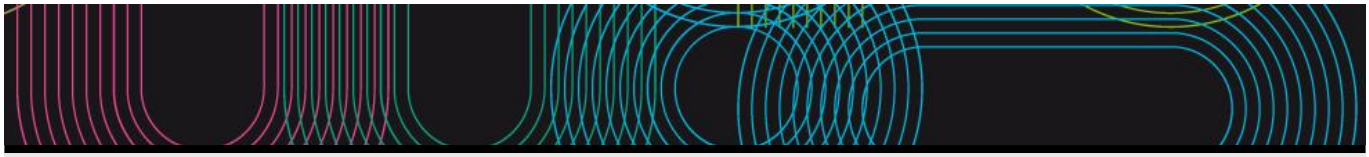

(*)Centro Universitario da Defensa da Escola Naval Militar de Marín

Grado en Ingeniería Mecánica

Subjects			
Year 1st			
Code	Name	Quadmester	Total Cr.
P52G382V01101	Graphic expression: Graphic expression	1st	9
P52G382V01102	Chemistry: Chemistry	1st	6
P52G382V01103	Mathematics: Calculus 1	1st	6
P52G382V01104	Mathematics: Algebra and statistics	2nd	9
P52G382V01105	Business: Introduction to business management	2nd	6
P52G382V01106	Physics: Physics 1	2nd	6
P52G382V01107	Computer science: Computing for engineering	2nd	6
P52G382V01108	Materials science and technology	2nd	6

IDENTIFYING DATA

Graphic expression: Graphic expression

Subject	Graphic expression: Graphic expression			
Code	P52G382V01101			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Basic education	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Feijoo Conde, Jorge			
Lecturers	Feijoo Conde, Jorge Garrido González, Iván Pérez Collazo, Carlos			
E-mail	jfeijoo@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This course aims to train the students in different aspects of the Graphic Expression in order to give them adequate skills for the management and interpretation of the representation systems most commonly used in the industrial field and its basic techniques to introduce them to the knowledge of the geometric shapes, generation and properties of the most frequent geometric entities, including the acquisition of spatial vision and comprehension to introduce them into the study of technological aspects of Graphic Expression in Engineering as well as into the knowledge and application of Standardization, in both basic and specific aspects. The subject will be developed aiming to enable the student to handle traditional techniques as well as new information and communication technologies.			

Training and Learning Results

Code	
B3	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	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	Capacity for handling specifications, regulations and mandatory standards.
C5	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	Problems resolution.
D6	Application of computer science in the field of study.
D9	Apply knowledge.
D17	Team working.

Expected results from this subject

Expected results from this subject	Training and Learning Results		
Get to know apply and understand the basic concepts and normalisation of the engineering design, on its broaden concept, allowing at the same time the development of the space ability.	B3 B4	C5	D2 D6
To acquire the capacity for abstract reasoning, and the establishment of efficient strategies and procedures for the resolution of graphic problems within the context of engineering projects.	B3 B4	C5	D2
Use of a graphic communication between technicians, by means of the realisation and interpretation of plans according to the Technical Drawing Standards, involving the use of new technologies.	B6	C5	D6 D9
To assume a favorable attitude for a permanent learning in the profession, being proactive and with a collaborative and committed spirit.	B4		D9
Work as a team, developing knowledge based on a critical and responsible technical-cultural exchange.	B4 B6		D9 D17
ENAEE learning outcome: KNOWLEDGE AND UNDERSTANDING: LO1.1.- knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes [level of achievement (basic (1), intermediate (2) and advanced (3)) for this learning outcome: Intermediate (2)].	B3	C5	
ENAEE learning outcome: ENGINEERING ANALYSIS: LO2.2.- ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical societal, health and safety, environmental, economic and industrial constraints [Intermediate (2)].	B4	C5	D2 D9

ENAEE learning outcome: INVESTIGATION AND INNOVATIONS: LO4.1.- ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, to carry out simulation and analysis in order to pursue detailed investigations and research of technical issues in their field of study [Basic (1)].	B6	
ENAEE learning outcome: INVESTIGATION AND INNOVATIONS: LO4.2.- ability to consult and apply codes of practice and safety regulations in their field of study [Intermediate (2)].	B6	
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.3.- understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study [Basic (1)].		D6 D9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.4.- ability to apply norms of engineering practice in their field of study [Intermediate (2)].	B6	D9
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large [Intermediate (2)].	B4	
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.2.- ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers [Intermediate (2)].		D17

Contents

Topic	
Section I. Descriptive geometry. Unit 1. Introduction to the representation systems.	1.1. Projective geometry. projective invariants. 1.2. Orthogonal projection system. 1.3. Dihedral system. 1.4. Axonometric system. 1.5. Conic system.
Section I. Descriptive geometry. Unit 2. Dihedral system.	2.1. General principles. 2.2. Representation of point, line, plane and volume. 2.3. Distances and true magnitude. 2.4. Intersections. 2.5. Relative positions: Parallelism, Perpendicularity.
Section I. Descriptive geometry. Unit 3. Orthogonal projection system.	3.1. Point, straight line and plane. Line of maximum slope on a plane. 3.2. Intersections. Application to covers and roofs. 3.3. Straight lines, surfaces and lands. Generalities and applications.
Section I. Descriptive geometry. Unit 4. Curves of Engineering.	4.1. Involute and evolute. Tracing and applications. 4.2. Rolling curves: cycloid, epicycloid and hypocycloid. Tracing and applications.
Section II. Standardised representation. Unit 5. Introduction - The technical drawing and the standardisation.	5.1. The Graphic Expression. 5.2. Standardization in Technical Drawing. 5.3. Regulation, specification and standard. 5.4. Types of standards. 5.5. Basic standards of Technical Drawing.
Block II. Standardised representation. Unit 6. Technical drawing basis.	6.1. Visualisation and representation of body shapes. 6.2. Methods of arrangements of views. 6.3. Types of views. 6.4. Cuts and sections. 6.5. Other conventionalisms: intersections, symmetrical pieces, interrupted views, repetitive elements, details, etc.
Section II. Standardised representation. Unit 7. Elements and ways of dimensioning.	7.1. General principles and basic standards. 7.2. Types of dimensioning. 7.3. Dimensioning elements. 7.4. Symbols. 7.5. Arrangement of dimensions. 7.6. Special indications (radii, equidistant elements, etc.). 7.7. Dimensioning systems. 7.8. Other indications (missing dimensions, particular specifications, etc.).

Section II. Standardised representation. Unit 8. Representation of standardised elements.	8.1. Standardized elements. 8.2. Representation of mechanical connections. - Definition of threaded joints. - Types of threads. - Conventional representation of threads. - Representation of riveted connections. 8.3. Representation of welded joints. 8.4. Representation of standard mechanical elements. - Springs. - Shafts. - Keyways and grooves. - Bearings. - Gears, chains and pulleys.
Section II. Standardised representation. Unit 9. Representation of groups.	9.1. Representation of mechanical groups. 9.2. Rules for the preparation of group drawings. 9.3. Reference of elements. 9.4. List of pieces. 9.5. Designation standardised materials. 9.6. Breakdown drawing. 9.7. Numbering of planes.
Section II. Standardised representation. Unit 10. Tolerances systems and surface finishes.	10.1. Basics and need of tolerances. 10.2. Dimensional tolerances and adjustment. 10.3. Standardized tolerances: UNE-ISO notation. 10.4. Geometrical tolerances. 10.5. Finishings and surface quality treatments.
Section II. Standardised representation. Unit 11. Symbology and schematic representations.	11.1. Introduction and standards of application. 11.2. Characteristic of the symbols. 11.3. Classes of symbols and codes. 11.4. Standardised symbols. 11.5. Graphic symbols for diagrams. 11.6. Typology of diagrams according to their nature and application. 11.7. Practical applications of schematic representations in Engineering. - Electrical system. - Pneumatic system. - Hydraulic system.
Practical Activity 1 (CAD 3D)	Basic design procedure: from sketch to solid.
Practical Activity 2 (CAD 3D)	Sketching and modeling tools (I).
Practical Activity 3 (CAD 3D)	Sketching and modeling tools (II).
Practical Activity 4 (CAD 3D)	Sketching and modeling tools (III).
Practical Activity 5 (CAD 3D)	Assembly drawings
Practical Activity 6 (CAD 3D)	Generation of views and plans.
Practical Activity 7 (CAD 3D)	Resolution of a case study
Practical Activity 8 (CAD 2D)	File formats and management. Setting. Drawing and modification tools (I). Line drawing by coordinates.
Practical Activity 9 (CAD 2D)	Drawing and modification tools (II). Object snap and trace.
Practical Activity 10 (CAD 2D)	Drawing and modification tools (III). Point and line formats.
Practical Activity 11 (CAD 2D)	Layer editing. Text and dimension formats. Scaling.
Practical Activity 12 (CAD 2D)	Presentation and drawing of plans. 2D sketching.
Practical Activity 13 (CAD 2D)	Blocks, attributes and external references.
Practical Activity 14 (CAD 2D)	Resolution of a case study

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	42	48	90
Practices through ICT	28	28	56
Problem solving	14	10	24
Project based learning	0	10	10
Seminars	25	7	32
Essay questions exam	13	0	13

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

Methodologies

	Description
Lecturing	Lecture session. Each thematic unit will be presented by the lecturer, and complemented with the comments of the students based on the assigned bibliography or other relevant information.

Practices through ICT	Computer exercises will be carried out focused on the use of CAD software for the generation of technical drawings and plans.
Problem solving	Exercises and / or study cases will be raised and solved individually or in groups.
Project based learning	Throughout the semester, a group project will be carried out in which each and every member of the group must collaborate, contributing and complementing the knowledge necessary for its achievement.
Seminars	Intensive course (25 hours) for those students who have failed the subject at first call, prior to the exam in second call. Group tutoring with the lecturer.

Personalized assistance

Methodologies	Description
Problem solving	In the personalized tutoring, each student, individually, can discuss with the lecturer any problem related to their learning achievements in the subject. The lecturer will solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD, as well as through telematic means (email, videoconference, Moovi forums, etc.) with previous appointment.
Seminars	Group tutoring with the lecturer. The lecturer will solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD, as well as through telematic means (email, videoconference, Moovi forums, etc.) with previous appointment.
Project based learning	The students will have at their disposal hours of tutoring in which they can consult any doubt related to the contents, organization and planning of the subject, with the development of the project, etc. The tutoring can be individualized, but group tutoring will be encouraged for the resolution of problems related to the activities to be carried out in group, or simply to inform the lecturer of the evolution of the collaborative project.

Assessment

	Description	Qualification	Training and Learning Results
Lecturing	Two evaluation tests/questionaries, in a continuous assessment, of short duration will be carried out throughout the semester. The tests will be carried out, proposed by the lecturer, at the most appropriate times within the classroom sessions of the subject. These two tests will be mandatory and required to pass the subject (percentage in the final qualification: 20%, 10% each assessment).	20	B3 C5 D2 B4 D9 B6
Practices through ICT	The evaluation of the abilities for using the CAD 2D/3D software is included in the 20% corresponding to the methodology of problems and/or exercises resolution, more specifically for the elaboration of plans and partial drawings of assembly mechanisms.	0	B4 C5 D2 D6 D9
Problem solving	During the semester, different assembly mechanisms will be proposed for their representation in the computer sessions through the use of the CAD 2D/3D software. It will be assessed through two tests within the classroom sessions of the subject (percentage in the final qualification: 20%, 10% each assessment).	20	B4 C5 D2 D6 D9
Project based learning	Throughout the semester, students will carry out a project related to the subject. The project will be developed in parallel to the syllabus of the course and will cover most of the aspects reflected in it. The project will be carried out in small groups of students that will be fixed during the first three weeks of class. The project grade will have two elements: 1) Delivery of the report (75%): Same score for all members of the group. 2) Final presentation / oral presentation (25%): individual score (according to the defense of each one).	20	B3 C5 D2 B4 D6 B6 D9 D17
Essay questions exam	A final exam will be carried out covering all the contents of the subject, both theoretical and practical, and that may include tests, reasoning questions, exercise solving and development of practical cases. It is required to achieve a minimum score of 4.0 points over 10 possible to pass the subject (percentage in the final qualification: 40%).	40	B3 C5 D2 B4 D9 B6

Other comments on the Evaluation

The final qualification will be determined based on the scores obtained in:

1. Final evaluation, through the assessments carried out in the calls and dates proposed by the University and the Center.

