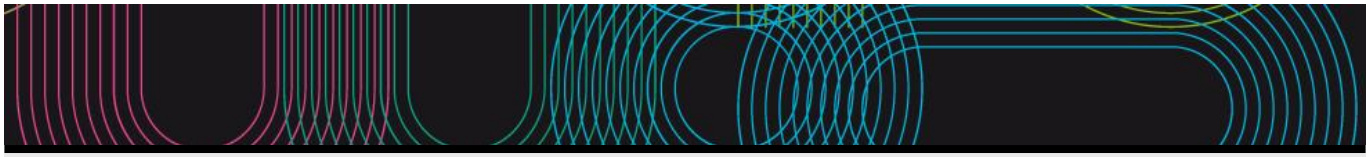

(*)Centro Universitario da Defensa da Escola Naval Militar de Marín

Grado en Ingeniería Mecánica

Subjects

Year 2nd

Code	Name	Quadmester	Total Cr.
P52G381V01201	Mathematics: Calculus II and differential equations	1st	6
P52G381V01202	Materials science and technology	1st	6
P52G381V01203	Thermodynamics and heat transfer	1st	6
P52G381V01204	Resistance of materials	1st	6
P52G381V01205	Fundamentals of electrical engineering	2nd	6
P52G381V01206	Mechanism and machine theory	2nd	6
P52G381V01207	Environmental technology	2nd	6
P52G381V01208	Fluid mechanics	2nd	6
P52G381V01209	English I	2nd	6

IDENTIFYING DATA

Mathematics: Calculus II and differential equations

Subject	Mathematics: Calculus II and differential equations			
Code	P52G381V01201			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Alvarez Hernandez, Maria			
Lecturers	Alvarez Hernandez, Maria González Coma, José Pablo			
E-mail	maria.alvarez@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The aim of this course is for students to learn the basic techniques of integral calculus in several variables, vector calculus, ordinary differential equations and their applications.			

Skills

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.
D3	Oral and written proficiency
D6	Application of computer science in the field of study.
D9	Apply knowledge.
D15	Objectification, identification and organization.
D16	Critical thinking.

Learning outcomes

Expected results from this subject	Training and Learning Results		
Understanding of the basic concepts of integral calculus in several variables.	B3	C1	D1
Knowledge of the main techniques of integration of functions of several variables.	B3 B4	C1	D1 D2 D9
Knowledge of the main results of vector calculus and its applications.	B3 B4	C1	D1 D2 D9
Understand the importance of integral calculus, vector calculus and differential equations for the study of the physical world.		C1	D9 D16
Apply knowledge of integral calculus, vector calculus and differential equations.		C1	D2 D6 D9 D16
Acquisition of the ability to use this knowledge to solve questions, exercises and problems manually and by computer.		C1	D1 D2 D3 D6 D9 D15 D16
Acquire the basic knowledge for solving linear differential equations and systems.	B3	C1	

ENAEE LEARNING OUTCOME: KNOWLEDGE AND UNDERSTANDING: LO1.1 - Knowledge and understanding of mathematics and other basic sciences inherent to his/her engineering specialisation, at a level that allows the acquisition of the rest of the competences of the degree [development level (basic (1), adequate (2) and advanced (3)) of this sub-outcome: Adequate (2)].	B3	C1	
ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS: LO2.2 - The ability to identify, formulate and solve engineering problems in their speciality; to choose and apply established analytical, computational and experimental methods appropriately; to recognise the importance of social, health and safety, environmental, economic and industrial constraints [Adequate (2)].	B4	C1	D1 D2 D9 D16
ENAEE LEARNING OUTCOME: RESEARCH AND INNOVATION: LO4.3 - Ability and skill to design and carry out experimental investigations, interpret results and draw conclusions in their field of study [Adequate (2)].			D9

Contents

Topic	
Integration in several variables	Curves and surfaces. Integration in the plane. Integration in space. Geometric and physical applications of the multiple integral.
Vector Calculus	Integration of fields along a curve. Integration of fields over a surface. Classical theorems of vector calculus. Applications.
Differential equations	General concepts. Methods for solving first-order ordinary differential equations. Second order linear differential equations. Systems of linear differential equations.
Numerical methods for initial value problems	Euler and Runge-Kutta methods.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	28	56
Problem solving	10	10	20
Mentored work	7	0	7
Practices through ICT	3	2	5
Seminars	15	13	28
Problem and/or exercise solving	4	4	8
Laboratory practice	1	1	2
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 in the theoretical classes the contents of the course. Students will have basic reference texts for the monitoring of the subject.
Problem solving	The lecturer will solve problems and exercises and the student will have to solve similar exercises to acquire the necessary capabilities.
Mentored work	The student will have to solve exercises and problems that will be corrected by the professor. Those exercises will be tackled in groups and will work on them.
Practices through ICT	The lecturer will solve problems and exercises through the use of the Matlab tool and the student will have to solve similar exercises to acquire the necessary abilities
Seminars	Intensive course of 15 hours for those students who have failed the subject in the first exam, prior to the exam at the second call.

Personalized assistance

Methodologies	Description
Problem solving	The faculty will personally answer the students' questions and queries, according to the timetable that will be published on the center's website, and by telematic means (e-mail, videoconference, Moovi forums, etc.) by appointment. In the sessions for problem solving, the professor will answer the questions raised by the students in a personalised manner.
Practices through ICT	In the sessions devoted to the accomplishment of informatics practices, the lecturer will answer the questions raised by the students.
Mentored work	In group tutorials, the lecturer will personally answer the questions of the students, will do complementary exercises or other activities.

Assessment

	Description	Qualification	Training and Learning Results

Problem solving	A complementary activity will be carried out consisting of resolution of exercises.	15	B3 B4	C1	D1 D2 D3 D6 D9 D15 D16
Problem and/or exercise solving	There will be two mid-term exams on Topics 1 and 2.	30	B3 B4	C1	D1 D2 D3 D9 D15 D16
Laboratory practice	A practical problem-solving exercise will be carried out with Matlab.	15	B3 B4	C1	D2 D6 D9
Essay questions exam	There will be a final continuous assessment exam on the contents of the whole subject.	40	B3 B4	C1	D1 D2 D3 D9 D15 D16

Other comments on the Evaluation

GENERAL OBSERVATIONS ON THE CALCULATION OF THE MARK:

The continuous assessment will consist of two written tests, for the first two themes, with a weight of 15% each, a Matlab laboratory practical, with a weight of 15%, and a hand-in of exercises to be developed, with a weight of 15%, being the weight of the final exam of 40%.

Students will have to take the ordinary exam of all the contents of the course, which will be 100% of the grade, in the following cases:

- Failure to complete or hand in any of the above points.

- Obtaining a mark of less than 4 points out of 10 in the final continuous assessment exam.

- Obtaining a mark lower than 5 points in the continuous assessment.

In the circumstances described in the first two sections of the above list, the continuous assessment mark would be assigned as the minimum value between a 4.5 and the mark calculated according to the weightings described above.

In any case, students who have passed the continuous assessment will have the possibility of taking the ordinary exam in order to obtain a higher mark. The assessment of students in the second and successive examinations will consist of an exam about the contents of the subject which will account for 100% of the mark.

ETHICAL COMMITMENT:

Students are expected to behave ethically. If unethical behaviour is detected (cheating, plagiarism, use of unauthorised electronic devices or other) will be automatically penalised with a grade of 0.0 in the current session.

Sources of information

Basic Bibliography

E. Marsden, A.J. Tromba, **Cálculo Vectorial**, Pearson-Addison Wesley, 2004

G.F. Simmons, **Ecuaciones diferenciales con aplicaciones y notas históricas**, Mc-Graw Hill, 1993

Complementary Bibliography

A. Quarteroni, F. Saleri, **Cálculo científico con Matlab y Octave**, Springer, 2006

Recommendations

Other comments

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

IDENTIFYING DATA

Materials science and technology

Subject	Materials science and technology			
Code	P52G381V01202			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Alfonsín Pérez, Víctor Ángel			
Lecturers	Alfonsín Pérez, Víctor Ángel Devesa Rey, Rosa Urrejola Madriñán, Santiago Rafael			
E-mail	valfonsin@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			

Skills

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.

Learning outcomes

Expected results from this subject	Training and Learning Results		
Understanding the mechanical behavior of metallic, ceramic, plastics and composites materials	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: synthesis, doping of semiconductors.
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
Problem solving	7	7	14
Seminars	15	10	25
Objective questions exam	1	2	3
Problem and/or exercise solving	1	2	3
Report of practices, practicum and external practices	0	6	6
Essay questions exam	3	4	7
Essay questions exam	3	2	5
Essay questions exam	3	2	5
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).
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
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
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
Report of practices, practicum and external practices	Attendance, participation and reports that will be delivered periodically	15	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.

ETHICAL COMMITMENT:

It is expected that students have an adequate ethical behaviour:

- If is detected an unethical behaviour (cheating, plagiarism, use of unauthorised electronic devices or others) during written exams, the student will be penalized with the impossibility to pass the course by the modality of continuous assessment, obtaining a qualification of 0.0.

- If this kind of behaviour is detected in ordinary or extraordinary exam, the student will obtain a qualification of 0.0.
- In the case of the practices reports, the total or partial copy in a report (according to the opinion of the lecturers), will be penalized in the final note of the practices with a qualification of 0.0.

Sources of information

Basic Bibliography

Callister, William, **Introducción a la Ciencia e Ingeniería de los Materiales I y II**, Tercera, Reverté, 2003

Askeland, Donald R, **Ciencia e Ingeniería de los Materiales**, Primera, Paraninfo- Thomson Learning, 2001

Smith, William F, **Ciencia e Ingeniería de los Materiales**, Quinta, McGraw-Hill, 2014

Complementary Bibliography

Pero-Sanz Elorz, J. A., **Ciencia e Ingeniería de los Materiales: estructura y propiedades**, Cuarta, Dossat, 2006

Mangonon, P. L., **Ciencia de Materiales: selección y diseño**, Primera, Prentice Hall, 2001

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.

IDENTIFYING DATA				
Thermodynamics and heat transfer				
Subject	Thermodynamics and heat transfer			
Code	P52G381V01203			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	González Gil, Lorena			
Lecturers	Eiras Barca, Jorge González Gil, Lorena			
E-mail	lorena.gonzalez@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The aim of this subject is to train future graduates in Bachelor Degree in Mechanical Engineering with the ability to apply the principles of Thermodynamics and Heat Transfer required in almost all industrial processes and domestic installations. The knowledge of these principles is basic in Thermal Engineering, for instance, to carry out an energy analysis (determining the energy and exergy efficiency) of power systems for electricity generation (combined cycle with steam and gas turbine), a mechanical power cycle, a heat pump cycle, etc. The knowledge of whether a thermodynamic process can occur in reality is essential for the design of new processes, as well as the knowledge of the maximum benefits that can be obtained by the different devices present in an energy installation, and the causes hindering those maximum benefits. Furthermore, the study of the thermodynamic properties of the working fluids that circulate through the devices, water, air, refrigerants, gases and gas mixtures, is essential to analyse the behaviour of thermal systems. Likewise, studying the procedure needed for the energy analysis of refrigeration, air conditioning and in combustion processes is of great interest. On the other hand, it is essential for students to know the heat transfer mechanisms, focusing on determining the way and rate of the energy exchanged. Thus, at the end of the course, students are expected to be able to properly state and solve heat transfer engineering problems and to perform a basic design of heat exchangers.			

