
E-mail	jmmatias@uvigo.es acaste@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	The aim of this course is to provide the student with the basic techniques in Algebra and Statistics that will be necessary in other courses of the degree. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

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

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Acquire the basic knowledge on matrices, vector spaces and linear maps.	B3	C1	
Handle the operations of the matrix calculation and use it to solve problems to systems of linear equations.	B3	C1	D2
Understand the basic concepts on eigenvalues and eigenvectors, vector spaces with scalar product and quadratic forms used in other courses and sove 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	36	24	60
Autonomous problem solving	0	40	40
Essay questions exam	4	0	4

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

Methodologies

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

Personalized assistance

Methodologies	Description
Lecturing	
Problem solving	
Autonomous problem solving	

Assessment

Description	Qualification	Training and Learning Results

Problem solving	Students will make several mid-term exams of Algebra and Statistics during the course.	40 por cento en Álxebra; 20 por cento en Estatística	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 Álxebra; 80 por cento en Estatística	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.

Sources of information

Basic Bibliography

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

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

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

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

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

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

Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously

Mathematics: Calculus I/V12G380V01104

IDENTIFYING DATA				
Mathematics: Calculus I				
Subject	Mathematics: Calculus I			
Code	V12G380V01104			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Martínez Martínez, Antonio			
Lecturers	Bajo Palacio, Ignacio Busto Ulloa, Saray Díaz de Bustamante, Jaime Estévez Martínez, Emilio Martínez Martínez, Antonio Martínez Torres, Javier Meniño Cotón, Carlos Prieto Gómez, Cristina Magdalena Rodal Vila, Jaime Alberto Vidal Vázquez, Ricardo			
E-mail	antonmar@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	(*)O obxectivo desta materia é que o estudante adquira o dominio das técnicas básicas de cálculo diferencial nunha e en varias variables e de cálculo integral nunha variable que son necesarias para outras materias que debe cursar na titulación.			

Skills	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering 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.
D6	CT6 Application of computer science in the field of study.
D9	CT9 Apply knowledge.
D14	CT14 Creativity.
D16	CT16 Critical thinking.

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

Contents

Topic	
Convergence and continuity	Introduction to real numbers. Absolute value. Euclidean space R^n. Successions. Series. Limits and continuity of functions of one and several variables.
Differential calculus of functions of one and several variables	Differential calculus of real functions of one real variable Differential calculus of functions of several real variables
Integral calculus of functions of one variable	The Riemann integral. Calculus of primitives. Improper integrals. Applications of the integral.

Planning

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

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

Methodologies

	Description
Problem solving	The professor will resolve problems and exercises type and the student will have to resolve similar exercises.
Laboratory practical	They will employ computer tools to resolve exercises and apply the knowledges obtained in the classes of theory.
Lecturing	The professor will expose in the theoretical classes the contents gives the matter.

Personalized assistance

Methodologies	Description
Problem solving	The professor will attend personally the doubts and queries of the students.
Laboratory practical	The professor will attend personally the doubts and queries of the students.

Assessment

	Description	Qualification	Training and Learning Results		
Problem and/or exercise solving	They will make proofs written and/or works.	40	B3 B4	C1	D1 D2 D6 D9 D14 D16
Essay questions exam	It will do a final examination on the contents of the whole of the matter.	60	B3 B4	C1	D1 D2 D9

Other comments on the Evaluation

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

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

Commitment:

"It expects that the present student a behaviour ethtic o suitable. In case to detect a behaviour no-ethic o (copy, plagiarism, use of electronical devices unauthorised, and others) consider hat the student doesnt the necessary requirements to surpass the matter. In this case the calification in the present course will be of suspense (0.0)."