2. Continuous evaluation, through the assessment of the practical works and activities proposed throughout the semester.

A numerical rating system with values from 0.0 to 10.0 points will be used according to current legislation (R.D. 1125/2003 of September 5, B.O.E. No. 224 of September 18). The subject will be considered passed when the student achieves a

minimum qualification of 5.0 points.

Those students who have not reached the minimum mark in the final exam of continuous assessment will obtain a maximum score of 4.5 points in continuous assessment.

All the students who have not passed the subject during the first call will have the possibility to recover the subject. The recovery plan consists of the right, already acquired, to perform a new exam, called extraordinary or second call, on the official dates, whose qualification will replace the previously obtained and, if it is higher, will be used for the calculation of the final marks.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo*, as well as point 6 of the fifth rule of *Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces,* **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity,** regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

Sources of information

Basic Bibliography

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TAIBO FERNÁNDEZ A., **Geometría descriptiva y sus aplicaciones**, Tébar Flores, 1983

Recommendations

Subjects that continue the syllabus

Graphic engineering/P52G381V01304

Other comments

There are no prerequisites to follow the course, although it is recommended that the student has some knowledge in technical drawing and geometry fundamentals at the level required in high school.

For the appropriate development of the practical classes and seminars, it is recommended that the student has the basic technical drawing tools: 45º and 60º setsquares, scale, compass and pencils or with different hardness.
It would also be advisable for the student to have a computer, with access to the Internet and software applications.

IDENTIFYING DATA				
Chemistry: Chemistry				
Subject	Chemistry: Chemistry			
Code	P52G382V01102			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Devesa Rey, Rosa			
Lecturers	Devesa Rey, Rosa Urréjola Madriñán, Santiago Rafael			
E-mail	rosa.devesa.rey@cud.uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	Chemistry is a scientific discipline that studies both the composition, structure and properties of matter, as well as the changes it undergoes during chemical reactions and its relationship with energy. From a degree point of view, engineering applies chemical knowledge to the economical production of specialty chemicals and materials with minimal adverse impact on the environment. This first-year course in mechanical engineering aims to explain to students the basics of chemistry that they can apply throughout their professional life. The overall objective of this subject is to introduce the basic theoretical concepts that allow students to understand the nature of matter, going from atoms to molecules and from these to states of aggregation (solids, gases and liquids), introducing intermolecular forces. The fundamentals of chemical kinetics and thermodynamics necessary to understand chemical reactions and equilibria will be provided. And finally, basic concepts of organic and inorganic chemistry will be introduced, as well as different industrial applications of chemistry.			

Training and Learning Results	
Code	
B3	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	Ability to understand and apply the basic knowledge of general chemistry, organic chemistry and inorganic chemistry, and their applications in engineering.
D2	Problems resolution.
D10	Self learning and work.
D17	Team working.

Expected results from this subject	Training and Learning Results		
The student knows the chemical bases on which support the industrial technologies. Specifically, the student will acquire basic knowledge of general chemistry, as well as organic and inorganic chemistry and their applications in engineering, which will allow them to apply the basic concepts and fundamental laws of chemistry. The student will receive a theoretical-practical training that will allow to take advantage of the laboratory practices and solve basic problems related to this matter.	B3	C4	D2 D10 D17
ENAEE learning outcome: KNOWLEDGE And UNDERSTANDING: LO1.1- Knowledge and understanding of the mathematics and other inherent basic sciences to his speciality of engineering, in a level that allow to purchase the rest of the competitions of the title. [Level of development: Intermediate (2)]	B3	C4	
ENAEE learning outcome: COMMUNICATION AND TEAMWORKING: LO7.2- Ability to work effectively in national and international contexts, individually and as a team, and to cooperate with both engineers and people from other disciplines. [Intermediate (2)]			D10 D17

ENAEE learning outcome: D10

CONTINUOUS TRAINING: LO8.1- Ability to recognize the need for their own continous training and to undertake this activity throughout their professional life independently.

[Intermediate (2)]

ENAEE learning outcome: D10

CONTINUOUS TRAINING: LO8.2- Ability to stay up-to-date with news in science and technology.

[Intermediate (2)]

Contents

Topic	
UNIT 1 (U1): ELEMENTAL CHEMISTRY (8 hours)	U1-1. ATOMIC THEORY AND STRUCTURE OF MATTER (3 hours) Introduction to the atomic structure. Structures periodicity. Atom characteristics: Atomic number and atomic mass. Isotopes. Periods and groups. Mendeleev's classification. Periodicity of the properties: atomic volume, ionization energy, electronic affinity and electronegativity. Nuclear chemistry. U1-2. CHEMICAL BONDING (3 hours) Introduction to chemical bonding. Covalent bond: Lewis notation. Valence bond theory. Ionic bond. Metallic bond. U1-3. AGGREGATION STATES (2 hours) Gaseous State: Ideal Gases, Real Gases. Intermolecular forces. Liquid State: Characteristics of liquids. Surface tension and viscosity. State changes: Fusion, evaporation and sublimation. Solutions: Mechanism, classification and colligative properties. Solubility of gases in liquids. Colloidal mixtures. Solid state: Melting points, phase diagrams. Properties of solids.
UNIT 2 (U2): REACTIONS AND CHEMICAL PROCESSES (18 hours)	U2-1 CHEMICAL REACTIONS (I) (12 hours) Stoichiometric aspects. Energy aspects: thermochemistry. Kinetic aspects. Introduction to chemical equilibrium. Acid-base reactions and pH Equilibrium of solubility. U2-2 CHEMICAL REACTIONS (II) (6 hours) Redox reactions. Applied electrochemistry: batteries and potential. Corrosion and surface treatment. Electrochemical sensors.
UNIT 3 (U3) INTRODUCTION TO INDUSTRIAL CHEMISTRY (2 hours)	U3-1 INTRODUCTION TO CHEMICAL ENGINEERING (1 hour) Basic concepts of Chemical Engineering. Instrumentation and analysis in Chemical Engineering. U3-2 CHEMICAL INDUSTRY. INORGANIC AND ORGANIC CHEMISTRY (1 hour) Basic Principles of Organic and Inorganic Chemistry. Oil and derivatives: Petrochemistry. Coal: Carbochemistry.

PRACTICES OF LABORATORY (14 hours) includes in this epigraph the realisation of a project.	PL1. CHEMICAL BALANCE: LE CHATELIER´S PRINCIPLE Two reversible reactions will be studied, that have the advantage of the great ease with which the presence of reactants and products are detected, caused by color changes or by the appearance of a precipitate. PL2. ACID-BASE TITRATION: TITRATION CURVE Acid-base titrations are very useful to accurately determine the concentration of an acid/basic solution by adding a base or an acid of known concentration. Specifically, the assessment of a strong base with a strong acid will be carried out, for which different amounts of acid will be added and the pH of the resulting solution will be measured. In this way, the corresponding "titration curve" will be obtained and the pertinent conclusions will be drawn. PL3. REDOX AND ELECTROCHEMICAL PROCESSES: ELECTROLYSIS In order to become familiar with the chemical changes induced by an electric current and with the quantitative relationships involved, students will carry out the following experiences: Electrolysis of aqueous CuSO4(aq) and electrolysis of NaCl(aq). PROJECT Five laboratory sessions will be dedicated to the project, with the following estimated distribution: P1. Presentation of the project: Proposal for treatment systems for ballast water. P2-3 Experimental work in the laboratory. P4 Preparation of the report- P5 Presentation of the results.
SEMINARS (7 hours)	The planning of the seminars will correspond to the development of theory and laboratory classes. S1. Atomic theory and bonding S2. Aggregation states S3. Termochemistry S4. Chemical equilibrium S5. Acid-base S6. Solubility S7. Redox

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	28	44	72
Problem solving	7	7	14
Seminars	15	8	23
Laboratory practical	14	14	28
Objective questions exam	4	0	4
Objective questions exam	9	0	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	The theory classes explain the fundamentals of each topic. Students have in advance a textbook where the subject being studied is developed, in addition to the information available in Moovi, which contains all the files related to the masterclasses, seminars and laboratory practices. The theory classes are recommended to dedicate between half an hour and an hour depending on the content. Lecturers will use computer presentations and the blackboard. Presentations will be provided to the students prior to the classes, so the lecturer and the students will focus onto the exhibition and understanding of the concepts. Anyway, these presentations should not be considered like substitutes of the texts, but like complementary material.

Problem solving	In these classes the students will be given a series of problem bulletins that they have to solve in groups. The teaching material that they have to use is prepared, and the different alternatives will be discussed working in a group and there will be a pooling of the alternatives studied. The student must solve exercises and problems that will be corrected and evaluated by the lecturer.
Seminars	Those students who have not passed the course at the first opportunity will attend an intensive course, of 15 hours, in which reinforcement tasks of the main theoretical and practical contents taught in the course will be carried out. At the end of this course, the extraordinary exam will take place.
Laboratory practical	A series of laboratory practices have been designed in order to fix concepts explained in the classroom and thus students develop their ability to propose technical solutions. The didactic method to be followed in the teaching of the practical classes consists of the teacher supervising the work carried out by the various groups into which the students are divided. Two sessions will be devoted to laboratory work. A methodology of project-based learning will be followed during five laboratory sessions. A project to be carried out in a group (preferably two people) will be proposed. The solution of the project will demand the contribution of the knowledge acquired by each member of the group, thus guaranteeing the positive interdependence that is required for the success of collaborative work. On the other hand, the project will be evaluated in such a way as to guarantee individual enforceability and positive interdependence, that is, all members of the group must have worked and contributed to the final product and must master, at a minimum, all aspects of the project. The project will be carried out in five laboratory sessions. Material and bibliography will always be provided, and a public exhibition of the completed project will be held.

Personalized assistance

Methodologies	Description
Seminars	Attention to the student will be carried out in a personalized way either in tutorships or through email. In the field of tutorships, academic tutoring actions are distinguished as well as personalized tutoring. In the first case, the students will have at their disposal hours of tutorships in which they can consult any questions related to the contents, organization and planning of the course, as well as contents and exercises, etc. The tutorships can be individualized, but groups will be encouraged to solve problems related to the activities carried out. In the personalized tutorships, each student, individually, will be able to discuss with the lecturer any problem that is preventing her/him from carrying out an adequate follow-up of the course, in order to find some kind of solution between them. By combining both types of tutorships, it is intended to compensate for the different learning rhythms through attention to diversity. The lecturers of the course will answer the doubts and queries of the students in person or by telematic means (email, videoconference, Moovi forums, etc.) at the time that will be published on the CUD-ENM website or by appointment.