Skills	
Code	
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.
B5	Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
B6	Capacity for handling specifications, regulations and mandatory standards.
B7	Ability to analyze and assess the social and environmental impact of the technical solutions.
B11	Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Industrial Technical Engineer.
C7	Knowledge of applied thermodynamics and heat transfer. Basic principles and their application to solving engineering problems.
D2	Problems resolution.
D7	Ability to organize and plan.
D9	Apply knowledge.
D10	Self learning and work.
D17	Working as a team.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Capacity to know, understand and use the principles and fundamentals of applied thermodynamics	B4 B5 B6 B7	C7	D2 D7 D9 D10 D17
Ability to know and understand the principles and fundamentals of heat transmission	B5 B6 B7 B11	C7	D2 D7 D9 D10 D17

Ability to know and understand the principles and fundamentals of thermal equipment and generators	B4 B6 B7 B11	C7	D2 D7 D9 D10 D17
Analyze the operation of thermal systems, such as heat pump systems, refrigeration cycles or power cycles, identifying components, as well as the cycles used to obtain high performance.	B4 B5 B6 B7 B11	C7	D2 D7 D9 D17
ENAEE learning outcome: KNOWLEDGE and UNDERSTANDING: LO1.2.- 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: [Advanced (3)].		C7	
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 [Advanced (3)].	B4 B7		D2 D9
ENAEE learning outcome: RESEARCH AND INNOVATION: 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 B11		
ENAEE learning outcome: RESEARCH AND INNOVATION: LO4.2.- Ability to consult and apply codes of practice and safety regulations in their field of study [Basic (1)].	B6 B7 B11		
ENAEE learning outcome: RESEARCHING AND INNOVATION: LO4.3.- Ability to design and conduct experiments, interpret data and draw conclusions [Intermediate (2)].		C7	D9
ENAEE learning outcome: ENGINEERING PRACTICE LO5.4.- Ability to apply norms of engineering practice in their field of study [Basic (1)].	B6 B7 B11		D9
ENAEE learning outcome: ENGINEERING PRACTICE LO5.5- Awareness of non-technical -societal, health and safety, environmental, economic and industrial implications of engineering practice [Basic (1)].	B7		
ENAEE learning outcome: MAKING JUDGEMENTS LO6.1.- Ability to gather and interpret relevant data and handle complex concepts within their field of study, to make judgements that involve reflection on ethical and social issues [Basic (1)].	B6 B7 B11		

Contents

Topic	
BLOCK 1 (B1): Properties of pure, simple and compressible substances	B1-1. Review of basic concepts and definitions - Systems definition - Description of the systems and their behaviour - Temperature measurement. Zero Law of Thermodynamics - Heat and specific heat - Phase change and latent heat - Ideal gas. State equations - The First Law of Thermodynamics - Thermodynamic transformations of an ideal gas - The Second Law of Thermodynamics B1-2. Properties of a pure, simple and compressible substance - Definition of the thermodynamic state - The p-v-T relationship - Calculation of thermodynamic properties - The ideal gas model - Internal energy, enthalpy and specific heats of ideal gases - Calculation of internal energy and enthalpy changes in ideal gases - Polytropic processes of an ideal gas

BLOCK 2 (B2): Energy analysis of systems according to the First and Second Law	B2-1. Energy analysis of control volumes - Conservation of mass - Conservation of energy - Steady state analysis - Transient analysis B2-2. The Second Law of Thermodynamics - Using the 2nd law - Formulations of the 2nd law - Identification of irreversibilities - Application of the 2nd low to thermodynamic cycles - The Kelvin temperature scale - Maximum efficiency measurements for cycles operating between two heat sources - The Carnot cycle B2-3. Entropy and its use - Clausius inequality - Definition of entropy change - Obtaining entropy values - Entropy change in internally reversible processes - Entropy balance for closed systems - Entropy balance for control volumes - Isentropic processes - Isentropic efficiencies of turbines, nozzles, compressors and pumps B2-4. Exergy analysis - Definition of exergy - Exergy balances - Exergy efficiency (second law)
BLOCK 3 (B3): Introduction to thermodynamic analysis of thermal motors and machines	B3-1. Power production facilities - Introduction to power production facilities - Vapor power production: the Rankine Cycle - Gas turbine power production facilities: the Brayton cycle - Combined cycle B3-2. Gas cycles in reciprocating internal combustion engines - Otto cycle - Diesel cycle B3-3. Refrigeration cycles - Refrigerators - Heat pumps

BLOCK 4 (B4): Fundamental concepts and principles in heat transfer	B4-1. Introduction to heat transfer - Fundamental concepts in heat transfer - Mechanisms of heat transfer: conduction, convection and radiation - Fourier's law. Thermal conductivity and diffusivity - Newton's law of cooling. Convection coefficient - Stefan-Boltzmann law. Emissivity and absorptivity B4-2. Heat transfer by conduction - General heat conduction equation - One-dimensional conduction in steady state. Plane walls - Thermal resistance. Thermal resistance network - Global heat transfer coefficient - Stationary conduction with thermal energy generation - Conduction in radial systems: cylinders and spheres B4-3. Heat exchangers - General considerations - Classification of heat exchangers. Characteristics and selection criteria - Parallel, countercurrent and cross flow temperature distribution - Considerations for the design of heat exchangers - Heat flow exchanged - Logarithmic mean temperature difference (DTML) method - Efficiency method-number of transfer units (E-NUT) B4-4. Heat transfer by convection - Movement of a fluid. Laminar and turbulent flows - Boundary layers of convection: hydraulic and thermal - Dimensionless numbers - Free and forced convection - Empirical correlations for external and internal flows B4-5. Heat transfer by radiation: general principles - Fundamental concepts. Electromagnetic spectrum. Thermal radiation - Blackbody radiation. Planck's Law. Wien's Law - Definitions: radiation intensity, irradiance, emissivity - Surface absorptivity, reflectivity and transmissivity - Kirchhoff's Law

PRACTICAL CONTENTS	The seven practices proposed aim to consolidate and deepen the knowledge acquired in the theoretical classes while developing research skills: design of experiments, analysis and collection of experimental data, discussion of results using appropriate sources of information, etc. PL 1. Mechanical equivalent of heat This practice aims to determine the mechanical equivalent of heat, that is, the relationship between the energy unit (Joule) and the heat unit (calorie). Through this practical experience, it is highlighted the large amount of mechanical energy that needs to be transformed into heat to significantly increase the temperature of a small mass. PL 2. Linear thermal expansion of solids Study of linear thermal expansion in iron, brass and aluminum thin tubes. Estimation and comparison of the coefficients of expansion of these materials. The implications of the materials expansion on structural safety will be evaluated, as stated in the Technical Building Code (CTE). PL 3. Introduction to thermographic techniques It is intended to initiate students in the use of thermographic cameras as a tool applied to the study of insulation in buildings and predictive maintenance. The environmental implications of their use will be analysed. The importance of emissivity in this technique will be studied. PL 4. Thermal conductivity of metals It will be determined the heat flux that occurs through U-shaped metal bars whose ends are immersed in hot and cold water. It will be proved that the heat flux depends on the composition of the material, as well as its cross section and length. PL 5. Determination of insulation properties It is intended to observe the thermal properties of different insulating materials for the management and understanding of concepts such as thermal insulation, thermal conductivity and heat capacity. PL 6. Heat exchanger The aim is to better understand the operation of heat exchangers, establish energy balances and determine the effectiveness and the integral coefficient of heat transfer as a function of the direction and flow of the fluids. Likewise, the DTLM and ε-NUT methods will be validated and the dimensionless numbers will be applied to estimate the theoretical heat transfer coefficients. PL 7. Alternative energies. Study of a solar collector. It is intended to initiate students in the study of a solar collector, analyse the energy received by radiation and make an energy balance of the energy used for domestic hot water, thus being able to meet the requirements of the CTE. Different configurations of the equipment will be tested in order to understand its operation and find the one that maximizes energy use.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	37	65
Laboratory practical	14	7	21
Problem solving	7	7	14
Seminars	15	12	27
Problem and/or exercise solving	0	4	4
Objective questions exam	4	4	8
Essay questions exam	3	2	5
Essay questions exam	6	0	6

*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. In addition to the information published on the online teaching platform Moovi, which contains the file with the lesson slides, the students have in the recommended bibliography the contents of each leasson with a more detailed development.
Laboratory practical	Application of the knowledge acquired in the lectures to the resolution of practical problems. A series of practices have been designed in accordance with the content of the subject in order to fix the explained concepts, so that the the student develops his creativity and his ability to propose technical solutions
Problem solving	The student must solve exercises and problems related to the subject individually.
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. The lecturer briefly reviews theoretical concepts of the subject and proposes problems to be solved, while individually supervising the work of each student. An active learning methodology is promoted.

Personalized assistance

Methodologies	Description
Lecturing	Assistance in groups of approximately 40 students. To complement the personalized assistance, a tutorial action will be carried out. In the scope of the tutorial action, it can be distinguished between academic tutoring actions (in group or individually) and personalized tutoring. Both types of tutorial action are combined to compensate for the different learning rhythms and thus paying attention to diversity. The lecturers of the subject will solve the questions and queries of the students in person or online (via email, videoconference, Moovi forums, etc.) at the time scheduled on the website of the center or by appointment.
Laboratory practical	Assistance in groups of 20 students. It is complemented with academic and personalized tutoring.
Problem solving	Assistance in groups of 10 students. It is complemented with academic and personalized tutoring.
Seminars	Continuous tutorng action, with constant support by the lecturer to the student's learning process. Students receive personalized assistance in small groups. It is complemented with academic and personalized tutoring.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	The assessment will be carried out through deliverables and a questionnaire (ECP). The questionnaire will be loaded in Moovi and it will assess the knowledge acquired in the lectures and in the laboratory related to the practices. On the other hand, the deliverables of each practice evaluate the quality of the experimental data collection, the understanding of the practice, synthesis capacity, logical reasoning, teamwork and the search for appropriate sources of information that help to understand the problem under study and to contrast the results obtained. The mark of each deliverable and the questionnaire will be out of 10 points. The global grade of practices will be the average of the mark of all the deliverables and the questionnaire.	20	B4 C7 D2 B5 D7 B6 D9 B7 D10 B11 D17
Problem and/or exercise solving	During the semester different tasks (TE) will be proposed, some will be individual and others may be in group. The objective of these tasks will be to promote the understanding of the theoretical/practical contents and to delve into other key aspects of the subject, such as the management and application of regulations such as the Technical Building Code in matters of energy saving. These activities will be compulsory and scored, each one of them, out of 10 points.	10	B4 C7 D2 B5 D7 B6 D9 B7 D10 B11 D17
Objective questions exam	Mid-term exams (PP) Their objective is to evaluate the theoretical contents and the ability to solve problems acquired during part of subject, since two mid-term exams will be conducted (weighting 15% each). These tests will consist of a series of questions and exercises that prioritize conceptual and logical reasoning, in order to verify the intellectual maturity of the students to obtain conclusions from contents presented in lectures. Both test will be compulsory and scored on 10 points each.	30	B4 C7 D2 B5 D7 B7 D9 B11 D10