Sources of information

Basic Bibliography

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

Burgos, J., **Cálculo Infinitesimal de varias variables**, 2ª, McGraw-Hill, 2008
Galindo Soto, F. y otros, **Guía práctica de Cálculo Infinitesimal en una variable**, 1ª, Thomson, 2003
Galindo Soto, F. y otros, **Guía práctica de Cálculo Infinitesimal en varias variables**, 1ª, Thomson, 2005
Larson, R. y otros, **Cálculo 1**, 9ª, McGraw-Hill, 2010
Larson, R. y otros, **Cálculo 2**, 9ª, McGraw-Hill, 2010
Stewart, J., **Cálculo de una variable. Trascendentes tempranas**, 7ª, Thomson Learning, 2014
Complementary Bibliography
García, A. y otros, **Cálculo I**, 3ª, CLAGSA, 2007
García, A. y otros, **Cálculo II**, 2ª, CLAGSA, 2006
Rogawski, J., **Cálculo. Una variable**, 2ª, Reverte, 2012
Rogawski, J., **Cálculo. Varias variables**, 2ª, Reverte, 2012
Tomeo Perucha, V. y otros, **Cálculo en una variable**, 1ª, Garceta, 2011
Tomeo Perucha, V. y otros, **Cálculo en varias variables**, 1ª, Garceta, 2011

Recommendations

Subjects that continue the syllabus

Mathematics: Calculus 2 and differential equations/V12G330V01204

Subjects that are recommended to be taken simultaneously

Mathematics: Algebra and statistics/V12G330V01103

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

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

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Know the role of the company in the field of economic activity.		C6	D18
Understand the basic aspects that characterize the different types of companies.		C6	D1 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	
1. THE COMPANY	1.1 The nature of the firm 1.2 The role of the company in the socio-economic system. 1.3 The company as a system. 1.4 The environment of the company. 1.5 Company objectives and goals. 1.6 Types of companies.

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	45.5	78
Laboratory practical	18	45	63
Objective questions exam	3	6	9
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

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

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

Other comments on the Evaluation

1. Ethical commitment:

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

(0.0).

2. Continuous evaluation system

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

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

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

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

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

1. 75% of the practices of the subject have been correctly developed.

2. At least a grade of 5 out of 10 (passed) has been obtained in the last test type test (which will cover all the contents seen in the subject).

3. The weighted average of the marks obtained in the test type tests is a minimum of 5 out of 10 (passed), this being the grade obtained in the subject.

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

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

It will be understood that a student has opted for continuous assessment when, fulfilling the necessary requirements

regarding the completion of practices, participates in the second test type test.

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

3. Students who do not opt for continuous assessment

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

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

4. About the July call

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

5. Prohibition of the use of electronic devices

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

Sources of information

Basic Bibliography

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

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

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

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

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Basics of operations management/V12G320V01605

IDENTIFYING DATA				
Physics: Physics II				
Subject	Physics: Physics II			
Code	V12G380V01202			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Fernández Fernández, José Luís			
Lecturers	Añel Cabanelas, Juan Antonio Blanco García, Jesús Cabaleiro Álvarez, David Fernández Fernández, José Luís Hermida Merino, Daniel López Vázquez, José Carlos Lugo Latas, Luis Lusquiños Rodríguez, Fernando Paredes Galán, Ángel Pérez Rodríguez, Martín Quintero Martínez, Félix Ribas Pérez, Fernando Agustín Sánchez Carnero, Noela Belén Soto Costas, Ramón Francisco Varela Benvenuto, Ramiro Alberto			
E-mail	jlfdez@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	This undergraduate course is the second quarter of introductory physics. The focus is on electricity, magnetism and thermodynamics			

Skills	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
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 practical	18	18	36
Objective questions exam	1	0	1
Problem and/or exercise solving	3.5	0	3.5
Essay questions exam	3	0	3
Report of practices, practicum and external practices	0	9	9