Assessment

	Description	Qualification	Training and Learning Results
Problem solving	AUTONOMOUS PROBLEM SOLVING AND SYSTEMATIC OBSERVATION The autonomous resolution of exercises or questions proposed by the lecturers of the course will be evaluated, assessing, among other concepts: the adequate resolution of exercises, the approach, order and delivery on time.	10	B3 C4 D2 D10 D17
Laboratory practical	REPORT OF LABORATORY PRACTICES (10 % of the final note) The activities carried out in the laboratory will be evaluated, the resolution of questions from the practice script, the attitude and order in the laboratory and the resolution of questionnaires about the practices carried out, which can be done in person or through the virtual platform of the subject. EVALUATION OF THE LEARNING BASED IN PROJECTS (10 % of the final note) The final project delivered will be evaluated, taking into account criteria related to the content and format of the final report delivered, as well as the use of language, the quality of the presentation and the answers to questions from the teachers, in the case of the presentation. oral. In this presentation, any member of the group must answer questions about the project. Everyone must therefore demonstrate in-depth knowledge of the delivered product, regardless of the part on which they have focused their efforts.	20	B3 C4 D2 D10 D17

Objective questions exam	INTERMEDIATE EXAMS All the knowledge acquired so far will be evaluated by taking two intermediate exams: o Test 1: 10% of the final grade o Test 2: 20% of the final grade	30	B3 C4	D2 D10
Objective questions exam	GLOBAL EXAM It will consist of a part of theoretical concepts and a part of problems. It is a necessary condition to pass the course by continuous evaluation to obtain a minimum of 4 points. The qualification of the student who does not exceed this minimum will be the weighted sum of the grades obtained up to that moment, as long as it does not exceed 5, in which case, the qualification will be a 4.	40	B3 C4	D2 D10

Other comments on the Evaluation

Ordinary and Extraordinary Exams

In order to evaluate all the skills in the ordinary and extraordinary exams, these will include, in addition to theory questions and part of problems, questions from the laboratory part. The evaluation will be considered positive when a score of 5 points out of 10 is reached.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo , as well as point 6 of the fifth rule of Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces, any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity, regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

Sources of information

Basic Bibliography

Petrucci, R. H., Herring, F.G., Madura, J.D., Bissonnette, C., **Química General**, 8, Ed. Prentice-Hall, 2009

Willis, C.J., **Resolución de problemas de Química General.**, 1, Ed. Reverté., 1995

Complementary Bibliography

Chang, R., **Química**, 4, Ed. McGraw Hill, 2006

Atkins, P.W., **Química General**, 1, Ed. Omega, 1992

Reboiras, M.D, **Cuestiones de opción múltiple de química general**, 1, Ed. Abecedario, 2010

Quiñoá, E., Riguera, R. y Vila, J.M:, **Nomenclatura y formulación de los compuestos inorgánicos**, 1, Ed. McGraw Hill, 2006

Fernández, M. R. y col., **1000 Problemas de Química General**, 1, Ed. Everest, 2007

Masterton, W.L. y Hurley C.N., **Química, Principios y Reacciones**, 4, Ed. Thomson, 2003

López Cancio, J.A., **Problemas de Química**, 1, Ed. Prentice Hall, 2001

Recommendations

Other comments

It is recommended that students of the subject "Chemistry" have taken and passed the subject of chemistry in the last year of high school or have passed the specific test for access to the degree. Knowledge of formulation is recommended.

IDENTIFYING DATA				
Mathematics: Calculus 1				
Subject	Mathematics: Calculus 1			
Code	P52G382V01103			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Cores Carrera, Débora			
Lecturers	Cores Carrera, Débora			
E-mail	cores@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The general aim of this subject is that the students acquire knowledge of the basic techniques of the differential and integral calculus of one variable and differential calculus of several variables, that are required in other subjects that follow in the degree.			

Training and Learning Results	
Code	
B3	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	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	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	Analysis and synthesis
D2	Problems resolution.
D6	Application of computer science in the field of study.
D9	Apply knowledge.
D14	Creativity.
D16	Critical thinking.

Expected results from this subject	Training and Learning Results		
Comprehension of basic knowledge of integral calculus of functions of one variable.	B3	C1	D1
Comprehension of the basic knowledge of differential calculus of one and several variables	B3	C1	D1
A good command of differential calculus techniques for the location of extremes, the local approximation of functions and the numerical resolution of systems of equations.	B3 B4	C1	D2 D9 D14 D16
Use of computer tools to solve problems of differential calculus and integral calculus.	B3 B4	C1	D2 D9 D14 D16
A good command of integral calculus techniques for computing of areas, volumes and surfaces.	B3 B4	C1	D2 D6 D9 D16

Contents	
Topic	
Lesson 1. Limits and continuity in R.	Bolzano's theorem. Bisection's method.
Lesson 2. Differential calculus in R.	Optimization. Rolle's theorem. Mean value theorem. Taylor's polynomial. Newton-Raphson's method.

Lesson 3. Integral calculus of one variable.	Properties of the indefinite integral. Fundamental integration techniques. The definite integral. Applications of the definite integral.
Lesson 4. Sequences and Series.	The real numbers. Definition and basic concepts of sequences. Convergence of sequences. Convergence criteria and limits calculation techniques. Definition and basic concepts of series. Convergence of series. Convergence criteria for series.
Lesson 5. Limits and continuity of real functions of several variables.	The euclidean space Rn. Concept of a function of several variables. Limit of a function of several variables. Continuity of functions of several variables. Properties of the continuous functions.
Lesson 6. Differential calculus of real functions of several variables.	Directional derivatives. Partial derivatives. Gradient vector and Jacobian matrix. Differentiability of a real function of several variables. Conditions for the differentiability. Higher order differentiability. Hessian matrix. Local behaviour of differentiable functions.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	26	54
Problem solving	14	12	26
Mentored work	6	1	7
Seminars	15	10	25
Problem and/or exercise solving	4	4	8
Laboratory practice	1	1	2
Essay	0	4	4
Essay questions exam	9	15	24

*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 expose the contents of the course in the theoretical lessons. The students will be able to consult bibliographic references as well as the notes of the course.
Problem solving	During the lessons of problems, the lecturer will solve model problems. The students will have a copy of the solutions of all the exercises that are made or proposed during these lessons. In the computer sessions, the students will use the Matlab/Octave computer tool, in order to apply the concepts presented in the theory lessons to practical cases. The students will have notes and scripts of the practices.
Mentored work	The students will have to solve exercises and problems that will be graded by the lecturer. Those exercises will be approached in groups and will be discussed on during seminar hours. Additionally, some of the mentored lessons (seminars) will be used for clarifying doubts related to Matlab practices.
Seminars	Intensive course of 15 hours for those students that have failed the course in their first call, previous to the exam in second call. Mentored lessons in groups with the lecturer.

Personalized assistance

Methodologies	Description
Lecturing	During the lecture lessons, the lecturer will clarity student doubts regarding the theoretical concepts exposed at that time.
Problem solving	During the exercise and problem sessions, the lecturer will answer in a personalized way the student doubts.
Seminars	During the mentored lessons, the lecturer will perform a personalized assistence to the students, proposing complementary exercises or any other kind of activities that will result in the best use of the lessons for the students. The lecturers of the course will answer the doubts and queries of the students, both personally, according to the schedule that will be published on the web page of the centre, as well as online (email, videoconference, Moovi forums, etc.) by previous appointment.

Assessment

	Description	Qualification	Training and Learning Results		
Problem and/or exercise solving	Threre will be two partial exams, the first one will evaluate Lessons 1, 2 and 3 and the second one Lesson 4. Each one of the exams is 15% of the mark of continuous evaluation.	30	B3 B4	C1	D2 D9 D16
Laboratory practice	There will be a scored practice related to the contents given during the computer lessons. The weight in the continuous evaluation will be 15%.	15	B3 B4	C1	D2 D6 D9
Essay	There will be proposed a delivery of certain exercises along the whole course. The weight in the continuous evaluation will be 15%.	15	B3 B4	C1	D2 D6 D9
Essay questions exam	There will be a final exam with all the contents of the course. The weight in the continuous evaluation will be 40%.	40	B3 B4	C1	D1 D2 D14 D16

Other comments on the Evaluation

The students will have to take the regular exam with all the contents of the course, that will count as the 100% of the mark, in the case that the final note of continuous evaluation if lower than 5 (NEC lower than 5). Additionally, the students will have to take the regular exams if any of the following items occurs:

- No performing or delivery of any of the scored items above.
- Obtaining a lower mark than 4 points out of 10 in the final exam of continuous evaluation.

In the previous cases, the final mark of continuous evaluation will be: min{NEC, 4}.

In any case, the students that have passed the continuous evaluation, will have the possibility to take the regular exam in order to improve their mark.

The evaluations of the students in second and successive calls will be an exam with all the contents of the course that will count as the 100% of the mark.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo , as well as point 6 of the fifth rule of Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces, **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity**, regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

Sources of information

Basic Bibliography

J. Burgos, **Cálculo Infinitesimal de una variable**, McGraw Hill, 1994
J. Burgos, **Cálculo Infinitesimal de varias variables**, McGraw Hill, 1995
J.L. Bradley, K.J. Smith, **Cálculo (Volúmenes 1 y 2)**, Prentice Hall Iberia, 1998
R. Larson, R.P. Hostetler, B.H. Edwards, **Cálculo I y II**, McGrawHill, 2010

Complementary Bibliography

Recommendations

Other comments

The students of Calculus I are recommended to review the contents of trigonometry and differential and integral calculus corresponding to Bachillerato (equivalent to high school or A levels).

IDENTIFYING DATA				
Mathematics: Algebra and statistics				
Subject	Mathematics: Algebra and statistics			
Code	P52G382V01104			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	González Coma, José Pablo			
Lecturers	Álvarez Hernández, María Cores Carrera, Débora González Coma, José Pablo González-Cela Echevarría, Gerardo			
E-mail	jose.gcoma@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The objective of this subject is that the student acquires knowledge of the basic techniques of Linear Algebra and Statistics that are required in other subjects that must be taken later in the degree.			

Training and Learning Results	
Code	
B3	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	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	Problems resolution.
D5	Information Management.
D6	Application of computer science in the field of study.
D9	Apply knowledge.

Expected results from this subject	Training and Learning Results		
Acquire the basic knowledge of matrices, vectorial spaces, and linear applications.	B3	C1	
Manage matrix calculus operations and, using this knowledge, solve problems related to linear equations systems.	B3	C1	D2
Understand the basics of eigenvectors and eigenvalues, vector spaces with a scalar product and quadratic forms used in other subjects, and solve basic problems related to these topics.	B3	C1	D2 D9
Acquire knowledge of database handling and exploratory analysis.	B3	C1	D5
Being able to model uncertainty scenarios through the calculation of probabilities.	B3	C1	D2
Knowing the basic statistical techniques and models in their application to the industrial field and performing inferences from data samples.	B3	C1	D2 D5 D9
Using software tools to solve problems related to the contents of the subject.	B3		D2 D6
ENAEE learning outcome: KNOWLEDGE AND UNDERSTANDING: LO1.1- Knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes [Intermediate (2)].	B3	C1	
ENAEE learning outcome: ENGINEERING ANALYSIS: LO2.2.- Ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical - societal, health and safety, environmental, economic and industrial - constraints [Intermediate (2)].		C1	D2 D9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.2.- Practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Basic (1)].			D2 D9
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- Ability to effectively communicate information, ideas, problems and solutions in the engineering field and with society in general [Intermediate (2)].			D5

ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.2.- Ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers [Intermediate (2)].	D5

Contents	
Topic	
Topic 1 (Algebra). Matrices and systems of linear equations	Matrices. Operations. Elementary matrices. Echelon and reduced echelon forms. Rank of a matrix. Invertible matrices. Calculation of the inverse matrix. Determinant of a square matrix. Properties and calculation. Homogeneous and non-homogeneous systems. Existence of solutions.
Topic 2 (Algebra). Vectorial spaces and linear applications	Vector space and subspace. Generator systems. Linear independence. Basis and dimension. Systems of coordinates. Change of basis. Linear applications. Associated matrix. Kernel and rank of a linear application.
Topic 3 (Algebra). Eigenvalues and eigenvectors	Eigenvalues and eigenvectors. Characteristic equation. Diagonalizable matrices. Characteristic polynomial. Cayley-Hamilton theorem. Matrix functions. Exponential matrix of a square matrix.
Topic 4 (Algebra). Vectorial spaces with scalar product. Quadratic forms	Vector spaces with scalar product. Orthogonality. Orthonormal basis. Gram-Schmidt orthogonalization procedure. Orthogonal diagonalization of symmetric matrices. Real quadratic forms. Classification. Sylvester criterion.
Topic 1 (Statistics). Descriptive statistic and regression	Concept and uses of statistics. Variables and attributes. Types of variables. Representations and charts. Measures of location or position. Measures of dispersion. Analysis of bivariant data. Linear regression. Correlation.
Topic 2 (Statistics). Probability	Concept and properties. Conditioned probability and independence of events. Bayes Theorem.
Topic 3 (Statistics). Discrete and continuous random variables	Concept. Types. Probability distribution function of a random variable. Discrete and continuous random variables. Characteristics of a random variable. Remarkable distributions: Binomial, geometric, Poisson, hypergeometric, uniform, exponential, normal. Central limit theorem
Topic 4 (Statistics). Statistical inference	General concepts. Sampling distributions. Estimation. Confidence interval estimate. Hypothesis testing.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	42	42	84
Problem solving	18	14	32
Practices through ICT	4	4	8
Project based learning	4	4	8
Mentored work	14	0	14
Seminars	25	20	45
Problem and/or exercise solving	4	4	8
Essay questions exam	12	14	26
*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 present the contents of the subject in the theoretical sessions. The students will be able to consult bibliographical references for the development of the course as well as the notes of the course.
Problem solving	In the problem sessions, the lecturer will solve problems and model exercises. The student will have a copy of the solutions of all the exercises that are realized or proposed in these lessons.
Practices through ICT	In the laboratory sessions, the software tools Matlab and Excel will be used to apply the concepts presented in the theory sessions to practical scenarios. The student will be provided with notes and practice guides.