Essay questions exam	Final Exam (EF) Its objective is to evaluate the theoretical contents and the ability to solve problems acquired during the whole subject in the lectures and seminars. This test will consist of a series of questions and exercises that prioritize conceptual and logical reasoning, in order to verify the intellectual maturity of the students to obtain conclusions from contents presented in lectures. This test will be compulsory and scored on 10 points.	40	B4 C7 D2 B5 D7 B7 D9 B11 D10
Essay questions exam	Ordinary and Extraordinary Exam If the students do not pass the continuous evaluation, they will have an ordinary exam after the final exam. In this exam the students will be evaluated of all the contents taught in the lectures, seminars and practical sessions. This exam will represent 100% of the final grade of the student. It will be necessary to obtain a grade higher than 5 points out of 10 to pass the exam. If the students do not pass the ordinary exam, they would go directly to the second call in July. In the extraordinary exam the student will be examined of all the theoretical/practical contents taught in the subject during the ordinary course.	100	B4 C7 D2 B5 D7 B6 D9 B7 D10 B11

Other comments on the Evaluation

Sources of information

Basic Bibliography

Çengel, Yunus y Boles, Michael, **Termodinámica**, 9ª, McGraw-Hill, 2019

Moran M.J. y Shapiro H.N., **Fundamentos de Termodinámica Técnica**, 2ª, Reverté, 2015

Çengel Y.A., y Ghajar A.J., **Transferencia de Calor y Masa. fundamentos y aplicaciones**, 6ª, McGraw-Hill, 2020

Incropera F.P. y DeWitt D.P, **Fundamentos de transferencia de calor**, 4ª, Pearson Education, 2000

Complementary Bibliography

Wark, K. y Richards, D.E., **Termodinámica**, 6ª, McGraw-Hill, 2001

Haywood R.W, **Ciclos termodinámicos de potencia y refrigeración**, Limusa, 2000

Çengel Y.A., **Introduction to Thermodynamics and Heat Transfer**, McGraw-Hill, 2008

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Segura, J, **Termodinámica Técnica**, Reverté, 1988

Baehr, H. D, **Tratado moderno de termodinámica**, Tecnilibro, S.L, 1987

Holman, J. P, **Transferencia de Calor**, 8ª, Mc Graw-Hill, 1998

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Alarcón Aguín, J. M.; Granada Álvarez, E.; Vázquez Alfaya, M. E., **SISCECT, Simulación y cálculo de ciclos termodinámicos**, Bellisco, 1999

Chapman A.J., **Transmisión de calor**, 3ª, Bellisco, 1990

Lienhard IV J.H., Lienhard V J.H., A, **A heat transfer textbook**, Phlogiston Press, 2005

Segura J., y Rodriguez J, **Problemas de Termodinámica Técnica**, Reverté, 1993

Lacalle, Nieto, **Problemas de Termodinámica Técnica**, 3ª, Dextra, 2017

Corrochano Sánchez, C.; Muñoz Antón, J,; Ortiz Gómez, A.; Fernández Benítez, J.A., **Problemas de transferencia de calor**, Dextra, 2014

Recommendations

Subjects that continue the syllabus

Thermal engineering I/P52G381V01403

Other comments

To successfully complete this subject, the student must have the following skills:

- Written and oral comprehension.
- Abstraction, basic calculation and synthesis of information.

IDENTIFYING DATA				
Resistance of materials				
Subject	Resistance of materials			
Code	P52G381V01204			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Regueiro Pereira, Araceli			
Lecturers	Regueiro Pereira, Araceli Suárez García, Andrés			
E-mail	regueiro@cud.uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	Introduction to linear elastic materials, and analysis of internal loadings, stress and strain relationships. Study of the fundamentals of mechanics of materials and particularization for shafts and beam structures.			

Skills	
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.
C14	Knowledge and use of the principles of strength of materials.
D1	Analysis and synthesis
D2	Problems resolution.
D9	Apply knowledge.
D10	Self learning and work.
D16	Critical thinking.
D17	Working as a team.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Know the differences between rigid and elastic solids.	B3 B4	C14	D1 D2 D9 D10 D16 D17
Apply the acquired knowledge to maximum stress calculation at a point in a deformable solid.	B3 B4	C14	D1 D2 D9 D10 D16 D17
To know the basic principles governing Strength of Materials.	B3 B4	C14	D1 D2 D9 D10 D16 D17
To know the relationships between the different stresses and the stresses they cause.	B3 B4	C14	D1 D2 D9 D10 D16 D17

Apply the acquired knowledge to the determination of stresses.	B3 B4	C14	D1 D2 D9 D10 D16 D17
Apply the acquired knowledge of stresses to their estimation in bar elements.	B3 B4	C14	D1 D2 D9 D10 D16 D17
To know the fundamentals of the deformations of bar elements.	B3 B4	C14	D1 D2 D9 D10 D16 D17
Apply the knowledge acquired to the dimensioning of busbar elements.	B3 B4	C14	D1 D2 D9 D10 D16 D17
ENAEE LEARNING OUTCOME: KNOWLEDGE AND UNDERSTANDING. LO 1.2: Knowledge and understanding of the engineering disciplines specific to their speciality, at the level necessary to acquire the rest of the competences of the degree, including notions of the latest developments. Level of development: Adequate (2). NOTE: The possible values for the level of development are: Basic (1), Adequate (2) and Advanced (3).	B3	C14	
ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS. LO 2.2: The ability to identify, formulate and solve engineering problems in their speciality; to choose and apply established analytical, computational and experimental methods appropriately; to recognise the importance of social, health and safety, environmental, economic and industrial constraints. Level of development: Adequate (2).	B4		D1 D2 D9 D16
ENAEE LEARNING OUTCOME: RESEARCH AND INNOVATION. LO 4.3: Ability and skill to plan and carry out experimental research, interpret results and reach conclusions in their field of study. Level of development: Basic (1).		C14	D9

Contents	
Topic	
Topic 1. Statics	- Concept of the elastic solid - Vector. Dot Product and Cross Product - Moment of a force - Static balance. Equations - Moments and products of inertia - Static balance and elastic balance - Requests on a section in elastic regime
Topic 2. Basic concepts of Strength of Materials	-Object and purpose of strength of materials - Tensions and deformations. - Tension state. Stress matrix. Mohr's circle - Principle of relative stiffness and superposition - Elastic balance - Reactions in ligatures. Types of supports - Isostatic and hyperstatic systems - Security coefficient. Admissible tension
Topic 3. Traction-Compression	- Normal effort - Tensile deformations - Statically determinate problems - Hyperstatic problems - Monoaxial traction or compression caused by thermal variations or assembly defects
Topic 4. Fundamentals of buckling	- Definition - Critical load. Euler's formulation - Application limits of the Euler formulations

Topic 5. Bending and shear	- Beams. Deformation and classes. Forces applied to beams - Shear stress and bending moment - Relations between shear stress, bending moment and load - Diagram of shear forces and bending moments - Types of bending. Assumptions and limitations - Normal tensions. Navier's Law - Concept of resistant module. Optimum sections - Analysis of deformations: turns and arrows. Moment-curvature relationship. Elastic equation. Theorems for the calculation of deformations - Hyperstatic flexion
Topic 6. Failure criteria	- Limit state - Ductile material - Fragile material - Security factor
Laboratory Session 1: Tensile test	The student will play with tensile test, as well as the normative that describe them.
Laboratory Session 2: F-Tool software practice (I)	The student will calculate tensile and shear stress values in different assumptions by using a structural calculation software.
Laboratory Session 3: Compression test	The student willl play with compression test, as well as the normative that describe them. You will make different more and less slender prototypes and calculate the critical force. The grip must be the same for all of them, implying a sudden change of section. The normal stress diagram will also be calculated.
Laboratory Session 4: Shear test	The student willl play with shear test, as well as the normative that describe them.
Laboratory Session 5: Bending test	The student willl play with bending test, as well as the normative that describe them. Analyze different configurations: bi-embedded, bi-articulated and bi-supported beam. Calculate the bending moment and the deflection associated with each of them.
Laboratory Session 6: Modulus of elasticity	This practice will focus on the calculation of the experimental modulus of elasticity. The student will use the data collected by the student in the previous laboratory sessions. For this, the association of the elastic modulus and the tensions in each test carried out will be reviewed.
Laboratory Session 7: F-Tool software practice (II)	Student will analyze bar structures of increasing complexity, obtaining tensile, shear and bending stresses, as well as the deformation under different types of load.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	28	56
Laboratory practical	14	14	28
Seminars	7	0	7
Essay questions exam	13	26	39
Laboratory practice	15	5	20

*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 lectures, the fundamentals of each topic are explained. Students will have the slides of the lectures at their dispossal
Laboratory practical	In laboratory sessions, the concepts taught in lectures will be applied. A series of practices have been designed to show the concepts explained in lectures and develop the student ability to propose technical solutions.
Seminars	In the seminars, a series of problems are analysed and proposed to be carried out. Students must solve exercises and problems under the supervision of the lecturer

Personalized assistance

Methodologies	Description

Lecturing	In the personalized assistance, a distinction is made between academic and personalised assessment. In the academic assessment, students will have at their disposal tutoring sessions in which they can ask any question related to the contents, organisation and planning of the subject. In the personalised assessment, 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 them. By combining both types of assessment, the aim is to compensate for the different learning rhythms through attention to diversity. Both will be scheduled by appointment

Assessment

	Description	Qualification	Training and Learning Results		
Essay questions exam	Final Test (PF) which represents 40% of the continuous assessment (EC). 2 Theoretical-Practical Controls (PT) representing: 2x15%=30% of EC.	70	B3 B4	C14	D1 D2 D9 D10 D16
Laboratory practice	Practice Reports (PL) which represent 20% of the EC. Questionnaires and Tests (CT) representing 10% of EC.	30	B3 B4	C14	D1 D2 D9 D16 D17

Other comments on the Evaluation

Continuous assessment

The continuous assessment (EC) method will assess the results achieved by students in the different activities carried out throughout the course, grouped into four parts: Final Exam (PF), Theoretical-Practical Controls (PT), Laboratory Practices (PL) and Deliverable Reports (PE). The weights for each part will be: PF 40 %, PL 30 %, PE 20 % and CT 10 %.

There will be two evaluation controls of theoretical-practical knowledge (PT1 and PT2) throughout the course. Each of them will account for 15 % of the final continuous assessment mark. These controls will be interspersed with the theory sessions. The PT FINAL grade will be the arithmetic mean of PT1 and PT2.

The student will be assessed for each laboratory session carried out (PL1 to PL7). Each practice will account for 3% of the final continuous assessment grade, except for PL2 and PL7, which will be 2.5%. This evaluation will be carried out by reports or questionnaires. It could be the case that a report and a questionnaire could be requested simultaneously for the assessment of a single session. The delivery of the reports and the completion of the questionnaires will be carried out telematically through the MOOVI platform. In addition, during seminar and/or theory class hours, students will be asked to complete and submit different exercises (PE).