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

Methodologies

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

Personalized assistance

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

Assessment

	Description	Qualification	Training and Learning Results
Objective questions exam	Tests for the assessment of acquired knowledge that include closed questions with different response options (true/false, multiple choice, matching of elements...). Students select a response among a limited number of choices.	10	B3 C2
Problem and/or exercise solving	Test in which the student must solve a series of problems and / or exercises in a time / conditions set by the teacher. In this way, the student should apply the acquired knowledge.	40	B3 C2 D2
Essay questions exam	Tests that include open questions on a topic. Students should develop, relate, organize and present knowledge on the subject in an argued response.	40	B3 C2
Report of practices, practicum and external practices	Preparation of a report by the students which reflects the characteristics of the work that has been carried out. Students must describe the developed tasks and procedures, show the results or observations made, as well as the data analysis and processing.	10	B3 C2 D9 D10

Other comments on the Evaluation

Continuous assessment (denoted EC) will have a weight of 40% in the final mark, and will include the lab mark (20%, denoted ECL) and the class mark (20%, denoted ECA).

The mark ECA will be evaluated by means of tests on the topics covered in the lectures. These tests will comprise objective questions and/or essay questions.

The mark ECL will be evaluated by the lab reports and tests on the topics covered in the laboratory sessions.

Those students unable to attend the continuous assessment and who have been granted the waiver of the continuous assessment have the possibility of taking a final test to obtain a REC mark with a weight of 40% of the final mark. This test will include the contents of the lab sessions (weight of 20%, denoted RECL) and the topics covered in the lectures (weight of 20%, denoted RECA).

The remaining 60% of the final mark will be obtained by taking a final exam. This will consist of two parts: a theoretical part (denoted T) with a weight of 20% of the final mark, and another part on problem solving (denoted P) with a weight of 40% of the final mark. The theoretical part will consist of a test comprising objective questions and/or essay questions. Those students not attending the final exam will obtain a mark of non-presented.

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

Final mark G for the continuous assessment modality:

G = ECL + ECA + T + P.

Final mark G for the assessment at the end of the course and July (RECL and RECA only for those students who have been granted the waiver of the continuous assessment):

G = ECL (or RECL) + ECA (or RECA) + T + P.

To pass the course, a student must obtain a final mark G equal to or higher than 5.

Ethical commitment: Every student is expected to follow an appropriate ethical behaviour. In the case that unethical conduct is detected (copy, plagiarism, utilisation of unauthorised electronic devices, or others), it will be considered that the student does not fulfil the necessary requirements to pass the subject. In this case, the final mark in the present academic year will be "suspenso" (0.0).

Students should not possess or use any electronic device during the tests and exams, unless specifically authorised to do so. The mere fact that a student carries an unauthorised electronic device into the examination room will result in failing the subject in the present academic year and the final mark will be "suspenso" (0.0).

Sources of information

Basic Bibliography

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

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

Complementary Bibliography

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

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

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

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

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

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

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

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

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

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

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

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

Recommendations

Other comments

Basic recommendations:

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

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

IDENTIFYING DATA				
Computer science: Computing for engineering				
Subject	Computer science: Computing for engineering			
Code	V12G380V01203			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Rodríguez Damian, María Sáez López, Juan			
Lecturers	Ibáñez Paz, Regina Manzanedo García, Antonio Pérez Cota, Manuel Rodríguez Damian, Amparo Rodríguez Damian, María Rodríguez Diéguez, Amador Sáez López, Juan Vázquez Núñez, Fernando Antonio			
E-mail	mrdamian@uvigo.es juansaez@uvigo.es			
Web	http://moovi.uvigo.gal/			
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			

Skills	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
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 algorythims using a programming language	B3 B4	C3	D2 D7 D17
Structured and modular programming fundamentals	B3 B4	C3	D2 D5 D17

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	1	2
Practices through ICT	22	24	46
Problem solving	11	18	29
Previous studies	1	5	6
Autonomous problem solving	6	20	26
Lecturing	10	0	10
Objective questions exam	4	7	11
Problem and/or exercise solving	8	12	20
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

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

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

Personalized assistance

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

Assessment

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

Other comments on the Evaluation

Ethical commitment:

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

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

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

CONTINUOUS ASSESSMENT OPERATION

In the present course, the continuous assessment will collect all the evidence oflearning from the person enrolled and will be grouped into three assessments.The first two will take place preferably in the laboratories: Test 1 and Test2. The third evaluation may be written: Test 3. If the student does notrenounce to the continuous evaluation system, tests that are not attended will be considered as qualified as zero (0.0). A minimum score of 30% out of 10 (3.0points) must be obtained in the last two evaluations: Test 2 and Test 3, inorder to be eligible to have the final average calculated. If this requirementis not met and the final average is equal to or greater than 5, the final grade will be 4:

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

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

First call (May/June):

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

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

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

Second call (June/July):

If a person does not reach the passing level in the first exam (May/June) but has passed the minimum mark in the second exam: Test 2, in the second call (June/July) he/she can choose to keep the grades of the first two tests, and take a 4-points exam, or take a 100% exam in the subject (10 points). If the person takes the 3-points test, he/she will be asked for a minimum score of 30% out of 10 (3. 0 points) in order to calculate the final grade. If this requirement is not met and the final average is equal to or greater than 5, the final grade will be 4.

NON-CONTINUOUS EVALUATION OPERATION

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

First call (May/June):

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

Second call (June/July):

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

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

Sources of information

Basic Bibliography

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

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

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

Complementary Bibliography

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

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

Recommendations

IDENTIFYING DATA				
Matemáticas: Cálculo II e ecuacións diferenciais				
Subject	Matemáticas: Cálculo II e ecuacións diferenciais			
Code	V12G380V01204			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1	2c
Teaching language	Castelán Galego Inglés			
Department	Matemática aplicada I Matemática aplicada II			
Coordinator	Cachafeiro López, María Alicia			
Lecturers	Bazarra García, Noelia Busto Ulloa, Saray Cachafeiro López, María Alicia Calvo Ruibal, Natividad Castejón Lafuente, Alberto Elias Durany Castrillo, José Estévez Martínez, Emilio Fernández García, José Ramón Godoy Malvar, Eduardo Martínez Brey, Eduardo Martínez Torres, Javier Prieto Gómez, Cristina Magdalena			
E-mail	acachafe@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	U obxectivo que se persegue con esta asignatura é que o alumno coñeza as técnicas básicas de o cálculo integral en varias variables, cálculo vectorial, ecuaciones diferenciales ordinarias e as súas aplicacións.			

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

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

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

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

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	32	60	92
Resolución de problemas	22	24	46
Prácticas de laboratorio	9	0	9
Exame de preguntas de desenvolvemento	3	0	3
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

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

Atención personalizada

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

Avaliación

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

Other comments on the Evaluation

A avaliación continua levarase a cabo sobre os criterios anteriormente expostos. A cualificación final do alumno será a mellor nota entre a obtida mediante avaliación continua e a obtida na proba final.
Aqueles alumnos que non se acollan á avaliación continua serán evaluados cun exame final sobre os contidos de toda a materia que supoñerá o 100% da nota.
A avaliación dos alumnos en segunda convocatoria consistirá nun exame sobre os contidos da asignatura que supoñerá o 100% da nota.
Compromiso ético:
Espérase que o alumno presente un comportamento ético adecuado. En caso de detectar un comportamento non ético (por exemplo, copia, plagio, utilización de aparellos electrónicos non autorizados) considerarase que o alumno non reúne os requisitos necesarios para superar a materia. Neste caso a cualificación global da asignatura no presente curso académico será de suspenso con cualificación numérica de 0.