Project based learning	This Matlab laboratory practices are about developing a realistic project that solves a practical problem. A predefined guide will be used and a product that responds to the requirements will be obtained.
Mentored work	In the group tutorials (internally called seminars), the student will have the possibility to raise doubts about the subject that will be solved by the lecturer. Additionally, these sessions can be used to solve doubts related to the laboratory practices.
Seminars	An intensive course of 25 hours is organized for those students who have failed the subject at the first call, prior to the exam in the second call.

Personalized assistance

Methodologies	Description
Lecturing	In the lecture sessions, the faculty members will resolve any doubts raised by the students regarding the theoretical concepts presented at that time.
Problem solving	In the sessions for the resolution of exercises and problems, the lecturer will answer in a personalized way the doubts raised by the students.
Practices through ICT	In the sessions devoted to the realization of computer practices, the lecturer will answer in a personalized way the doubts raised by the students.
Seminars	In the intensive course, the lecturer will answer the doubts of the students in a personalized way, suggesting complementary exercises or other types of activities that will help the students to make the best use of the sessions.
Mentored work	In the mentored work sessions, the lecturer will answer in a personalized way the doubts of the students, proposing complementary exercises or any other kind of activities that will result in the best use of the classes of the students. These sessions are organized according to the schedule that will be published on the web page of the center, and through telematic means (e-mail, videoconference, Moovi forums, etc.) by appointment.
Project based learning	In the project based learning sessions, the lecturer will address any doubts that may arise regarding the objectives of the project, the application of the theoretical foundations for the proposed scenario, or in relation to the use of the tool. These questions will be addressed in a personalized way for each student.

Assessment

	Description	Qualification	Training and Learning Results		
Problem and/or exercise solving	Algebra Block. Two partial exams of Topics 1 and 2 will be done (30%). Algebra practice exam with Matlab (15%). Complementary activities of Algebra exercises (15%). Statistics Block. Two partial exams of Topics 1 and 2 will be done (30%). Statistics practice exam with Excel (15%). Complementary activities of Statistics exercises (15%).	60	B3	C1	D2 D5 D6 D9
Essay questions exam	There will be a final exam of continuous evaluation of the Algebra part and the Statistics part. The final exam of continuous evaluation is mandatory and marked out of 10 points.	40	B3	C1	D2 D5 D9

Other comments on the Evaluation

It is necessary to reach 50% of the mark in order to pass the course.

A continuous evaluation mechanism will be used, which it is intended to monitor the student's progress throughout the course, assessing their effort globally. Denoted as EV_CON, the continuous evaluation mark is calculated as follows:

EV_CON = 0.2*T1 + 0.1*P1 + 0.2*T2 + 0.1*P2 + 0.4*PE.

In case the student fails to pass the course in the ordinary call, he/she will have the right to a second evaluation opportunity (extraordinary call) that will take place in the distance mode on the dates established for that purpose by the Master's Academic Committee. The evaluation will consist in that case in a single written test that will account for 100% of the grade, being necessary to obtain at least 50% to pass the subject.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo , as well as point 6 of the fifth rule of Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces, **any violation of academic integrity in the assessment process, as well as the**

cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity, regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

In case of any difference between the guides in Galician/Spanish/English related to the evaluation, what is indicated in the teaching guide in Spanish will always prevail.

Sources of information

Basic Bibliography

Lay, David C., **Álgebra lineal y sus aplicaciones**, 4ª, Pearson, 2012

De la Villa, A., **Problemas de Álgebra**, 4ª, CLAGSA, 2010

Cao, Ricardo et al., **Introducción a la Estadística y sus aplicaciones**, 1ª, Pirámide, 2001

Devore, Jay L., **Probabilidad y estadística para ingeniería y ciencias.**, 7ª, Cengage, 2008

Complementary Bibliography

Strang, G., **Álgebra lineal y sus aplicaciones**, 3ª, Addison-Wesley Iber., 2007

Arvesú, J., **Problemas resueltos de Álgebra Lineal**, 1ª, Paraninfo, 2005

Pérez, C., **Estadística aplicada a través de Excel**, 1ª, Pearson, 2002

Canavos, G., **Probabilidad y Estadística. Aplicaciones y Métodos**, 1ª, McGraw-Hill, 2001

Recommendations

Other comments

It is recommended that students of the Algebra and Statistics subject have completed the subject Calculus I and review the properties of trigonometric functions, operations with polynomials, operations with complex numbers and the basic knowledge of statistics corresponding to Bachillerato (equivalent to high school or A levels).

IDENTIFYING DATA				
Business: Introduction to business management				
Subject	Business: Introduction to business management			
Code	P52G382V01105			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Garrido González, Iván			
Lecturers	Feijoo Conde, Jorge Garrido González, Iván Pérez Rial, Leticia			
E-mail	ivgarrido@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This subject is part of the Basic Training module and aims to provide students with a global vision of companies, acquiring a series of knowledge that will bring them closer to the business reality for its practical application. The aim is to enable students to choose the most suitable legal form for the needs of a business project, analyzing the environment of the activity, and thus being able to design the organizational structure and the most appropriate business strategy to achieve the goals through the management of the people who integrate it, taking decisions according to the level of information available. They are also expected to be able to choose the most convenient funding and to use production and marketing techniques. The aim is to achieve these objectives in order to continue and approach the training in other subjects of later courses and to be able to exercise the skills developed with the learning of the subject. Specifically, it is intended that the engineer and naval officer knows the legal-economic areas to properly perform their responsibilities as an administrator of public funds.			

Training and Learning Results	
Code	
B9	Ability to organize and plan within the sphere of a company, and other institutions and organizations.
C6	Adequate knowledge of the concept of enterprise, institutional and legal framework of enterprises. Organization and Business Management.
D1	Analysis and synthesis
D2	Problems resolution.
D7	Ability to organize and plan.
D11	Ability to understand the meaning and application of the gender perspective in the various fields of knowledge and professional practice with the aim of achieving a more just and egalitarian society.
D18	Working in an international context.

Expected results from this subject		Training and Learning Results	
To understand the role of the company in the field of the economic activity and its contribution to a more equitable development of society.		C6	D11 D18
To understand the basic aspects that characterize the different types of companies.		C6	D1 D18
To know the legal framework of the different types of companies.		C6	D1
To know the most relevant aspects about the organization and management in the company.	B9	C6	D1 D18
To acquire skills on the processes that affect business management.	B9	C6	D2 D7 D18
Learning outcome ENAEE: KNOWLEDGE AND COMPREHENSION: LO1.3.- Be aware of the multidisciplinary context of engineering. [Adequate (2)].	B9		
Learning outcome ENAEE: ANALYSIS IN ENGINEERING: LO2.1.- The ability to analyze products, processes and complex systems in their field of study; to choose and apply in a relevant way analytical, calculation and experimental methods already established and to correctly interpret the results of such analysis. [Basic (1)].			D2

Learning outcome ENAEE: ANALYSIS IN ENGINEERING: LO2.2.- The ability to identify, formulate and solve engineering problems in their field; to choose and apply properly the analytical, computational and experimental methods already established; to recognize the importance of social, health and safety, environmental, economic and industrial constraints [Adequate (2)].			D1 D11
Learning outcome ENAEE: ENGINEERING PROJECTS: LO3.1.- Ability to project, design and develop complex products (parts, components, finished products, etc.), processes and systems of their specialty, that meet the established requirements, including being aware of social, health and safety, environmental, economic and industrial aspects; as well as selecting and applying appropriate project methods. [Basic (1)].			D2 D7 D11
Learning outcome ENAEE: PRACTICAL APPLICATION OF ENGINEERING: LO5.5.- Knowledge of the social, health and safety, environmental, economic and industrial implications of engineering practice [Basic (1)].			D11
Learning outcome ENAEE: PRACTICAL APPLICATION OF ENGINEERING: LO5.6.- General ideas about economic, organizational and management issues (such as project management, risk and change management) in the industrial and business context. [Adequate (2)].	B9	C6	
Learning outcome ENAEE: JUDGMENT MAKING: LO6.1.- Ability to collect and interpret data and handle complex concepts within their field, to make judgments involving reflection on ethical and social issues [Basic (1)].	B9		D11
Learning outcome ENAEE: JUDGMENT MAKING: LO6.2.- Ability to manage complex technical or professional activities or projects of their field, taking responsibility for the making decisions [Basic (1)].	B9		
Learning outcome ENAEE: COMMUNICATION AND TEAMWORK: LO7.1.- Ability to communicate effectively information, ideas, problems and solutions in the engineering field and with society in general [Adequate (2)].			D18

Contents

Topic	
Unit 1: THE COMPANY	1.1 Concept of company. 1.2 Function of the company 1.3 Aims of the company 1.4 Institutional and legal framework. 1.5 Types of company. 1.6 The company like system.
Unit 2: STRATEGIC DIRECTION	2.1 The importance of the business environment. 2.2 Types of business environments. 2.3 Analyses of the general business environment. PEST. 2.4 Evaluation of the specific business environment and attractiveness of a sector or market: Michael Porter's five competitive forces model. 2.5 Internal analyses. SWOT 2.6 Management levels and executive functions. 2.7 The strategic process and types of strategies.
Unit 3: THE FINANCIAL SYSTEM (PART I). ECONOMIC AND FINANCIAL STRUCTURE OF THE COMPANY	3.1 The importance of economic-financial management in the company. 3.2 Economic-financial structure of the company: assets, net worth and liabilities. 3.3 Financial situations: equilibrium. 3.4 Concept of annual accounts. 3.5 Economic and financial diagnosis through the analysis of balance sheets: reports for management. 3.6 Working capital or turnover funds.
Unit 4: THE FINANCIAL SYSTEM (PART II). THE RESULTS OF THE COMPANY	4.1 Economic-financial diagnosis by means of ratio analysis. 4.2 Liquidity. 4.3 Solvency. 4.4 Return on equity and return on assets.
Unit 5: THE FINANCIAL SYSTEM (PART III). INVESTMENT	5.1 Concept of investment. 5.2 Types of investments.
Unit 6: THE FINANCIAL SYSTEM (PART IV). FINANCE	6.1 Concept of financing. 6.2 Types of financing sources. 6.3 Methods or criteria for selection and valuation. 6.4 Minimum or average maturity date.
Unit 7: THE PRODUCTION SYSTEM (PART I). GENERAL ISSUES	7.1 Concepts associated with production. 7.2 Background. 7.3 Decisions associated with the production function. 7.4 Techniques to increase productivity. 7.5 Industrial safety techniques.