The final continuous assessment test (PF) will include all the contents of the subject and will have a weight of 40% in the final continuous assessment mark.

The continuous assessment mark (NEC) will be the result of applying the weighted arithmetic average of the marks for each of the parts (PF, PT, PL and PE), as shown in the following equation:

$NEC=0.4\ PF+0.3\ PT+0.2\ PL+0.1\ CT$

In order to pass the continuous assessment, two conditions must be met: having a $NEC \geq 5$ and a $PF \geq 4$. If the latter condition is not met, the PL grade will be ignored, and the student will obtain a failing grade in the continuous assessment of the subject, with a score equal to the minimum of 4.0 and the weighted average of PF and PT.

Ordinary exam

Those students who do not manage to pass the subject by the continuous assessment method must do the ordinary exam, where all the competences of the subject will be assessed. The results of this exam will account for 100% of the student's final mark. A mark greater than 5 is a requirement for passing the course. Finally, it is worth highlighting that all students have the option to raise their NEC. In other words, students who have passed the subject by continuous assessment will have the possibility of taking the ordinary exam to improve their mark.

Extraordinary exam

Students who have not passed the course in the ordinary exam will sit an extraordinary exam which will have the same format and the same requirements as the ordinary exam.

Ethical commitment

As both a member of the military and a student of the University of Vigo, the student is subject to the obligations derived from both institutions. As far as university students are concerned, the University Student Statute, approved by Royal Decree 1791/2010 of 30 December, establishes in article 12, point 2d, that university students have the duty to "refrain from using or cooperating in fraudulent procedures in assessment tests, in the work carried out or in official university documents". Likewise, the Law 39/2007 on Military Careers, in its article 4 concerning the rules of behaviour of the military, states in its fifteenth rule that the military "shall perform their duties and obligations with accuracy, motivated by a sense of honour, [...]".

Therefore, the student is expected to behave ethically. If unethical behaviour is detected during the course (cheating, plagiarism, use of unauthorised electronic devices or other), the student will be penalised with a grade of "0.0" on the written test or deliverable and will have an NEC of "0.0" at the end of the term.

Sources of information

Basic Bibliography

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Complementary Bibliography

Hibberler, R.C., **Mecánica de materiales**,

Ferdinand P. Beer, E. Russel Johnson, JR., David F. Mazurek & Elliot R. Eisenberg, **Mecánica vectorial para ingenieros**,

Recommendations

Other comments

The subject Strength of Materials is the study of the behaviour of real materials in relation to their strength, stiffness and stability. This course requires the necessary conceptual basis for its correct understanding. For this reason, in order to successfully complete it, the student must have:

- Ability of written and oral comprehension.

- Ability of abstraction, basic calculation and synthesis of information.

IDENTIFYING DATA				
Fundamentals of electrical engineering				
Subject	Fundamentals of electrical engineering			
Code	P52G381V01205			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	Falcón Oubiña, Pablo			
Lecturers	Falcón Oubiña, Pablo González Prieto, José Antonio Val García, Jesús del			
E-mail	pfalcon@cud.uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	The knowledge of electricity, its use and its protections is basic for the development of any kind of engineer, regardless of his branch. That is why Fundamentals of Electrical Engineering represents one of the most important pillars of the knowledge of the future technician, and given its broad spectrum, it will contain a theoretical part and a further part eminently practical. The main objective of this course is to transmit the fundamental concepts of the Theory of Circuits and Electrical Machines for application in the design of electrical distribution systems and electronic circuits. These concepts represent the basis of electrical engineering which brings together different aspects and technical sciences such as, among others, Electronics, Power Electronics, Control and Regulation, Automation Systems and Electrical Machines. All this forms the basis of the current field of action of industrial electricity.			

Skills	
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.
C10	Knowledge and use of the principles of circuit theory and electrical machines.
D1	Analysis and synthesis
D2	Problems resolution.
D6	Application of computer science in the field of study.
D10	Self learning and work.
D14	Creativity.
D16	Critical thinking.
D17	Working as a team.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
To understand the basics of the operation of circuits and electrical machines	B3	C10	
Familiarisation with current techniques for the analysis of electrical circuits		C10	D6
Know the techniques of measure of electrical circuits			D6 D10
To acquire skills on the process of analysis of electrical circuits			D1 D2 D6 D10 D14 D16 D17
ENAEE learning outcome: KNOWLEDGE and UNDERSTANDING: LO1.2.- 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		
ENAEE learning outcome: KNOWLEDGE and UNDERSTANDING: LO1.3.- awareness of the wider multidisciplinary context of engineering [level of achievement (basic (1), intermediate (2) and advanced (3)) for this learning outcome: Intermediate (2)].		C10	

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 [level of achievement (basic (1), intermediate (2) and advanced (3)) for this learning outcome: Intermediate (2)].	D2 D16
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 [level of achievement (basic (1), intermediate (2) and advanced (3)) for this learning outcome: Intermediate (2)].	D6
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 [level of achievement (basic (1), intermediate (2) and advanced (3)) for this learning outcome: Intermediate (2)].	D10 D17

Contents	
Topic	
Unit 1. Direct current circuits	This topic aims to study the techniques of analysis and resolution of basic DC circuits. 1.1 Introduction and general concepts. Common measurement units. 1.2 Electrical circuit. Elementary components. 1.3 Kirchhoff's Laws. 1.4 Voltage and current sources. Font conversion. 1.5 Voltage and current dividers. 1.6 Serial and parallel association. 1.7 Analysis of circuits by nodes and meshes. 1.8 Theorems of Thévenin and Norton.
Unit 2. Alternating current circuits	The objective of this topic is to study the techniques of analysis and resolution of basic alternating current circuits. 2.1 Periodic waveforms and associated parameters. 2.2 Phasorial representation. 2.3 Impedance and admittance concept. Elements of the circuit: Resistance, Capacitor and Inductor. 2.4 Active, reactive and apparent power. Triangle of powers. Power factor 2.5 Analysis of alternating circuits
Unit 3. Three-phase current circuits	This topic aims to study the techniques of analysis and resolution of basic circuits in three-phase current. 3.1 Definition and origin of three-phase systems. 3.2 Star-delta connection. 3.3 Balanced three-phase systems. 3.4 Power in three-phase systems. Measuring systems. 3.5 Power factor. Definition, use and correction.
Unit 4. Direct current machines	The objective of this topic is to understand the operation, parameters basic and utilities of a DC machine. 4.1 Basic constituent elements and operating principle. 4.2 Switching. Reaction of the armature. 4.3 Power balance and losses. 4.4 Excitation and equivalent circuits. Torque-speed curves. 4.5 Inversion of the direction of rotation and speed regulation.
Unit 5. Transformers	This topic aims to understand the operation, basic parameters and uses of a transformer. 5.1 Principle of operation of transformers and main parts 5.2 Real transformer. Equivalent circuit. 5.3 Running regime. 5.4 Open and short circuit tests. 5.5 Losses and performance. 5.6 Excitation and connection current. 5.7 Constructive characteristics.

Unit 6. Asynchronous machines	This topic aims to understand the operation, parameters and utilities of an asynchronous machine. 6.1 Principle of operation. Fundamental parts. 6.2 Equivalent circuit. 6.3 Open and short circuit tests. 6.4 Power balance. Rotational torque and maximum torque. 6.5 Start-up. Speed regulation
Unit 7. Synchronous machines	This topic aims to understand the operation, parameters and utilities of a synchronous machine. 7.1 Principle of operation. Fundamental parts. 7.2 Types of excitation. 7.3 Linear and non-linear analysis. Equivalent circuit. 7.4 Alternator. Characteristics and applications. 7.5 Active and reactive power. 7.6 Balance of power, performance and torque. 7.7 Starting a synchronous motor
Practices Block I	Practices related to electrical circuits The aim of this group of practices is that the student understands the basic concepts of continuous, alternating and three-phase circuits, as well as a methodology for solving them. To do this, electronic instrumentation equipment will be used, as well as basic circuits assembled on prototyping boards. In the practices of this block it will be proposed the assembly and analysis of electrical diagrams whose operation is not known a priori. Practice 1: Dangers of electric current. Protection measures. Introduction to the handling of instrumentation equipment and assembly of basic DC circuits. This practice has a double objective. In a first part, the student will be taught the precautions to be taken when handling electrical circuits, making him aware of the dangers related to electric current, presenting him the basic electrical safety measures, the operation of protection and safety devices, and teaching him how to manage the danger. In the second part of the practicum, the student will be familiarized with the instrumentation equipment of the Electrical Engineering Laboratory by assembling basic DC circuits on a prototyping board (or breadboard). These circuits will include basic assemblies for measuring voltages in series and parallel, as well as voltage and current dividers. Practice 2: Assembly of direct current circuits This practice aims to make more advanced circuits and aims to have the student experiment with resistive elements and sources on a prototype board. The student will check concepts seen in theory like Ohm's law, Thevenin's theorem, Boucherot's theorem, etc. Practice 3: Assembly and measurement of alternating current circuits In this practice, the assembly of alternating current circuits is carried out in prototyping board, as well as learning how to use the functions and make measurements with the oscilloscope. Practice 4: Simulation of PSIM circuits in alternating current The student will learn how to analyze a circuit in AC by means of the PSIM circuit simulation software. Practice 5: Three-phase energy systems The objective of this practice is to introduce students to the use of real three-phase systems. The sources in the lab will be used to feed passive loads and measure their consumption parameters with three-phase measuring equipment.

Practices Block II	The purpose of this group of practices is for the student to understand the basic concepts of motors and electric machines. Panels with different electrical machines will be used, as well as simulation software. In the practices of this block, tests or assemblies of machines without previous assembly guide will be proposed. Practice 6: Dangers of electrical machines. Protection measures. Tests on single-phase transformer. The objective of this practice is twofold. In the first part, the student will be taught the precautions to be taken when working with electrical machines, explaining the basic safety measures, the operation of the protection and safety devices, and teaching him how to manage the danger. In the second part of the practical, the student will learn the main characteristics of a single-phase transformer. For this purpose, he/she will experimentally determine the parameters that govern its operation, using the so-called open and short-circuit tests. The student must be able to carry out the appropriate assembly for the realization of these tests, measuring voltages, currents and powers. From the result of the measurements, the student must be able to interpret the obtained data and get from them the necessary information to know and quantify the different power losses in a real transformer. With these data the student must construct the equivalent model of a real transformer. Practice 7: Three-phase asynchronous motor. The objective of this practice is the assembly of a three-phase asynchronous motor in star and delta. The student must reason and select the correct configuration for the power source available in the laboratory and perform the perform the start-up of the motor. The values obtained for speed and consumption will be compared with the values provided by the manufacturer.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	28	38	66
Laboratory practical	14	7	21
Seminars	7	3	10
Seminars	15	15	30
Essay questions exam	13	10	23
*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 master classes. In these sessions, the basic theoretical contents of the programme will be explained in detail, giving explanatory examples with which to deepen the understanding of the subject. Computer presentations and blackboard will be used. A copy of the slides will be given to the students prior to the exhibition, focusing lecturer's and student's efforts in the understanding of the topics. Anyway, the paper reproductions of slides should never be considered as substitutes for texts or notes, but as complementary material.
Laboratory practical	Practical set-ups corresponding to the contents seen in the classroom will be carried out in the laboratory, or complementary aspects not covered in the theoretical classes will be treated. The methodology used consists of the lecturer supervising the work carried out by the different groups into which the students are divided. The laboratory practices are aimed at reinforcing the theoretical concepts covered in the classroom sessions.