Bibliografía. Fontes de información

Basic Bibliography

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

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

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

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

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

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

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

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

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

Complementary Bibliography

Recomendacións

Subjects that it is recommended to have taken before

Matemáticas: Álxebra e estatística/V12G320V01103
Matemáticas: Cálculo I/V12G320V01104

Other comments

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

IDENTIFYING DATA				
Chemistry: Chemistry				
Subject	Chemistry: Chemistry			
Code	V12G380V01205			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Cruz Freire, José Manuel			
Lecturers	Alonso Gómez, José Lorenzo Álvarez Álvarez, María Salomé Bolaño García, Sandra Bravo Bernárdez, Jorge Cruz Freire, José Manuel Gómez Costas, Elena Gómez Graña, Sergio Lorenzo Fernández, Paula Moldes Moreira, Diego Nóvoa Rodríguez, Ramón Prieto Jiménez, Inmaculada Rey Losada, Francisco Jesús Salgado Seara, José Manuel Sousa Castillo, Ana Vecino Bello, Xanel			
E-mail	jmcruz@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	This is a basic subject, common for all levels of the industrial fields studies. At the end of the course the students will have a basic knowledge about the principles of general chemistry, organic chemistry and inorganic chemistry, and its application to Industry. This knowledge will be further applied and expanded in other areas of the studies.			

Skills	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
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.

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

Contents
Topic

1. Atomic theory and chemical bonding	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. 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.
2. States of aggregation: Solids, gases, pure liquids and solutions	2.1. Solid state: Introduction. Classification of solids: amorphous solids, molecular crystals and liquid crystals, Covalent crystals and ionic crystals. 2.2. Gaseous state: Characteristics of the gas phase. Ideal gases: Equation of state. Real gases: Equation of state. Properties of gases. 2.3. Liquid state: Characteristics of the liquid phase: physical properties (density, surface tension, viscosity). Changes of state. Phase diagram. Solutions: colligative properties
4.Chemical equilibrium: in gas phase, acid-base-base, redox, solubility	(4.1. Chemical equilibrium: Concept of Equilibrium. Equilibrium Constant. Types of equilibrium. The Le Chatelier Principe. 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. 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. 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.
5. Chemical kinetics	5.1. Basic Concepts: Reaction Rate. Reaction Order. Kinetic Constant. Rate Equation. 5.2. Determination of the Rate Equation: Initial rate method. Integrated Rate Laws. 5.3. Factors affecting the Reaction Rate.
6. Basic principles of Organic Chemistry	6.1. Fundamentals of Organic formulation and functional groups: 6.1.1. ºStructure of the organic compounds: Alkanes, alkenes and alkynes. Aromatic Hydrocarbons. 6.1.2. Alcohols and phenols. 6.1.3. Ethers. 6.1.4. Aldehydes and ketones. 6.1.5. Esters. 6.1.6. Carboxylic acids and derivatives. 6.1.7. Amines and nitro-compounds.
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 corrosión 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. Drilling and crude oil extraction. 11.5. Fractioning of oil. 11.6. Cracking, alkylation, reforming and isomerisation of hydrocarbons. 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. Hyidrogenation of carbon. 12.6. Direct liquefaction of carbon. Gasification.

Planning

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

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

Methodologies

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

Personalized assistance

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

Assessment

	Description	Qualification	Training and Learning Results
Autonomous problem solving	Students must solve independently, and periodically submit problems or exercises formulated by the faculty member. The results and the procedure followed in the execution will be evaluated. 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 and/or exercise solving	The evaluation of the knowledge gained by students in seminars will be through a written exam, in the official announcement of examinations, in which the student must solve 4 or 5 problems related to the subject under study. The exam will be graded according to the current legislation, with a numerical final grade between 0 and 10.	40	B3 C4 D2 D10
Report of practices, practicum and external practices	After each laboratory session, the student should answer an oral question or prepare a detailed report including aspects such as objective and theoretical foundations, procedure followed, materials used, results and interpretation. 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.

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

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

Ethical commitment:

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

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

Sources of information

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Complementary Bibliography

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Sánchez Coronilla, A., **Resolución de Problemas de Química**, Ed. Universidad de Sevilla,
Brown, L.S., Holme, T.A., **Chemistry for engineering students**, Brooks/Cole Cengage Learning, 3rd ed.,

Recommendations

Subjects that it is recommended to have taken before

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

Other comments

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