Unit 8: THE PRODUCTION SYSTEM (PART II). PRODUCTION COSTS	8.1 Concept of cost. 8.2 Classification of costs. 8.3 The cost of production. 8.4 The income statement. 8.5 The break-even point.
Unit 9: THE MARKETING SYSTEM	9.1 Introduction and basic concepts. 9.2 Objectives. 9.3 Consumer behavior. 9.4 Marketing plan. Marketing Mix tools. 9.5 Marketing in the Armed Forces.
Unit 10: THE MANAGEMENT SYSTEM (PART I). PROCUREMENT MANAGEMENT	10.1 Definition and characteristics of engineering projects. 10.2 Project management guidelines. 10.3 The procurement management process (contracting). 10.4 Technical and administrative specifications.
Unit 11: THE MANAGEMENT SYSTEM (PART II). PLANNING AND CONTROL	11.1 Nature and concept of planning. 11.2 The planning process in a company. 11.3 Principles of effective planning. 11.4 Nature and concept of control. 11.5 Types of control.
Unit 12: THE MANAGEMENT SYSTEM (PART III). HUMAN RESOURCES MANAGEMENT	12.1 Concepts. 12.2 Culture and leadership. 12.3 Organizational structure. 12.4 Search, selection and hiring. 12.5 Education and training. 12.6 Appraisal and compensation. 12.7 Talent management.
Unit 13: THE MANAGEMENT SYSTEM (PART IV). CORPORATE SOCIAL RESPONSIBILITY AND CORPORATE SUSTAINABILITY	13.1 Introduction and basic concepts. 13.2 Major environmental impacts of business activities and projects. 13.3 Benefits of CSR for the organization. 13.4 Socially responsible investment. 13.5 CSR applied to Defense. The particular case of the Spanish Navy. 13.6 Examples of the application of CSR in companies.

PROGRAMMING OF PRACTICAL CREDITS	Practice 1: The company and strategic management. Aims and development: The student is expected to solve problems related to the general and specific business environment, as well as to establish strategic decisions, using tools such as Pestel analysis, Porter's five competitive forces model, SWOT analysis, the BCG matrix and the Ansoff matrix. Practice 2: Analysis of financial statements. Aims and development: It is intended that the student performs an economic-financial diagnosis of a company by analyzing its balance sheet, ratios and profitability. Practice 3: Financing and investment. Aims and development: The main objective of this practice is to familiarize the student with the financing and investment of the company by applying financing systems, as well as to determine the profitability of an investment project by means of NPV and IRR indicators. Practice 4: Production organization. Objectives and development: The main objective of this practice is that the student becomes familiar with the concepts of costs, productivity and stocks. Practice 5: Planning and control. Objectives and development: The main objective of this practice is that the student understands and carries out a planning of concrete objectives and knows the different forms of control. For this purpose, management planning tools such as Gantt charts and basic concepts of the program review and evaluation technique will be used. Practice 6: Corporate social responsibility. Objectives and development: It is intended that the student is conscious of the presence of corporate social responsibility in the environment of the Armed Forces and its different fields and actions. In addition, for the realization of this practice, the cooperative learning technique known as puzzle or jigsaw will be used, which promotes learning, student motivation, personal commitment and the need for cooperation with classmates as tools to achieve success as a team. Practice 7: Presentation of the case study. Objectives and development: Delivery of the report and oral presentation of the case study "Development of a business plan based on the Business Model Canvas" raised during the seminars of the course and carried out autonomously applying the tools seen during the course. This work, which will be developed in groups, will reflect the need for a company to have a multidisciplinary set of technical experts in different fields in order to implement strategic decisions that allow it to adapt to the turbulent environment and, therefore, survive and/or increase its competitiveness. For this purpose, the members of the group must create a Startup developing, both in the report and in the presentation, each of the characteristic blocks of a business plan, from the definition of the product and the customer segment to be addressed, through the analysis and quantification of the target market, the definition of the different strategies to be used in each of the blocks proposed, such as pricing, as well as a thorough economic-financial analysis of present and future needs. Consequently, they will have to assume the existing functions in a company (according to the different topics developed in this subject): strategic management, financial management, production, commercialization (marketing), planning and control, human resources management, corporate social responsibility, and procurement management (purchasing and/or subcontracting). In this way, students will be able to appreciate the great diversity of different professional fields of work that can be accessed with this subject and, therefore, the multidisciplinary context of engineering. All the members of the group will participate in the presentation and the professors will individually evaluate the work, participation and scope of knowledge of each student in the defense session by means of the corresponding sections of a rubric designed for this purpose. The presentation will be made in the presence of a professor of the CUD-ENM belonging to a teaching field other than business organization.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	20	25	45
Case studies	8	10	18
Laboratory practical	14	14	28
Seminars	7	7	14
Seminars	14	18	32
Essay questions exam	13	0	13

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

Methodologies	
	Description
Lecturing	Classroom sessions (I): These sessions seek to present in detail the basic fundamentals of the content of the programmed topics to provide students with the necessary knowledge to advance in their learning.
Case studies	Classroom sessions (II): Likewise, in a complementary manner and to consolidate concepts, a diagnosis of real situations (case studies) from a business point of view is carried out in certain specific situations detected as appropriate. For this purpose, current news from specialized media are analyzed (in the form of articles and videos), seeking to generate a participative, reflective and debating atmosphere among students in the classroom, which provides the lecturer with information regarding the understanding of knowledge. Based on the above methodology, students appreciate the direct application of the contents of the subject and interest in the subject is encouraged.
Laboratory practical	At the beginning of the practical classes, small lecture sessions will be developed to introduce concepts and transfer the tasks to be developed by the students. This work will consist of problem solving (aimed at reinforcing the theoretical concepts addressed in the classroom sessions) with the direct and personalized support (classroom work) at all times by the lecturer, for the resolution of questions and to provide advice derived from their real business experience. It will be proposed, in most of the practices, the realization in group to stimulate the collaboration and the approach of the different topics being more enriching for the student, trying that the work is a joint action of the members and not individual. Practice 7 involves, as indicated below, the presentation of a work (case study) developed by groups during the course. All the members of each group must take part in the presentation and the lecturers will individually evaluate the work, participation and scope of knowledge of each student in the defense session by means of a rubric designed for this purpose.
Seminars	The seminar sessions of the course will address the approach of the case study "Development of a business plan based on the Business Model Canvas" through personalized and group tutorials. The work, which will be developed in groups, should include aspects related to the different functions that exist in a company and that have been covered in the course: strategic management, financial management, production, marketing, planning and control, human resources management, corporate social responsibility and procurement management (purchasing and/or subcontracting). Thus, each seminar will address the aspects related to the corresponding theory topic, relating them specifically with the practical case.
Seminars	Intensive course for those students who failed the subject in the first round, prior to the exam in the second round.

Personalized assistance	
Methodologies	**Description**
Seminars	Within the scope of the tutorial action, academic tutoring actions are distinguished, as well as personalized tutoring. In the first case, the students will have at their disposal hours of tutorials in which they can consult any question related to the contents, organization and planning of the subject, with the development of the topics, practical cases, etc. The tutorials can be individualized, but group tutorials will be encouraged for the resolution of problems related to the activities to be carried out in group, or simply to inform the lecturer of the evolution of the collaborative work. In the personalized tutorials, each student, individually, will be able to discuss with the lecturer any problem that is preventing him/her from following the course properly, in order to find some kind of solution between both of them. By combining both types of tutorial action, the aim is to compensate for the different learning rhythms through attention to diversity. The lecturers of the course will personally answer the questions and queries of the students, both face to face and non face to face, according to the schedule that will be published in the web page of the center, and through telematic means (e-mail, videoconference, forums of the Moovi platform) under the modality of previous appointment.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	Deliverables Practicals (DP): The development of the practicals will consist of solving problems or practical cases aimed at reinforcing the theoretical concepts discussed in the classroom sessions. The tasks will be carried out in groups to stimulate the collaboration and the approach to the different topics. The individual score for this section will be derived from the evaluation of the deliverables requested from the students (exercises, reports, questionnaires).	10	B9 C6 D1 D2 D7 D18
Seminars	Case Study (CS): During the course a group work will be carried out. It will be made during the seminar sessions of the course and will be developed autonomously afterwards. This work consists on solving the case study "Development of a business plan based on the Business Model Canvas". The work must address the different business functions developed during the course. The CS grade (20% of the continuous evaluation grade) will include the evaluation of the memory delivered (70% CS) and the oral presentation made in Practice 7 (30% CS) using a rubric designed for this purpose. Since the work must be evaluated in a way that ensures individual enforceability and positive interdependence (i.e., all group members must have worked on and contributed to the final product and must have knowledge of all aspects of the project), the oral presentation session will involve all group members, and any member of the group must be able to answer questions about the whole project. Therefore, everyone must demonstrate a thorough knowledge of the delivered product. Lecturers will individually evaluate each student's work, participation and scope of knowledge. The presentation will be made in the presence of a CUD-ENM lecturer from a teaching field other than business organization.	20	B9 C6 D1 D2 D7 D11 D18
Essay questions exam	Partial Tests (PT): There will be two partial tests of continuous evaluation (2x15% of the qualification) that will include the material taught until that moment. Final Test (FT): There will be a final continuous evaluation test (40% of the grade). The objective of these tests is the evaluation of the level of knowledge by means of development questions, both of theoretical concepts and problems.	70	B9 C6 D1 D2

Other comments on the Evaluation

The final continuous evaluation test will take place during the week of evaluation and will be evaluated out of 10 points. It will be necessary to obtain a grade higher or equal to 4 points out of 10 in the final continuous evaluation test in order to be able to pass the continuous evaluation.

Two partial tests of continuous evaluation will be carried out. Each control will suppose a 15% in the grade of continuous evaluation and they will not eliminate contents in relation to the final test.

The student will have to take the ordinary exam of all the contents of the course, which will represent 100% of the grade, if the final grade of continuous evaluation is less than 5 points out of 10.

In any case, the student who has passed the continuous evaluation, will have the possibility of taking the regular exam to raise the grade.

Characteristics of the Final Test (FT)

The final continuous evaluation test, in which theoretical and practical knowledge will be evaluated, is aimed at the evaluation of the learning of all the contents selected for the course and will be prepared according to the following characteristics:

- It must be complete, which means, it will aspire to cover all the subject taught, either theoretically or practically (including the teaching part taught since the second partial), since it is about judging what the student knows about the subject, not about a part of it.

- It should consist of a series of questions that prioritize conceptual and logical reasoning, in order to verify the intellectual maturity acquired by students to draw conclusions from the notions or theories presented in class.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo*, as well as point 6 of the fifth rule of *Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces,* **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity,** regardless of the percentage of importance that the test in question had in

the overall continuous assessment and independently of other disciplinary actions that may be applied.

Sources of information

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LÓPEZ FERNÁNDEZ, R., **Logística de aprovisionamiento.**, 1ª ed, Ed. Paraninfo, 2014

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OCESE, A.; ALFARO, J., **La responsabilidad social, motor de cambio empresarial, una propuesta española para Europa y América Latina.**, 1ª ed, Ed. Mc Graw Hill Education, 2014

Recommendations

Other comments

This subject does not have any type of prerequisite, nor does it presuppose any previous knowledge of the subject. The knowledge and skills acquired by taking this course will make it easier to develop the third year course Fundamentals of Business Organization.

In order to successfully complete the course, it is recommended that students have:

- well-developed written and oral comprehension skills,
- ability to abstract and synthesize information,
- group work and group communication skills.

IDENTIFYING DATA				
Physics: Physics 1				
Subject	Physics: Physics 1			
Code	P52G382V01106			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Vázquez Carpentier, Alicia			
Lecturers	Eiras Barca, Jorge Vázquez Carpentier, Alicia			
E-mail	avcarpentier@cud.uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	The fundamental objectives shared by both this subject and its successor Physics II are, on the one hand, the consolidation with the adequate conceptual and formal rigor of previously acquired knowledge and, on the other hand, the establishment of the necessary bases for the further study of other disciplines of a basic or fundamental nature. All this, so that the final objective is not mere theoretical speculation but the application of the acquired knowledge to technology through the appropriate physical-mathematical models and schemes. The aptitudes and skills necessary for the resolution of technical problems related to Physics will be developed, practicing the analytical-deductive methodology of this science. The program of the Physics I course of the Mechanical Engineering Bachelor Degree is divided into five main blocks: Introduction, Kinematics, Dynamics, Fluids and Vibrations and Waves, which will be developed in eleven topics as detailed in the course syllabus. This subject is key for a better understanding of other subjects that will be studied later, such as Strength of Materials, Fluid Mechanics or Mechanisms and Machines Theory.			