Seminars	Since the tutorial action is approached as a group support action to the learning process of the student, these sessions, carried out in seminars and under the format of small group meetings, will serve to solve questions and to raise problems and exercises that will be solved by the students themselves. As far as possible, the problems will have a realistic orientation, trying to bring them closer to solving real situations involving other engineering disciplines such as traction/propulsion, industrial processes, production and manufacturing, etc. In this way, students will have a more transversal vision of the subject and will see how it can help to solve problems of other disciplines.
Seminars	Intensive course that is carried out as preparation for the extraordinary exams.

Personalized assistance

Methodologies	Description
Lecturing	Personalized answers to questions related to the exhibition by the teacher of the contents of the subject matter, theoretical bases and/or guidelines of a work or exercise that the student has to develop.
Seminars	In the field of tutorial action, there are academic tutoring actions as well as tutorial personalized actions. In the first case, students will have at their disposal tutorials to solve any question related to the contents, organization and planning of the subject, development of projects, etc. Tutorials can be individualized, but group tutoring is encouraged to solve problems related to the activities to be carried out in a group, or simply to inform the lecturer about the evolution of collaborative work. In the personalized tutorials, each student, individually, will be able to comment with the lecturer any questions he may have, problems that are preventing him from following up on the subject properly, in order to find some kind of solution. The aim of combining both types of tutorial action is to compensate the different learning rates through attention to diversity. The lecturers of the course will personally answer the questions and queries of the students, according to the timetable that will be published on the centre's website, and through telematic means (e-mail, videoconference, Moovi forums, etc.) by appointment.
Laboratory practical	Individual attention will be given to the implementation activities of the knowledge in a given context and the acquisition of basic and procedural skills on the subject.

Assessment

Description	Qualification	Training and Learning Results

Lecturing	The final grade will be determined from the grades obtained in: 1. Continuous evaluation, through the assessment of practical work and activities proposed throughout the course. 2. Final evaluation, by means of examinations carried out in the calls and dates set by the University and the Centre. In the framework of the continuous evaluation, it will be a first theoretical partial examination of the contents seen so far (circuits of direct and alternating current). This test will account for 15% of the total grade final of continuous assessment, there being no minimum score on this test. Before the final exam of the course, a second exam will be taken with contents related to three-phase systems and electrical machines seen up to that point. This test will account for 15% of the total the final mark for continuous assessment, there being no minimum mark in this proof. Throughout the four-month period, they will take place at different times, short questionnaires to check follow-up and commitment to subject by the students. The tests will be carried out with the support of the platform for the subject's tele-education. These tests will involve in total 10% of the final mark for continuous assessment, with no minimum mark. At the end of the four-month period, a final exam will be taken that will cover the all the contents of the course, both theoretical and practical, and which may include multiple choice tests, reasoning questions, resolution of problems and development of case studies. The examination, which will account for 40 per cent of the final continuous assessment score, will be based on the assessment of problem-based learning by the parties to the Block I: Circuit Theory (Direct Current, Alternating Current and three phase) and Block II: Electrical Machines. It will be distributed in trouble and/or theoretical questions, which can be about the theory and seminars seen in the classroom or about the practices seen in the laboratory. In order to pass the course, a mark of 5.0 points out of 10 will be required in the computation of the final Continuous Evaluation Note (NEC). Additionally is required: - A minimum of 40% of the score assigned to Block I (Theory of Circuits) - A minimum of 40% of the score assigned to Block II (Machines Electrical) Those students who do not reach the minimums established in any of the two parts, must be submitted to the Ordinary Examination. In this case, your the final continuous evaluation note (NEC) will be calculated as: NEC = min {4.0, NEC}	80	B3 C10	D1 D2 D14 D16
Laboratory practical	Laboratory practical will be evaluated on the basis of the work done by the student during the practice sessions and by evaluating the technical reports produced at the end of each one. The grade for this block of practices will represent 20% of the total grade end of continuous evaluation. The student must reach 40% of the score assigned to the practices of each of the blocks of the subject.	20	B3 C10	D1 D6 D10 D16 D17

Other comments on the Evaluation

Qualification Assurance Plan

Recovery plan of the final qualification in the First Call

This plan consists of the right to take a new exam, called the Ordinary exam, on the dates set by the centre, which will replace, if it is higher, the score previously obtained and will count for all purposes in the calculation of the final grade of the first call. This exam will be open to those students who:

- Have not passed the subject during the Continuous Assessment (NEC < 5.0)
- Wish to improve the grade obtained by the Continuous Assessment method.
- Have not fulfilled the ethical commitment that is developed below.

The ordinary examination will be based on the evaluation of problem-based learning in the parts of Block I: Circuit Theory (direct current, alternating current and three-phase current) and Block II: Electrical Machines. The practice part will also be evaluated with a test based on the circuit and machine simulation tool that will be used during the course.

The ordinary examination will contain a theoretical part and a practical part. The student will pass the course when the Note of the Ordinary Examination (NEO) is greater or equal to 5.0 points out of 10, being also necessary to overcome the minimums established in the following table:

Minimum Score		
Theory (T) 80%	Block I	40%
	Block II	40%
Practice(P) 20%	Blocks I+II	40%

Once the minimums for each of the parts are exceeded, the NEO will be calculated as:

NEO = 0.8-T + 0.2-P

If the minimums are not passed, the score of the ordinary examination will be calculated as:

NEO = min {4.0, NEO}

Finally, the corresponding First Call Note (NPC) will be calculated from the Note of the Ordinary Examination (NEO) and the Note of the Continuous Evaluation Examination (NEC) as

NPC = max {NEC, NEO}

Recovery plan of the final qualification in the Second Call

Students who have not passed the subject during the first call have the right again to a second exam, called Extraordinary or Second Call, on the dates set by the centre. It is understood that the mark obtained in the exam replaces, if it is higher, the mark obtained in the ordinary or first call exam. This exam will contain a practical part, in addition to the theoretical part. The evaluation system will be governed by the same scales and weightings as those established for the ordinary exam, so that the student will pass the subject when the score of the Extraordinary Examination (NEE) is greater than or equal to 5.0 points out of 10. Once the minimums for each of the parts have been passed, the Extraordinary Examination Note (NEE) will be calculated as:

NEE = 0.8-T + 0.2-P

If the minimums are not passed, the score of the extraordinary examination will be calculated as:

NEE = min {4.0, NEE}

Plan to improve the final rating

Each and every student can access a plan to improve their final grade. The improvement plan consists of the right to take a new exam, coinciding with the ordinary or first call exam, on the dates set by the centre, whose grade will replace the one previously obtained, as long as it is higher than the one already obtained, and will count for all purposes as the only reference in the calculation of the final grade. It is understood that the mark obtained in the exam, in the event that it is higher than the mark obtained through the continuous assessment of the subject throughout the four-month period, replaces the aggregation of the marks of the partial tests of continuous assessment, the practice marks, the marks of the short questionnaires and the final exam of the subject.

Ethical commitment

If unethical behavior (cheating, plagiarism, use of unauthorized electronic devices or others) is detected, either during a written test or in the completion of practice reports, you will be penalized as follows:

- *Continuous evaluation*: Given the diverse teaching methodology followed to evaluate each of the two blocks that make up the subject, different considerations will be taken into account. In this way:
- *Scoring tests (partial exams, short questionnaires and final exam)*: All points obtained up to this point will be automatically eliminated, without the possibility of recuperation, and will be excluded from the continuous assessment method. The student must pass the subject in the ordinary exam.

Practice reports: all students involved in copying all or part of a report (at the discretion of the subject's teachers) will be penalized in the final grade of the practice block with a mark of 0.0.

Ordinary exam: A grade of 0 will be given in all parts of the exam, and students must take the extraordinary exam.

Extraordinary exam: A grade of 0 will be given in all parts of the exam.

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Recommendations
Subjects that continue the syllabus
Electronic technology/P52G381V01301 Fundamentals of automation/P52G381V01401 Naval engines and machines/P52G381V01409

Other comments

The subject Fundamentals of Electrical Engineering has no associated prerequisites. However, in order to take this course successfully, the student must have:

- Written and oral comprehension skills
- Ability of abstraction, basic calculation and synthesis of information
- Skills for group work and group communication
- At least basic notions acquired in the subjects of Physics II and Mathematics.

The most common learning difficulties are linked to a lack of such knowledge, but it can be overcome with a little effort and the means of this Centre

IDENTIFYING DATA				
Mechanism and machine theory				
Subject	Mechanism and machine theory			
Code	P52G381V01206			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	Pérez Vallejo, Javier			
Lecturers	Cacabelos Reyes, Antón González Gil, Arturo Pérez Vallejo, Javier			
E-mail	jvallejo@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The main objective of the subject will be to provide students with knowledge of the principles of the Theory of Machines and Mechanisms, collecting such competence from the Ministerial Order CIN/351/2009 that establishes the requirements for the verification of the degrees that enable for the exercise of the profession of Industrial Technical Engineer. This subject will develop said competence, allowing the knowledge acquired to develop subsequent competences in other subjects.			