Training and Learning Results	
Code	
B3	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	Understanding and mastering the basics of the general laws of mechanics, thermodynamics, waves and electromagnetic fields, and their application for solving engineering problems.
D2	Problems resolution.
D9	Apply knowledge.
D10	Self learning and work.

Expected results from this subject	Training and Learning Results		
Know the basic instrumentation to measure physical magnitudes.	B3	C2	D2 D9 D10
To know the basic techniques for the evaluation of experimental data.	B3	C2	D2 D9 D10
Develop practical solutions to elementary technical problems of the engineering in the fields of the mechanics and of fields and waves.	B3	C2	D2 D9 D10
ENAEE LEARNING OUTCOME: KNOWLEDGE And UNDERSTANDING: 1.1 Knowledge and understanding of mathematics and other basic sciences inherent to their engineering specialty, at a level that allows them to acquire the rest of the competencies of the degree.Level of development (basic(1), intermediate(2) or advanced(3)): Intermediate(2)].	B3	C2	
ENAEE LEARNING OUTCOME: ANALYSIS IN ENGINEERING: 2.2. The ability to identify, formulate and solve engineering problems in their specialty; to choose and properly apply established analytical, computational and experimental methods; to recognize the importance of social, health and safety, environmental, economic and industrial constraints (Basic(1)).		C2	D2 D9
ENAEE LEARNING OUTCOME: INVESTIGATION And INNOVATION: 4.3. Ability and skill to design and carry out experimental investigations, interpret results and reach conclusions in their field of study (Basic(1)).		C2	D9
ENAEE LEARNING OUTCOME: COMMUNICATION And TEAM WORKING: 7.2. Ability to function effectively in national and international contexts, individually and in teams, and to cooperate both with engineers and people from other disciplines (Basic(1)).			D10

Contents	
Topic	
1.- Physical quantities and measurement	1.1 Magnitudes, quantities, units and measurements. 1.2 Dimensional homogeneity. 1.3 The International System. Universal constants and characteristics. 1.4 Theory of errors.
2.- Vector Calculus	2.1 Vectors. Types. 2.2 Coordinate Systems. 2.3 Operations with vectors. 2.4 Scalar and vector fields. 2.5 Central fields. Newtonian fields. 2.6 Integral theorems of vector analysis.
3.- Particle kinematics	3.1 Fundamental concepts: position vector, velocity, acceleration. 3.2 Study of some types of motion. 3.3 Relative motion.
4.- Particle dynamics	4.1 Forces and interactions. 4.2 Fundamental principles of mechanics: Newton's Laws. 4.3 Conservation principles. 4.4 Diagrams of the free solid. 4.5 Applications of Newton's Laws.
5.- Work and energy	5.1 Work and power. 5.2 Kinetic energy. 5.3 Gravitational and elastic potential energy. 5.4 Conservative and non-conservative forces. Law of conservation of energy. 5.5 Principle of least action.
6.- Dynamics of a particle system	6.1 Center of masses. Equation of motion of the center of masses. 6.2 Linear momentum of a particle system. Conservation theorem. Impulse. 6.3 Angular momentum of a particle system. 6.4 Kinetic energy of a particle system. Conservation theorem. 6.5 Law of conservation of energy of a particle system. 6.6 Collisions.
7.- Rotation and dynamics of a rigid body	7.1 Kinematics of rotation. 7.2 Energy in rotational motion. 7.3 Moment of inertia. Steiner's theorem. 7.4 Rotational dynamics of a solid. 7.5 Angular momentum. Conservation theorem. 7.6 Gyroscopes.
8.- Static equilibrium and elasticity	8.1 Equilibrium conditions. Ligatures. Center of gravity. 8.2 Examples of static equilibrium in rigid solids. 8.3 Stresses, deformation and modulus of elasticity. 8.4 Elasticity and plasticity.
9.- Fluid mechanics	9.1 Density. 9.2 Pressure in a fluid. 9.3 Fundamental principles of Fluidostatics. Archimedes principle. 9.4 Continuity equation. 9.5 Bernoulli's equation.
10.- Vibrations	10.1 Periodic motions. 10.2 Simple harmonic motion (s.h.m.). 10.3 Force and energy of a simple harmonic oscillator. 10.4 The simple physical pendulum. 10.5 Damped free oscillations. 10.6 Forced oscillations. Resonance.
11.- Wave motion	11.1 Concept of wave. 11.2 Wave motion. General study. 11.3 Energy of wave motion. 11.4 Wave interference. 11.5 Standing waves.
PRACTICES OF LABORATORY	P1 Measure and calculation of errors. P2 Resolution of problems. Cinematics. P3 Dynamics. P4 Centre of masses and dynamic of a system of particles. P5 Dynamics of the rigid solid. P6 Resolution of problems. Static balance. P7 Vibrations and waves.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	28	56
Seminars	14	0	14
Laboratory practical	14	14	28
Mentored work	15	11	26
Essay questions exam	13	13	26

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

Methodologies

	Description
Lecturing	In these sessions the basic theoretical contents of the program will be explained in detail, exposing explanatory examples with which to deepen the understanding of the subject. Presentations and the blackboard will be used in combination. The paper reproductions of the slides should never be considered as substitutes for the texts or notes, but as complementary material.
Seminars	There are sessions of problem solving and exercises where the student must solve, individually or under supervision, a series of problems and practical exercises addressing the theoretical contents of the subject. The didactic method to be followed in the teaching of the seminars is that the lecturer supervises the work done by the students solving problems and practical exercises.
Laboratory practical	They correspond to laboratory sessions, and problem and exercise solving sessions. In the laboratory sessions, in order to contribute to the acquisition of the basic competence CB3 (A3) and the transversal competence CT10 (D10), the evaluation of the practical sessions is considered with the preparation of individual reports or by means of questionnaires related to the work derived from the laboratory session. In the problem and exercise solving sessions and in order to acquire the competences CT2 (D2) and CT9 (D9) the student must solve, individually or under supervision, a series of practical problems and exercises dealing with the theoretical contents of the subject.
Mentored work	They correspond to sessions of the intensive course of preparation for the extraordinary exam, where the lecturer will propose complementary problems and activities to review the contents of the course and will answer the questions raised by the students.

Personalized assistance

Methodologies	Description
Lecturing	In the field of tutorial action, the students will have at their disposal hours of tutorials in which they can ask any question related to the contents, organization and planning of the subject, etc. In the personalized tutorials, each individual student will be able to discuss with the lecturer any problem that is preventing him/her from following the subject properly, in order to find some kind of solution between both of them.
Laboratory practical	In the sessions destined to the realization of laboratory practices, the professor will answer in a personalized way the questions raised by the students.
Seminars	In the group tutorials, the lecturer will personally answer the student's questions, suggesting complementary exercises or other types of activities that will help the students to make the best use of the classes.
Mentored work	During the reinforcement course, students will have at their disposal hours of tutorials in which they can ask any question related to the subject. The lecturers of the course will personally answer the questions of the students in the schedule that will be published in the center website, as well as through e-mail or through other telematic means (use of the virtual office by appointment, videoconference, use of Moovi forums, etc.).

Assessment

	Description	Qualification	Training and Learning Results		
Lecturing	Evaluation by means of complementary activities consisting of the resolution of problems proposed by the lecturer of the subject or any other activity that may be established. The student may be asked to present the resolution of the problems in class	15	B3	C2	D2 D9 D10
Laboratory practical	Reports or questionnaires on the practices and the work derived from them.	15	B3	C2	D2 D9 D10

Essay questions exam	Two intermediate written tests and the final evaluation test.	70	B3	C2	D2 D9 D10

Other comments on the Evaluation

Next we show the percentage that each of the parts represents in the student's final grade.

- Intermediate test 1 (PI1)=15%
- Intermediate test 2 (PI2)=15%
- Laboratory practices evaluation test (EP)=15%
- Complementary Activities (AC)=15%
- Final test (PF)=40%

The student's final evaluation will be based on the sum of the score given to each of the above mentioned parts, being the continuous evaluation grade (NEC):

$NEC = 0,15 \cdot PI1 + 0,15 \cdot PI2 + 0,15 \cdot EP + 0,15 \cdot AC + 0,4 \cdot PF$

However, minimum requirements and conditions will be demanded in some of the sections to ensure a balance between all types of competencies.

The student must take the regular exam of all the contents of the course, which will account for 100% of the grade, when the NEC grade is less than 5 or obtains a grade lower than 4 points out of 10 in the final exam of continuous evaluation. In this last case, the grade of the continuous evaluation will be the minimum of the continuous evaluation grade calculated with the previous formula and 4 points.

In any case, the student who has passed the continuous evaluation will be offered the opportunity to take the regular exam to raise the grade.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo*, as well as point 6 of the fifth rule of *Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces,* **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity**, regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

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Recommendations

Subjects that it is recommended to have taken before

Mathematics: Calculus 1/P52G382V01103

Other comments

In order to successfully complete this course the student must follow the following recommendations and possess the following skills:
1. Active attendance to classes, both theoretical and practical.
2. Maintain a minimum daily or weekly study.
3. Cultivate reasoning and ingenuity in the learning of the subject, rather than simple memorization procedures.
4. Ability to learn to solve physical problems based on a good theoretical foundation and sufficient practice in the use of basic mathematical tools. It is essential that the student masters the basic aspects of integral and differential calculus to pass the course.

IDENTIFYING DATA				
Computer science: Computing for engineering				
Subject	Computer science: Computing for engineering			
Code	P52G382V01107			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Barragáns Martínez, Ana Belén			
Lecturers	Barragáns Martínez, Ana Belén Rodelgo Lacruz, Miguel			
E-mail	belen@cud.uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	This course belongs to the module of Basic education, and its main goal is providing to the students an overview of the world of the computers. The course is focused on making the students to learn how a computer works internally, from hardware and software perspective, as well as to design programs employing a high level language. She/he will familiarise also with the systems of management of databases. It is proposed a course of computing and conceptual programming sufficiently general, oriented to provide to the student a perspective of designer and programmer of small applications. Although the course is not oriented to the study of a particular operating system or programming language, it does necessary employ a concrete language in the realization of the practical activities, becoming the learning of this language a secondary aim of the course.			

Training and Learning Results	
Code	
B3	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	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	Basic knowledge on the use and programming of computers, operating systems, databases and software applications in engineering.
D1	Analysis and synthesis
D2	Problems resolution.
D5	Information Management.
D6	Application of computer science in the field of study.
D7	Ability to organize and plan.
D17	Team working.

Expected results from this subject	Training and Learning Results		
Skills in handling computers and operating systems	B3 B4	C3	D2 D5 D6 D7
Basic understanding of how computers work	B3	C3	D1 D6
Database fundamentals	B3	C3	D5 D6
Capability to implement simple algorythims using a programming language	B3 B4	C3	D1 D2 D5 D6 D7 D17
Structured and modular programming fundamentals	B3	C3	D6 D7
Skills regarding the use of computer tools for engineering	B3 B4	C3	D5 D6

ENAEE learning outcome: KNOWLEDGE AND UNDERSTANDING: LO1.1- Knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes [Intermediate (2)].	B3	C3	
ENAEE learning outcome: ENGINEERING ANALYSIS: LO2.2.- Ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical - societal, health and safety, environmental, economic and industrial - constraints [Intermediate (2)].	B4	C3	D1 D2
ENAEE learning outcome: ENGINEERING DESIGN: LO3.2.- Ability to design using some awareness of the forefront of their engineering specialisation [Intermediate (2)].	B4		D7
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.2.- Practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Intermediate (2)].	B4	C3	D2
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.2.- Ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers [Intermediate (2)].			D7 D17

Contents

Topic	
Concepts and basic programming techniques applied to engineering	Objectives and development: This topic aims to explore the concepts and basic programming techniques and algorithms, as well as modular and structured programming methodologies. Topic index: Introduction to programming. Programming methodologies. - Modular programming. - Structured programming. Algorithms and its description. Programming languages. Phases in the development of a program. Conclusions.
Introduction to C programming language	Objectives and development: Once the student has mastered the basic concepts of programming, this unit introduces the C programming language. Most of this unit will be addressed in the practical sessions of the course. Topic index: Data types - Variables. - Expressions. - Operators. Structure of a C program. - Style in programming. - Basic instructions. - Sequential structure. The conditional structure. - Simple conditional structure. - Multi-conditional structure. The repetitive structure. - Repetitive structures controlled by condition. - Repetitive structures controlled by counter. Strings and arrays. - Strings. - Vectors and matrices. Files. - Input and output with format. - Handling files. Structured programming. Modules and subroutines. - Definition of functions. - Passing parameters by value and by reference. Conclusions.

Foundations of operating systems: concept, evolution and structure	Objectives and development: The objective of this unit is, on the one hand, to establish the concept of operating system, its functions and its aims, and on the other hand, to present its structure and main components to provide to the student with an overview. Topic index: Concept of operating system. History and evolution of the operating systems: types of systems. Components and services of the operating system. Structure of the operating system. Conclusions.
Introduction to database management systems (DBMS)	Objectives and development: In this unit the management systems of relational databases are presented to the students: the basic concept as well as the SQL language will be addressed. Topic index: Basic concepts: relational model, primary and foreign keys. Indexes. The SQL language. Conclusions.
Basic computer architecture	Objectives and development: This unit is intented to present the structure and main components of a computer to provide to the student with an overview of its operation. Topic index: History and evolution of computers. Basic computer architecture. Main components. Conclusions.
Practice 0: Introduction to the computer lab and its tools.	Objectives and development: In the first session of laboratory the student will familiarise with the tools to be used during the course: Linux operating system, the command interpreter, gcc compiler and different text editors emacs, saw, nano, gedit, etc.
Practice 1: Variables. Data Input/Output.	Objectives and development: The fundamental goal of this session is that the student knows the different types of existent data, and that understands which functions allow to carry out the data input by keyboard and the data output by screen.
Practice 2: Flow diagrams.	Objectives and development: The goal of this session is that the student learns to develop flow diagrams in the design phase of a program.
Practice 3: Selective and repetitive structures.	Objectives and development: The main goal of these sessions is that the student understands the operation of the selective structures if-else and switch as well as the repetitive structures for, while and do-while.
Practice 4: Manipulation of strings and arrays.	Objectives and development: The main goal of this session is that the student understands how the mechanisms of manipulation of strings and arrays work in the C language.
Practice 5: Manipulation of files.	Objectives and development: The fundamental goal of this session is the familiarization with data files. The student learns to design and implement solutions to a problem where it is necessary to access to text file to read and/or write data, being also an objective that the student understands how the system calls work.
Practice 6: Functions.	Objectives and development: The main goal of this session is the familiarization of the student with the modular programming and the use of functions. It will have to know also the differences between passing parameters to functions by value and by reference.
Practice 7: Programming project.	Objectives and development: This practice consists in the resolution of a more complex problem, posed so that its solution needs the cooperative work of two students (or three students, as an exception).

Practice 8: Introduction to SQL.	Objectives and development: Its goal is that the students learn to connect to a management system of relational databases (in particular, MySQL) from a Linux terminal and to interact with it by using the SQL language to carry out basic tasks: to create a table, to insert data, to make queries, etc. Students are expected to work only at the level of system user, not admin.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	14	28	42
Practices through ICT	18	18	36
Project based learning	10	8	18
Seminars	15	13	28
Problem solving	7	0	7
Systematic observation	0	0	0
Essay questions exam	11	4	15
Essay questions exam	2	2	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	Participatory masterclasses. In these sessions, the faculty will explain in detail the basic theoretical contents of the course, exposing clarifying examples that help to better understand the concepts. Computer presentations and the blackboard will be used, especially to transmit information like definitions, charts, algorithms, etc. When it is possible, a copy of the slides will be given to the students in advance, focusing the effort of the lecturers and the students on the exhibition and understanding of the concepts. Anyway, the reproductions in paper of the slides should not be considered like substitutes of the texts, but like complementary material.
Practices through ICT	Small participatory master sessions. Sometimes, it will be necessary to explain in the laboratory practical concepts giving useful advices for the best advantage of the practical classes. Supervised laboratory practices. The didactic method to be followed in the teaching of the practical classes consists in that the lecturer supervises the work and progress done by the different groups. The practices of laboratory are headed to strengthen the theoretical concepts tackled in the sessions in the classroom (with the master sessions as well as with the design of the project).
Project based learning	Project-based learning. As the course progresses, it will be proposed a project to be done in group (preferably of two people) that will last several weeks. We will use the educational methodology of project-based learning. The solution of the project will demand the contribution of the knowledge acquired by each member of the group, guaranteeing the positive interdependence that is required for the success of the collaborative work. On the other hand, the project will be evaluated guaranteeing the individual work and the positive interdependence, this is, all the members of the group must have worked and contributed to the final product and have to know all the aspects of the project. It will be provided material and bibliography, and it will exist the possibility of a public presentation of the project.
Seminars	An intensive course (15 hours long) is organized for those students who have failed the subject at first call, prior to the exam in second call. Group tutoring with the lecturer.
Problem solving	Resolutions of problems and/or exercises. These sessions, that take place in seminars and under the format of small group meetings, will serve for the resolution of questions about the project. Problems and exercises will be resolved by the students themselves.

Personalized assistance

Methodologies	Description

Problem solving	Regarding tutorials, it is possible to distinguish between academic and personalised tutorials. Students will be offered office hours so that they can ask every question related to contents, organisation and planning of the course. They can be one-to-one tutorials although group tutorials will be fostered in order to sort out the problems related to group activities or just in order to inform the instructor of the development of group work. Regarding one-to-one tutorials, each student will be able to talk to the instructor about any problem which is preventing her/him from coping with the subject properly, so that both can find a solution. By merging both kinds of tutorials, it is intended to compensate the different learning paces through measures of attention to diversity. The teachers will personally answer to the questions and queries of the students, both in person, according to the timetable that will be published on the centre's website, and by telematic means (e-mail, videoconference, Moovi forums, etc.) by appointment.

Assessment

	Description	Qualification	Training and Learning Results
Project based learning	The assessment of the programming project (practice 7) will be done by means of the following collection of strategies employed to value the process of project based learning: - Assessment of initial design of the project: 5% (Competencies CG3 (B3), CG4 (B4), CE3 (C3), CT1 (D1), CT6 (D6), CT7 (D7), CT17 (D17)). - Delivered final product (code and report): 30% (Competencies CG3 (B3), CG4 (B4), CE3 (C3), CT1 (D1), CT2 (D2), CT5 (D5), CT6 (D6), CT7 (D7), CT17 (D17)). - Improvements carried out over the initial specification of the project: 5% (Competencies CG3 (B3), CG4 (B4), CE3 (C3), CT1 (D1), CT2 (D2), CT5 (D5), CT6 (D6), CT7 (D7), CT17 (D17)). - Project defense (personal interview): Factor 0-1 (Competencies CG4 (B4), CE3 (C3), CT6 (D6), CT17 (D17)). Since the project has to be evaluated so that it is guaranteed the individual work as well as the positive interdependence (this is, all the members of the group must have worked and contributed to the final product and have to control all the aspects of the project), in the defence session, any member of the group must be able to answer to any question regarding the project. All of them must show, therefore, deep knowledge of the delivered product, independently of the part on which they had focused their efforts. The project defense will allow the lecturers to assess the degree of involvement in its development and the defense result will be a factor that will multiply the qualification corresponding to 35% of the project (except for the design) so that, if the group is not capable of answering the questions posed, this factor will be zero, nullifying the qualification obtained. On the contrary, if the group defends the submitted project well, said factor will be 1 and will consolidate its rating.	40	B3 C3 D1 B4 D2 D5 D6 D7 D17
Systematic observation	The participation and attitude of the student will be assessed during all the semester in theoretical classes and seminars as well as contributions in the online teaching platform.	5	B4 D2 D6 D7
Essay questions exam	Written exam: theoretical questions and problems The main goal of this exam is to assess the learning of all of the theoretical contents of the course. This exam must be complete, i.e., it will cover all of the contents, since the main goal is to assess what students know about the subject in general, not of a part of it. Second, the exam has to consist in a series of questions that make the conceptual and logical reasoning prevail, in order to verify the intellectual maturity of the students to obtain conclusions from the notions or the exposed theories in class.	35	B3 C3 D1 B4 D2 D6
Essay questions exam	The evaluation of the practices (with the exception of the practice 7 - project of programming) will be carried out through an examination of questions where it will be assessed the knowledge acquired by the student in the laboratory. This way, the instructor will ask about any aspect related to the practices implementation.	20	B3 C3 D1 B4 D2 D6

Other comments on the Evaluation

The evaluation criteria of each section will be published at the beginning of the semester.

The final assessment of student will be the sum of the punctuation awarded to each one of the before commented parts, being their grade of continuous evaluation (CEG): CEG = 0,35 * THEORY EXAM GRADE + 0,4 * PROJECT GRADE + 0,2 * PRACTICAL EXAM GRADE + 0,05 * PARTICIPATION.
However, some minimum requirements in any of the sections will be demanded to guarantee the balance between all the types of competencies. Those requirements are: 1. To get at least a 5 over 10 in the project evaluation. 2. To get at least a 4 over 10 in the theory exam.

Those students that do not fulfil any of the previous requirements, will have to attend to the ordinary examination to be able to pass the course, and their grade of continuous evaluation will be calculated as follows: FINAL_CEG = min(4,CEG).
All those students that wish to improve their qualification (obtained by continuous evaluation) will be able to attend to the ordinary exam. So much in the ordinary exam as in the extraordinary (July) all the competencies of the course will be evaluated. Thus, said examinations will include a practical programming test in the laboratory. Once finished the second semester, an intensive course (15 hours long) is organized to prepare the extraordinary exam.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo*, as well as point 6 of the fifth rule of *Order DEF/711/2022, of July 18, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces,* **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity,** regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

Sources of information

Basic Bibliography

Osvaldo Cairó, **Fundamentos de Programación: Piensa en C**, Pearson Prentice Hall, 2006

Complementary Bibliography

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Gregorio Fernández Fernández, **Curso de Ordenadores. Conceptos básicos de arquitectura y sistemas operativos**, 5ª Edición, 2ª Edición en el Servicio de Publicaciones de la E.T.S.I. Telecomunicación. UPM, 2004

Alan Beaulieu, **Aprende SQL**, 2ª edición, Anaya Multimedia/O'Reilly, 2009

Recommendations

Other comments

This course has no prerequisites and no prior knowledge about the course is expected. The knowledge and skills that are acquired will allow the student to develop with guarantees skills of later courses in which the management of a computer and / or computer applications related to engineering is required.
To be able to successfully complete the course, it is recommended that students have:
- a well-developed written and oral comprehension capacity,
- capacity for abstraction and synthesis of information,
- skills for group work and for group communication.