Skills	
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.
C13	Knowledge of the principles of the theory of machines and mechanisms.
D2	Problems resolution.
D6	Application of computer science in the field of study.
D9	Apply knowledge.
D10	Self learning and work.
D16	Critical thinking.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Know the basic foundations of the Theory of Machines and Mechanisms and their application in Mechanical Engineering to solve the problems related with said matter in the field of Industrial Engineering.	B3 B4	C13	D2 D9 D10 D16
Know, understand, apply and practice the concepts related to the Theory of Machines and Mechanisms.		C13	D2 D9 D10 D16
Know and apply the techniques of kinematic and dynamic analysis of mechanical systems.		C13	D2 D9 D10 D16
Know and use mechanism analysis software effectively.		C13	D2 D6 D9 D10 D16
ENAEE learning outcome: 1. KNOWLEDGE AND UNDERSTANDING. 1.2.- 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).	B3	C13	

ENAEE learning outcome: 2. ENGINEERING ANALYSIS. 2.2. 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. Level of achievement: Advanced (3).	B4	D2 D9 D16
ENAEE learning outcome: 3. ENGINEERING DESIGN. 3.1. Ability to develop and design complex products (devices, artefacts, etc.), processes and systems in their field of study to meet established requirements, that can include an awareness of non-technical, societal, health and safety, environmental, economic and industrial considerations; to select and apply relevant design methodologies. Level of achievement: Basic (1).	B4	D2 D9
ENAEE learning outcome: 5. ENGINEERING PRACTICE. 5.3. Understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study. Level of achievement: Basic (1).		D6 D9

Contents

Topic	
Unit 1: Introduction to the topology of mechanisms.	- Basic concepts: link, kinematic pair, kinematic chain, mechanism, machine. - Types of mechanisms. - Degrees of freedom. - Four bar mechanisms. Theorem of Grashof.
Unit 2: Analysis of positions and displacements.	- Graphic method. - Grafic-analytical method. - Analytical method: closed-loop equations.
Unit 3: Analysis of velocities.	- Elementary movements: rotation and translation. - Analysis of relative velocities. - Calculation of instantaneous centres of rotation. - Graphic method. - Analytical method.
Unit 4: Analysis of accelerations.	- Elementary movements: rotation and translation. - General movement with relative velocity, acceleration of Coriolis. - Relation between the acceleration of two points of the same element. - Graphic method. - Analytical method.
Unit 5: Analysis and synthesis of real mechanisms.	- Schematization of mechanisms. - Inversions. - Mechanical advantage.
Unit 6: Statics.	- Foundations. - Reduction of systems of forces to a point.
Unit 7: Dynamics of planar motion.	- Dynamically equivalent systems. - Inertia forces in planar motion, D'Alembert's principle.
Unit 8: Dynamics of rotary motion.	- Static balancing. - Dynamic balancing. - Balancing analysis.
Unit 9: Dynamic regulation of mechanisms: the flywheel.	- Analysis of machines with cyclic operation. - The flywheel as a control system of cyclic motion. - The flywheel as an energy storage system.
Unit 10: Cams.	- Cam and follower mechanism: types. - Displacement diagram and bond curves. - Kinematic analysis of the movement. - Graphic design of cam profiles.
Unit 11: Gears.	- Transmission mechanisms: generalities. - Types of gears and applications. - Main parameters of the spur gear geometry. Normalisation. - Fundamental law of gearing and gear ratio. - Strengths and power transmission of the spur gears. - Gear trains.

Laboratory practices (PL).	PL1.- Analysis of machinery. PL2.- Assembly and kinematic analysis of basic mechanisms. PL3.- Kinematic analysis of real mechanisms by means of simulation software. PL4.- Dynamic analysis of basic mechanisms by means of simulation software. PL5.- Defence of the project on design of a mechanism. PL6.- Kinematic analysis and design of cams. PL7.- Assembly and analysis of gear trains.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	35	63
Laboratory practical	14	7	21
Seminars	7	7	14
Problem solving	15	15	30
Mentored work	3	9	12
Essay questions exam	10	0	10

*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 lecture sessions, the foundations of each topic are explained. The students can access to the topic information in the bibliography books or the lecture slides uploaded in the subject repository.
Laboratory practical	In the laboratory sessions, the students apply the theory to problem resolution. A series of practices are proposed in accordance with the topic to settle the concepts. Hence, the creative proposal of solutions is promoted.
Seminars	In the seminar sessions, a series of applied exercises are proposed for the students to solve, either individually or in groups, under the supervision of the lecturer.
Problem solving	Intensive course for those students who have failed the subject in ordinary call, prior to the exam in extraordinary call. Group tutoring with the lecturer. Assessment tasks and reinforcement hours.
Mentored work	The students will have to make and expose a group project on the design of a mechanism.

Personalized assistance

Methodologies	Description
Seminars	In the scope of the tutorial action, we distinguish actions of academic tutoring and personalised tutoring. The students will have at their disposal hours of academic tutoring in which they will be able to ask any question related to the contents of the subject, its organisation, evaluation, etc. These tutorials can be individualised or in a group. Notwithstanding, group tutorials will be encouraged for solving problems or clarifying different contents of the subject. In addition, the lecturer will be available for the student to comment or ask for advice on any circumstance that prevents him/her from adequately following the subject (personalised tutorials). With the combination of these two types of tutorial action, we aim to achieve an academic-personal balance that allows the student to achieve their goals in the most effective way. The faculty of this subject will be available for tutorials in the schedule published on the website of the centre, as long as the students confirm in advance by email their interest in attending them. However, the students may arrange a tutorial with the lecturer at any time (not necessarily in this schedule). Finally, the teaching staff will be able to answer the students' questions by telematic means (email, videoconference, forums on the online teaching platform, etc.).

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	Practice Reports (MP): Reports to be delivered for each laboratory practice (if the practice is carried out in a group, only one group memory will be delivered). Each report will be scored out of 10 points. The MP grade will be the average value of the grades obtained in each report delivered and will represent 10% of the continuous evaluation grade.	10	B3 C13 D2 B4 D6 D9 D10 D16
Seminars	Assessable Exercises (EE): Resolutions of problems to be delivered that will be proposed along the course (in particular in the seminar hours). Each exercise will be scored out of 10 points. The EE grade will be the average value of the grades obtained in each exercise delivered and will represent 10% of the continuous evaluation grade.	10	B3 C13 D2 B4 D9 D10 D16

Mentored work	Group Project (TG): Common project consisting of the delivery of a report and an oral presentation. The project will be scored out of 10 points. The TG grade will represent 10% of the continuous assessment grade.	10	B3 B4	C13	D2 D6 D9 D10 D16
Essay questions exam	Partial Tests (PP): Two written tests (theoretical questions and problems) that evaluate the contents taught to date. These tests will be interspersed with theory sessions during the quadmester. Each test will be scored out of 10 points. The PP1 (15%) and PP2 (15%) grades will represent 30% of the continuous assessment grade. Final Test (PF): Written tests (theoretical questions and problems) that evaluate the entire subject. This test will take place at the end of the quadmester. The final test will be scored out of 10 points. The note PF will represent 40% of the continuous assessment grade.	70	B3 B4	C13	D2 D9 D10 D16

Other comments on the Evaluation

The student will have two calls to pass the subject: the ordinary and the extraordinary call. In the ordinary call, two options are considered to pass the subject: passing by continuous assessment or passing a final exam (ordinary exam), which will include all the contents of the subject. In case of failing the first call, the student will be able to pass the subject by passing the extraordinary exam, which will also include all the contents of the subject.

A numerical grading system with values between 0 and 10 will be used, according to the current legislation (R.D. 1125/2003 de 5 de septiembre, B.O.E. nº224 de 18 de septiembre).

Ordinary call: continuous assessment

The continuous assessment method (EC) will assess the results achieved by students in the different activities carried out throughout the course, grouping into five parts: Final Test (PF), Partial Tests (PP), Practice Reports (MP), Assessable Exercises (EE), and Group Project (TG). The grade of each part will be calculated as the arithmetic mean of the items made up to the moment of the evaluation in that part.

There will be two Partial Tests (PP) throughout the course. These continuous assessment tests will be interspersed with theory sessions during the quadmester. The student must present a report for each laboratory practice if indicated during the session, which will be evaluated in item MP. In the seminar and/or theoretical class hours, the student may be offered the completion and delivery of different exercises, which will be evaluated in item EE. In the event that a student cannot attend a session in which an evaluable exercise is carried out due to force majeure, he or she must notify the teachers by email so that it is recorded and this circumstance is taken into account at the assessment time. In addition, students must carry out and present a group project on the design of a mechanism (see laboratory practice PL5) that will be assessed in item TG. The final continuous assessment test (PF) will include all the contents of the subject and will have a weight of 40% in the final grade of continuous assessment.

The grade of the continuous evaluation (NEC) will be the result of applying the weighted arithmetic mean of the grade of each of the parts (PF, CT, MP, EE and TF), as reflected below:

$NEC = 0{,}40 \cdot PF + 0{,}15 \cdot PP1 + 0{,}15 \cdot PP2 + 0{,}10 \cdot MP + 0{,}10 \cdot EE + 0{,}10 \cdot TG$

To pass the subject by continuous assessment, three conditions must be met: i) having carried out all the evaluable tasks (except in duly justified cases); ii) having a score of at least 4 points out of 10 in the final continuous assessment test (PF); iii) having a value of NEC greater than or equal to 5. In case of breaching any of the first two conditions, the student's grade will be the minimum between their NEC and a 4, then obtaining a failure grade in the continuous assessment of the subject.

Ordinary call: ordinary exam

Those students who do not pass the subject through the continuous assessment method must take the ordinary exam, where all the competences of the subject will be assessed. The results of this exam will represent 100% of the student's final grade, being an essential requirement to pass the course to obtain a grade greater than or equal to 5 points out of 10. Finally, it should be noted that all students have the option of improving their grade obtained by continuous assessment (NEC) taking the ordinary exam.

Extraordinary call

Students who have not passed the subject in the ordinary call will take an extraordinary exam that will have the same format and the same requirements as the ordinary exam.

Ethical commitment

In their double condition of military and student of the University of Vigo, students are subject to the obligations derived from both institutions. As regards a university student, the University Student Statute, approved by Real Decreto 1791/2010 de 30 de diciembre, establishes in its article 12, point 2d, that the university student has the duty to abstain from using or cooperation in fraudulent procedures in assessment tests, in the work carried out or in official university documents. Likewise, the LCM, in its article 4 concerning the rules of behavior of the military, establishes in its fifteenth rule that the latter will carry out his duties and obligations exactly, driven by the feeling of honor, ...

Therefore, the student is expected to have adequate ethical behavior. If during the course unethical behavior is detected in the performance of any evaluable test or exercise (cheating, plagiarism, use of unauthorized electronic devices or others), the student in question will not pass the subject by continuous evaluation (in which he will obtain a rating of 0.0). Likewise, if this type of behavior were detected in the ordinary exam or in the extraordinary exam, the student would obtain a grade of 0.0 in such call.

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P. Lafont, A. Díaz Lantada, J. Echevarría Otero, **Diseño y cálculo de transmisiones por engranajes**, ETSII Universidad Politécnica de Madrid, 2009

Recommendations

Other comments

The student is required to have skills in the field of differential calculus, vector calculus and kinematics and dynamics calculus of the point and the solid. The knowledge acquired will in turn be necessary to properly study other subsequent subjects of the same Degree, such as Machine Design.

IDENTIFYING DATA				
Environmental technology				
Subject	Environmental technology			
Code	P52G381V01207			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	Maceiras Castro, María del Rocío			
Lecturers	González Gil, Lorena Maceiras Castro, María del Rocío			
E-mail	rmaceiras@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This syllabus collects the competencies that the students must acquire in this course, the calendar of planned educational activities, the contents and its distribution, an estimate of the volume of work of the student and the specific criteria of assessment. The aim of this subject is to form future graduates in Bachelor Mechanical Engineering with the ability to identify the environmental impacts of industrial and human activities, with the aim to minimize, prevent and solve them. In fact, the increase in legal requirements related to environmental protection, together with the interest of society in the application of more environmentally friendly technological solutions enhance the need for professionals capable of solving environmental problems within multidisciplinary contexts. To achieve this, in this subject it is carried out an approach to Environmental Engineering in combination with other knowledge fields, such as Mechanical Engineering (equipment design), Chemistry (study of pollutants and their behavior), Biology (biotechnological processes) and Process Engineering (design of physical, chemical and biological processes to mitigate contamination). More specifically, in this subject some technical and practical knowledge about environmental pollution in different ecosystems and their flows of matter and energy will be needed, to later study all the vectors of pollution and evaluate the most appropriate technologies to minimize them, complying whit the current legislation. Lastly, basic knowledge is given on the main policies, tools and indicators developed within the framework of environmental management for the prevention of industrial pollution.			