IDENTIFYING DATA				
Materials science and technology				
Subject	Materials science and technology			
Code	P52G382V01108			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Urréjola Madriñán, Santiago Rafael			
Lecturers	Alfonsín Pérez, Víctor Ángel Urréjola Madriñán, Santiago Rafael			
E-mail	urrejola@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	Currently, it is interesting to look for material properties that not only provide benefits in mechanical behavior, but also other characteristics such as appearance, shine, touch, etc., that can become important when selecting a material or another with similar mechanical characteristics. Many of these parameters are variable and could even depend on social trends. The unstoppable advance of society and the importance of some properties of materials at different scales, make their study especially relevant within the field of Engineering. The aim of this course is to introduce the main concepts of materials technology as well as to study the applications of the most common materials In addition, in this subject skills will be developed to apply theoretical and practical knowledge in order to solve problems in reference to materials from a basic and multidisciplinary point of view			

Training and Learning Results	
Code	
B3	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	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	Capacity for handling specifications, regulations and mandatory standards.
C9	Knowledge of the fundamentals of the science, technology and chemistry of materials. Understand the relationship between microstructure, the synthesis, processing and properties of materials.
D1	Analysis and synthesis
D5	Information Management.
D9	Apply knowledge.
D10	Self learning and work.

Expected results from this subject	Training and Learning Results		
New	B4 B6		
Knowing how the properties can be modified using mechanical processes and thermal treatments	B4	C9	D9
Knowing the basic techniques of the structural characterization of materials	B3 B6	C9	
Ability in the handling of diagrams and graphics			D1 D5
Ability in performing experiments	B6	C9	D10
To analyse the obtained results and their conclusions			D1 D9
Ability to apply standards of material testing	B6		D1 D9
ENAEE LEARNING OUTCOME. KNOWLEDGE AND UNDERSTANDING: LO1.2 - knowledge and understanding of engineering disciplines underlying their specialisation, at a level necessary to achieve the other programme outcomes, including some awareness at their forefront. [level of achievement (basic (1), intermediate (2) and advanced (3)) for this learning outcome: Intermediate (2)].	B3	C9	
ENAEE LEARNING OUTCOME. KNOWLEDGE AND UNDERSTANDING: LO1.3 - Awareness of the wider multidisciplinary context of engineering [Intermediate (2)].		C9	

ENAEE LEARNING OUTCOME. ENGINEERING ANALYSIS: LO2.2.- Ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical □societal, health and safety, environmental, economic and industrial □ constraints. [Intermediate (2)].	B4		D1 D9
ENAEE LEARNING OUTCOME. INVESTIGATIONS: LO4.1.- ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, to carry out simulation and analysis in order to pursue detailed investigations and research of technical issues in their field of study. [Intermediate (2)].	B6		D5
ENAEE LEARNING OUTCOME. INVESTIGATIONS: LO4.2.- Ability to consult and apply codes of practice and safety regulations in their field of study; [Basic (1)]	B6		
ENAEE LEARNING OUTCOME. INVESTIGATIONS: LO4.3.- Laboratory/workshop skills and ability to design and conduct experimental investigations, interpret data and draw conclusions in their field of study .[Intermediate (2)].		C9	D9
ENAEE LEARNING OUTCOME. ENGINEERING PRACTICE: LO5.1.- Understanding of applicable techniques and methods of analysis, design and investigation and of their limitations in their field of study: [Basic (1)].			D9
ENAEE LEARNING OUTCOME. ENGINEERING PRACTICE: LO5.2.- Practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study. [Basic (1)].	B4		D9
ENAEE LEARNING OUTCOME. ENGINEERING PRACTICE: LO5.3.- Understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study. [Basic (1)].		C9	D9
ENAEE LEARNING OUTCOME. ENGINEERING PRACTICE: LO5.4.- Ability to apply norms of engineering practice in their field of study. [Basic (1)].	B6		D9
ENAEE LEARNING OUTCOME. MAKING JUDGMENTS: LO6.1.- Ability to gather and interpret relevant data and handle complexity within their field of study, to inform judgements that include reflection on relevant social and ethical issues [Basic (1)].	B6		
ENAEE LEARNING OUTCOME.COMMUNICATION AND TEAM-WORKING: LO7.1.- ability to communicate effectively information, ideas, problems and solutions with engineering community and society at larg [Intermediate (2)].	B4		D1 D5
ENAEE LEARNING OUTCOME.COMMUNICATION AND TEAM-WORKING: LO7.2.- Ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers. [Intermediate (2)].			D10

Contents	
Topic	
Introduction to materials.	Definition of material. Present, past and future of materials. What is Materials Science and Technology and its multidisciplinary nature. Importance of materials in society: Ethical-social and environmental commitment. Material properties. Material trends. Relationship between structure and properties. Selection of materials: technical-economic commitment and market value.
Types of atomic bonds and derived properties	Types of bonds. Classification of materials. Atomic bond strength and derived properties.
Structure of crystalline materials	Crystalline and amorphous materials. Main crystalline systems. Metallic crystalline structures: Cristal systems (BCC,FCC,HCP, polymorphism and alotropy). Covalent and ionic main structures. Determination of crystal structure (X-Ray diffraction)
Imperfections of crystal structure	Crystal defects: Point defects, line defects, planar defects. Importance of crystal defects in the metal and ceramic properties. Microscopic techniques for the crystal defects identificacion.
Solid atomic diffusion.	Diffusion mechanisms. Fick's laws. Diffusion factors. Industrial applications of diffusion processes:
Basic deformation characteristics	Types of deformation: elastic, anelastic, viscoelastic and plastic. Mechanisms of deformation: viscous flow, slip and crystal twinning.
Tensile test, compression and flexion	Tensile test: Standarization. Conventional tensile test curve. Mechanical properties derived. Real tensile-deformation curve. Acritude coefficient. Comparison of tensile behaviour in different materials. Compression and flexion tests: Standarizarion. Characteristics. Comparison of their behaviour between different materials.
Hardness tests	Hardness: Concept. Shore test. Macrohardness test: Brinell, Rockwell and Vickers. Microhardness test: Vickers y Knoop. Standarization. Comparison between different test procedures.
Solidification process	Nucleation and growth. Basic concepts

Equilibrium phase diagrams: Introduction. Solid state phase transformations in equilibrium	Gibbs law. Lever rule. Binary equilibrium diagrams. Types. Invariant. solidification reactions. Equilibrium solid-state transformations: Metallic and ceramic. Examples: Fe-C phase diagram. Microestructure evolution for cooling: steel and foundries. Types based on the carbon content.
Polymeric materials	Plastic composition. Properties of the most important polymers. Applications. Recycling. Adhesives.
Ceramic and composite materials	Vitreous ceramics. Clay products. Structural ceramics and porcelain. Refractory ceramics. Abrasive Ceramics. Cements and concretes. Advanced technological ceramic.
Laboratory session 1. Webquest	Introduction to materials: Search for information in order to complete sheets about different materials, which must be presented orally for evaluation. The student must use different online databases, whose use and quality will be later qualified by the teacher.
Laboratory session 2. Mechanical tests: Hardness	Hardness coefficient determination of different metallic materials: Brinell, Rockwell and Vickers. Micro-hardness profile (Vickers) of a cemented test probe. Hardness coefficient determination for different plastic materials. Shore test (A and D)
Laboratory session 3. Mechanical tests: Tensile	Introduction to tensile tests. Tensile-Elongation diagrams. Young's modulus determination and resilient modulus through Tensile-elongation diagrams.
Laboratory session 4-5. Metallographic study of metals, iron and aluminum alloys.	Introduction to metallography. Test probes preparation and optical microscope handling. Metallographic observation of test probes: monophasic-biphasic alloys, steel, iron and aluminium.
Laboratory session 6. Phase diagrams.	Development of phase diagrams for a binary alloy using the cooling curves.
Laboratory session 7. Polimeric and ceramic materials	Collaborative activity where the students use interactive videos about the synthesis and shaping processes of polymeric and ceramic materials. This activity also includes the following items: multiple choice questions, fill in the blank questions, drag and drop images, etc.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	32	60
Laboratory practical	12	6	18
Autonomous problem solving	7	7	14
Seminars	15	15	30
Objective questions exam	2	1	3
Problem and/or exercise solving	2	1	3
Essay questions exam	3	3	6
Essay questions exam	3	3	6
Essay questions exam	3	3	6
Essay	2	2	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	Teaching in the classroom of the key concepts and procedures for learning the syllabus contents. The students have a textbook with the contents of the subject, in addition to the information of the web that contains the file with the subject's slides. It is recommended a dedication of half hour or an hour per class period.
Laboratory practical	Application of the knowledge acquired to the resolution of problems of materials science and technology. A series of practices have been designed in accordance with the content of the subject in order to assimilate concepts explained in this class. All the practices will be carried out in the corresponding laboratories (materials, chemistry and computer) by the students in small groups (3-4 students).
Autonomous problem solving	In the seminars, the student will have to solve exercises and problems that will be corrected by the lecturer. Likewise, they will have to do exercises in individual way.
Seminars	Intensive 15-hour course for those students who have failed the subject on the first call, prior to the exam on the second call. Group tutoring with the lecturer.

Personalized assistance

Methodologies	Description

Autonomous problem solving	In the field of tutorial action, academic tutoring actions are distinguished, as well as personalized tutoring. In the first case, the students will have at their disposal hours of tutorials in which you can consult any questions related to the contents, organization and planning of the subject, etc. In the personalized tutorials, each student, individually, can discuss with the teacher any problem that is preventing him/her from properly monitoring the subject, in order to find between them some type of solution. By combining both types of tutorial action, it is intended to compensate the different learning rhythms through attention to diversity. The lecturers will answer the questions of the students, both in person, according to the schedule that will be published on the website of the center, and telematically (email, videoconference, Moovi forums, etc. .) by previous appointment.
Seminars	Academic tutoring and personalized tutoring.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	Attendance, participation and periodical assignments.	15	B3 C9 D1 B6 D5 D9 D10
Objective questions exam	Several short tests consisting of theoretical questions will be carried out through the semester, with a maximum weight total of 10%	10	B3 C9 D1 B4 D5 B6 D9 D10
Problem and/or exercise solving	Two written exams (with a maximum weight total of 25%) consisting of the resolution of problems will be carried out through the semester.	25	B3 C9 D1 B4 D5 B6 D9 D10
Essay questions exam	A final continuous assessment consisting of all theoretical and practical contents will be carried out at the end of the semester. This exam will be graded over 10 points. Moreover, in this exam it will be necessary to overcome the 40% in each part (theory and problems)	40	B3 C9 D1 B4 D5 B6 D9 D10
Essay	An individual work related to the activities of seminars will be carried out (5%). In adittion, a collaborative work in groups of 2-3 students (5%) will be carried out in the last laboratory session, with the aim of having smaller groups and a longer period of time. This work is related to the contents of the subject and it evaluates the communication and the capacity for teamwork.	10	B4 C9 D1 D5 D9

Other comments on the Evaluation

CONTINUOUS ASSESSMENT:

The student must be examined of all the subject contents in the ordinary exam, if the final grade of continuous assessment is less than 5 and also in the following cases:

- The no realisation or delivery of any of the activities.
- Obtain a grade to inferior 4.0 points over 10 in any of the parts (theory and problems) of the final exam.

In the case that they do not fulfill those conditions, the maximum qualification of the student by continuous evaluation will be 4.0. In any case, the student that has passed the continuous evaluation, will have the possibility to attend to the ordinary exam to improve his/her grade.

INTENSIVE COURSE

In the case that the students do not pass the ordinary exam, they have to attend the extraordinary exam in July. The Defense University Center proposes for these students an intensive course of reinforcement during the months of June and July of 15 hours in three weeks, with the aim to prepare the exam.

ACADEMIC INTEGRITY:

Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo*, as well as point 6 of the fifth rule of *Order DEF/711/2022, of July 18, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces,* **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding**

assessment opportunity, regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

Sources of information

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Shackelford, James F, **Introducción a la Ciencia de Materiales para ingenieros**, Sexta, Prentice-Hall, 2007

Krauss, G., **Steels: heat treatment and processing principles**, Primera, ASM International, 2015

Recommendations

Other comments

In order to pass this subject, the student must remember the basic fundamentals of Physics and General Chemistry studied at High School.

In case of discrepancy in the information contained in this guide it will be understood that the edited version prevails in Spanish.