Skills	
Code	
B7	Ability to analyze and assess the social and environmental impact of the technical solutions.
C16	Basic knowledge and application of environmental technologies and sustainability.
D1	Analysis and synthesis
D2	Problems resolution.
D3	Oral and written proficiency
D9	Apply knowledge.
D10	Self learning and work.
D12	Research skills.
D17	Working as a team.
D19	Sustainability and environmental commitment. Equitable, responsible and efficient use of resources.

Learning outcomes		
Expected results from this subject	Training and Learning Results	
To know the available environmental technologies for control of gaseous pollutants	C16	D2 D3 D10
To know the basic processes for the conditioning of water and wastewater treatment	C16	D2 D3 D10
To know the performance of wastewater treatment plants	C16	D2 D3 D10
To know the integrated process of industrial waste treatment	C16	D2 D3 D10 D19

To know and be able to apply the different tools for preventing industrial pollution		C16	D1 D2 D3 D9 D10 D12 D17 D19
Ability to analyze and determine the social and environmental impact of the technical solutions to environmental problems	B7		D1 D3 D9 D10 D17 D19
ENAEE LEARNING OUTCOME. KNOWLEDGE AND UNDERSTANDING LO1.3.- awareness of the wider multidisciplinary context of engineering (level of development this sub-resulted of learning: Intermediate (2))		C16	
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))	B7		D1 D2 D9 D19
ENAEE LEARNING OUTCOME. ENGINEERING DESIGN LO3.1.- ability to develop and design complex products (devices, artefacts, etc.), processes and systems in their field of study to meet established requirements, that can include an awareness of non-technical societal, health and safety, environmental, economic and industrial considerations; to select and apply relevant design methodologies (Intermediate (2))	B7		D2 D9 D19
ENAEE LEARNING OUTCOME. INVESTIGATIONS LO4.2.- ability to consult and apply codes of practice and safety regulations in their field of study (Intermediate (2))	B7		
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 (Intermediate (2))			D9 D12
ENAEE LEARNING OUTCOME. ENGINEERING PRACTICE LO5.4.- ability to apply norms of engineering practice in their field of study (Basic (1))	B7		D9
ENAEE LEARNING OUTCOME. ENGINEERING PRACTICE LO5.5- awareness of non-technical societal, health and safety, environmental, economic and industrial implications of engineering practice (Intermediate (2))	B7	C16	D19
ENAEE LEARNING OUTCOME. MAKING JUDGEMENTS 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 (Intermediate (2))	B7		D19

Contents	
Topic	
LESSON 1: INTRODUCTION: IMPORTANCE OF ENVIRONMENTAL TECHNOLOGY IN SOCIETY	1. Pollution and environmental impacts 2. Milestones in environmental protection 3. Environmental catastrophes
LESSON 2: MAIN UNIT OPERATIONS USED IN ENVIRONMENTAL TECHNOLOGY	1. Introduction to the unit operations: concept and classification 2. Separation operations controlled by mass transfer 3. Separation operations controlled by heat transfer 4. Separation operations controlled by heat and mass transfer 5. Separation operations controlled by fluid mechanics 6. Membrane separation processes
LESSON 3: MASS BALANCES IN ENVIRONMENTAL ENGINEERING PROCESSES	1. Mass balances in steady state with and without chemical reaction 2. Mass balances in unsteady state with and without chemical reaction
LESSON 4: ATMOSPHERIC POLLUTION	1. Introduction 2. Types of pollutants 3. Effects of the atmospheric pollution 4. Technical solutions to air emission control
LESSON 5: WATER POLLUTION	1. Introduction 2. Types of pollutants 3. Indicators of water pollution 4. Wastewater treatment technologies
LESSON 6: SOIL POLLUTION	1. Introduction 2. Types of polllutants 3. Remediation techniques

LESSON 7: INTRODUCTION TO SOLID WASTE TREATMENT	1. Introduction 2. Types of solid waste 3. Solid waste treatment technologies
LESSON 8: ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT	1. Introduction to the tools for evaluating the environmental impact 2. Life cycle assessment 3. Environmental management system 4. Prevention and control of the industrial pollution: IPPC directive and PRTR regulation
Practice 1. Sedimentation	The objective of this practice is to determine the sedimentation rate of particles contained in a wastewater in order to design a sedimentation tank.
Practice 2: Coagulation - Flocculation	To improve sedimentation efficiency during wastewater treatment, in many cases, it is necessary to previously perform coagulation followed by flocculation. These processes are optimized in the laboratory.
Practice 3: Analysis of the main pollutants in wastewaters	In this practice, some of the key parameters in the contamination of a water are experimentally measured, such as the chemical oxygen demand and the concentration of sulfates, phosphates and chlorides.
Practice 4: Determination of the solids content of a water	The objective of the previous practice is complemented determining the solid content of a wastewater.
Practice 5: Extraction with solvents	This solid-liquid extraction practice is carried out in order to get the student familiarized with the chemical processes used to separate contaminants from a soil.
Practice 6: Introduction to the simulation software DWSIM	In this practice, it is used the chemical process simulator DWSIM (open source). The student will become familiar with the simulation tool and will carry out different examples such as conversion reactors, balance reactors, condensers and simple distillation columns.
Practice 7: Classification and labeling of solid waste	In this practice, the students familiarize with the regulations related to the classification and labeling of both hazardous and non-hazardous solid waste. In addition, it is addressed the importance of waste classification for worker safety and health and for society in general.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	31	59
Laboratory practical	14	7	21
Problem solving	7	7	14
Seminars	15	15	30
Objective questions exam	4	0	4
Essay	0	5	5
Problem and/or exercise solving	0	2	2
Essay questions exam	3	2	5
Essay questions exam	3	2	5
Essay questions exam	3	2	5

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

Methodologies

	Description
Lecturing	Teaching in the classroom of the key concepts and procedures for learning the syllabus contents. In addition to the information published on the online teaching platform, which contains the file with the lesson slides, the students have in the recommended bibliography the contents of each leasson with a more detailed development.
Laboratory practical	Application of the knowledge acquired to the resolution of problems of environmental technology. A series of practices have been designed in accordance with the content of the subject in order to fix concepts explained in this class.
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
Laboratory practical	Academic tutoring and personalized tutoring.

Lecturing	In the scope of the tutorial action, it can distinguished between academic tutoring actions and personalized tutoring. Both types of tutorial action are combined to compensate for the different learning rhythms and thus paying attention to diversity. The lecturers of the subject will solve the questions and queries of the students in person or online (via email, videoconference, MOOVI, forums, etc.) at the time scheduled on the website of the center or by appointment.
Seminars	Academic tutoring and personalized tutoring.
Problem solving	Academic tutoring and personalized tutoring.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	Evaluation of the work in the laboratory and of the summary report with the data obtained in the practices, its analysis and discussion. At the end of each practice, the student must prepare a detailed report including aspects such as: objectives and theoretical fundaments of the practice, experimental procedure, materials used, the results obtained and their discussion. In addition, the comprehension of the practice, the student's synthesis capacity, the writing style and the presentation of the report, as well as the student's personal contribution, are evaluated. These reports will be compulsory and rated, each of them, on 10 points, and represent 10% of the continuous assessment. In addition, an exam corresponding to laboratory practices (5%) will be carried out.	15	B7 C16 D1 D3 D9 D12 D17 D19
Objective questions exam	The theoretical and practical knowledge acquired by the student during the masterclasses and seminars will be monitored. There will be two continuous assessment tests of theory and problems (P1 and P2), with a weight of 15% each. Such tests will be compulsory and scored on 10 points.	30	B7 C16 D1 D2 D3 D9 D10 D12 D17
Essay	The students, in pairs or groups of 3, will carry out a written essay on contents related to Topic 8 "Environmental impact assessment and management" or on key aspects of other lessons that it is appropriate to further study. Part of the work will focus on seeking the real application of the addressed topic in different industrial or social fields, evidencing the multidisciplinary application of environmental engineering. Moreover, the students will have to reflect on the ethical and social implications of the studied content. Finally, each group will present their work orally and the peer-assessment among students will be encouraged.	5	C16 D1 D3 D9 D10 D12 D17 D19
Problem and/or exercise solving	During class hours, individual tasks (TI, 5%) and activities to promote the student learning (TO, 5%), that may be individuals or in groups and they will be proposed in order to monitor the contents taught. These activities will be compulsory and scored, each of them, on 10 points.	10	C16 D1 D3 D9 D10 D12 D17 D19
Essay questions exam	Final Exam (FE) At the end of the course, the knowledge acquired by the student will be evaluated by means of a written test with theoretical contents (4 points) and problems (6 points). Such exam will be compulsory and scored on 10 points.	40	B7 C16 D1 D2 D3 D9 D10 D12 D17
Essay questions exam	Ordinary Exam If the students do not pass the continuous evaluation, they will have an ordinary exam after the final exam. In this exam the students will be evaluated of all the contents taught, both theoretical and practical. It will be necessary to obtain a grade higher than 4 points out of 10 in each of the parts (theory and problems) in such exam. Besides, there will be a test related to the laboratory practices (with a weight of 5%).	100	B7 C16 D1 D2 D3 D9 D10 D12 D17
Essay questions exam	Extraordinary Exam The student will be examined of all the theoretical / practical contents taught in the subject during the ordinary course. In addition, it will be necessary to obtain a grade higher than 4 points out of 10 in each of the parts (theory and problems) evaluated in such exam. Besides, there will be a test related to the laboratory practices (with a weight of 5%).	100	B7 C16 D1 D2 D3 D9 D10 D12 D17

Other comments on the Evaluation

Minimum requirements to pass the continuous evaluation: the student must obtain a minimum of 5 in his/her total grade. In addition, the students will have to attend to the ordinary exam to pass the course in the following cases:

- The non-completion or delivery of any of the proposed tests/activities.
- If the obtained grade is lower than 4 points out of 10 in some of the parts (theory and problems) of the Final Exam.

Those students that do not fulfil any of the previous requirements will have a maximum grade of 4.0 in the continuous evaluation. All those students that have passed the continuous evaluation, but wish to improve their qualification, could attend to the ordinary exam.

ETHICAL COMMITMENT:

It is expected that the students have an adequate ethical behaviour.

- If it is detected an unethical behaviour (cheating, plagiarism, use of unauthorised electronic devices or others) during the final or partial exams, the student will be punished with the impossibility to pass the subject by the modality of continuous evaluation, obtaining a qualification of 0.0.
- If this type of behaviour is detected in the ordinary or extraordinary exam, the student will obtain a qualification of 0.0.
- In the case of the documents delivered to evaluate the laboratory practices, the total or partial copy in the report (according to the opinion of the teachers of the subject), will be penalized in the final grade of the practices with a qualification of 0.0.

INTENSIVE COURSE:

In the case that the students do not pass the ordinary exam, they have to do the extraordinary examn in July. The CUD-ENM proposes for these students an intensive course during the months of June and July of 15 hours during three weeks to prepare this exam. It will be elaborated a specific educational guide for such course. In the extraordinary exam, the student will be evaluated of all the practical/theoretical contents taught in the subject during the ordinary course. In addition, it will be necessary to obtain a grade higher than 4 points out of 10 in each part (theory and problems) of the exam.

Sources of information

Basic Bibliography

Guillermo Calleja, Francisco García, Antonio de Lucas, Daniel Prats, José M. Rodríguez, **Introducción a la Ingeniería Química**, Sintesis, 2008

Juan J. Rodríguez Jiménez, **La Ingeniería Ambiental: Entre el reto y la oportunidad**, Sintesis, 2002

Stanley E. Manahan., **Introducción a la Química Ambiental**, Reverté, 2007

Complementary Bibliography

Castells et al, **Reciclaje de residuos industriales: residuos sólidos urbanos y fangos de depuradora**, 2ª ed., Díaz de Santos, 2009

Domingo Gómez Orea, Mª Teresa Gómez Villarinio, **Evaluación de Impacto Ambiental**, 3ª ed., Mundi-Prensa, 2013

David M. Himmelblau, **Principios Básicos y Cálculos en Ingeniería Química**, 6ª ed., Prentice Hall Inc., 1997

Gerard Kiely, **Ingeniería Ambiental: Fundamentos, entornos, tecnologías y sistemas**, Mc Graw Hill, 1999

Glynn Henry, Gary W. Heinke, **Ingeniería Ambiental**, 2ª ed., Prentice Hall Inc., 1999

Metcalf & Eddy Inc., **Wastewater Engineering: Treatment and Resource Recovery.**, 5ª ed., Mc-Graw Hill, 2013

Tang Zhongchao, **Air Pollution and Greenhouse Gases: From Basic Concepts to Engineering Applications for Air Emission Control**, (eBook), Springer, 2014

Recommendations

Other comments

It recommends to the students have surpassed the subjects of Physical I, Physical II and Chemistry.

IDENTIFYING DATA				
Mecánica de fluídos				
Subject	Mecánica de fluídos			
Code	P52G381V01208			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	2c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Febrero Garrido, Lara			
Lecturers	Febrero Garrido, Lara Regueiro Pereira, Araceli			
E-mail	lfebrero@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	A materia de Mecánica de Fluídos ten un carácter básico, onde se aplican os principios fundamentais da física e a mecánica á materia fluída. Trátase de que os alumnos da titulación de grao en enxeñaría mecánica adquiran os coñecementos e ferramentas necesarias para saber analizar e comprender problemas fluídos de distinta categoría, para servir de apoio a outras materias do plan de estudos relacionadas coas propiedades e o movemento dos fluídos, de carácter tanto básico como máis orientadas a problemas reais no campo da enxeñaría. Foméntase así mesmo o desenvolvemento de habilidades e competencias xenéricas como o traballo en equipo e a aprendizaxe autónoma. A Mecánica de Fluídos describe os fenómenos físicos relevantes do movemento dos fluídos, describindo as ecuacións xerais dos devanditos movementos. Este coñecemento proporciona os principios básicos necesarios para analizar calquera sistema no que o fluído sexa o medio de traballo. O campo de aplicacións da Mecánica de Fluídos en enxeñaría é moi amplo: transporte de fluídos en condución, aeronáutica, motores, barcos, fluxos biolóxicos, etc. Os principios da Mecánica de Fluídos son necesarios para campos tan diversos como: - Deseño de maquinaria hidráulica. - Lubricación. - Sistemas de calefacción e ventilación, calor e frío. - Deseño de sistemas de tubaxes. - Medios de transporte: transmisión, climatización, sistema de escape, aerodinámica e hidrodinámica, refrixeración, etc. - Aerodinámica de estruturas e edificios - Centrais térmicas e de fluídos de produción de enerxía convencionais e renovables			

Competencias	
Code	
B4	Capacidade de resolver problemas con iniciativa, toma de decisións, creatividade, razoamento crítico e de comunicar e transmitir coñecementos, habilidades e destrezas no campo da Enxeñaría Industrial na especialidade de Mecánica.
B5	Coñecementos para a realización de medicións, cálculos, valoracións, taxacións, peritaxes, estudos, informes, planes de labores e outros traballos análogos.
C8	Coñecementos dos principios básicos da mecánica de fluídos e a súa aplicación á resolución de problemas no campo da enxeñaría. Cálculo de tubaxes, canais e sistemas de fluídos.
D2	Resolución de problemas.
D9	Aplicar coñecementos.
D10	Aprendizaxe e traballo autónomos.

Resultados de aprendizaxe			
Expected results from this subject	Training and Learning Results		
Entender os principios básicos do movemento de fluídos	B4 B5	C8	D2 D9 D10
Capacidade para calcular tubaxes e canles	B4 B5	C8	D2 D9 D10
Capacidade para manexar medidores de magnitudes fluídas	B4 B5	C8	D2 D9 D10
Capacidade para coñecer e dominar as ferramentas coas que se abordan os problemas de fluxos de fluídos.	B4 B5	C8	D2 D9 D10

RESULTADOS DE APRENDIZAXE ENAEE: 1. COÑECEMENTO E COMPRENSIÓN: Subresultado: 1.2 Coñecemento e comprensión das disciplinas de enxeñaría propias da súa especialidade, no nivel necesario para adquirir o resto de competencias do título, incluíndo nocións dos últimos adiantos. Nivel de desenvolvemento: Adecuado (2)		C8	
RESULTADOS DE APRENDIZAXE ENAEE: 2. ANÁLISE EN ENXEÑARÍA: Subresultado: 2.1 A capacidade de analizar produtos, procesos e sistemas complexos no seu campo de estudo; elixir e aplicar de forma pertinente métodos analíticos, de cálculo e experimentais xa establecidos e interpretar correctamente resultados de devanditas análises. Nivel de desenvolvemento: Adecuado (2)	B4		D2 D9
RESULTADOS DE APRENDIZAXE ENAEE: 2. ANÁLISE EN ENXEÑARÍA: Subresultado: 2.2 A capacidade de identificar, formular e resolver problemas de enxeñaría na súa especialidade; elixir e aplicar de forma adecuada métodos analíticos, de cálculo e experimentais xa establecidos; recoñecer a importancia das restricións sociais, de saúde e seguridade, ambientais, económicas e industriais. Nivel de desenvolvemento: Adecuado (2)	B4		D2 D9
RESULTADOS DE APRENDIZAXE ENAEE: 3. PROXECTOS DE ENXEÑARÍA: Subresultado: 3.1 Capacidade para proxectar, deseñar e desenvolver produtos complexos (pezas, compoñentes, produtos acabados, etc.), procesos e sistemas da súa especialidade, que cumpran cos requisitos establecidos, incluíndo ter conciencia dos aspectos sociais, de saúde e seguridade, ambientais, económicos e industriais; así como seleccionar e aplicar métodos de proxecto apropiados. Nivel de desenvolvemento: Básico (1)	B4 B5	C8	D2 D9
RESULTADOS DE APRENDIZAXE ENAEE: 3. PROXECTOS DE ENXEÑARÍA: Subresultado: 3.2 Capacidade de proxecto utilizando algún coñecemento de vangarda da súa especialidade de enxeñaría. Nivel de desenvolvemento: Adecuado (2)	B4 B5		
RESULTADOS DE APRENDIZAXE ENAEE: 4. INVESTIGACIÓNS E INNOVACIÓN. Subresultado: 4.3 Capacidade e destreza para proxectar e levar a cabo investigacións experimentais, interpretar resultados e chegar a conclusións no seu campo de estudo. Nivel de desenvolvemento: Adecuado (2)		C8	D9
RESULTADOS DE APRENDIZAXE ENAEE: 5. APLICACIÓN PRÁCTICA DA ENXEÑARÍA. Subresultado: 5.2 Competencia práctica para resolver problemas complexos, realizar proxectos complexos de enxeñaría e levar a cabo investigacións propias da súa especialidade. Nivel de desenvolvemento: Adecuado (2)	B4 B5		D2 D9
RESULTADOS DE APRENDIZAXE ENAEE: 5. APLICACIÓN PRÁCTICA DA ENXEÑARÍA: Subresultado: 5.3 Coñecemento de aplicación de materiais, equipos e ferramentas, tecnoloxía e procesos de enxeñaría e as súas limitacións no ámbito da súa especialidade. Nivel de desenvolvemento: Básico (1)			D9
RESULTADOS DE APRENDIZAXE ENAEE: 7. COMUNICACIÓN E TRABALLO EN EQUIPO. Subresultado: 7.2 Capacidade para funcionar eficazmente en contextos nacionais e internacionais, de forma individual e en equipo e cooperar tanto con enxeñeiros como con persoas doutras disciplinas. Nivel de desenvolvemento: Adecuado (2)			D10
RESULTADOS DE APRENDIZAXE ENAEE: 8. FORMACIÓN CONTINUA: Subresultado: 8.1 Capacidade de recoñecer a necesidade da formación continua propia e de emprender esta actividade ao longo da súa vida profesional de forma independente. Nivel de desenvolvemento: Básico (1)			D10
RESULTADOS DE APRENDIZAXE ENAEE: 8. FORMACIÓN CONTINUA: Subresultado: 8.2 Capacidade para estar ao día nas novidades en ciencia e tecnoloxía. Nivel de desenvolvemento: Básico (1)			D10

Contidos	
Topic	
UD I. INTRODUCIÓN	I.1. Conceptos fundamentais. Concepto de fluído I.2. O fluído como medio continuo I.3. Características dos fluídos I.4. Propiedades termodinámicas dun fluído. Fluídos newtonianos e non newtonianos I.5. Viscosidade e outras propiedades secundarias
UD II. FLUIDOESTÁTICA	II.1. Presión e gradiente de presión II.2. Equilibrio dunha partícula fluída II.3. Distribución de presións en hidrostática II.4. Forzas hidrostáticas sobre superficies planas II.5. Forzas hidrostáticas sobre superficies curvas II.6. Flotación e estabilidade II.7. Distribución de presións en movemento como sólido ríxido II.8. Medidores de presión

UD III. FUNDAMENTOS DO MOVEMENTO DE FLUÍDOS	III.1. Propiedades do campo de velocidade. Método Euleriano e Lagranxiano III.2. Patróns de fluxo: liñas de corrente, sendas e liñas de traza III.3. Clases de fluxos III.3.1. Segundo condicións cinemáticas III.3.2. Segundo condicións xeométricas III.3.3. Segundo condicións mecánicas de contorno III.3.4. Segundo condicións do movemento interno III.3.5. Segundo forma de reaccionar ante obstáculos III.4. Sistemas e volume de control III.5. Integrais estendidas a volumes fluídos III.5.1. Teorema do transporte de Reynolds
UD IV. RELACIÓNS INTEGRAIS PARA UN VOLUME DE CONTROL	IV.1. Conservación da masa IV.2. Conservación da cantidade de movemento IV.3. Teorema do momento cinético IV.4. Ecuación da enerxía IV.5. Fluxo sen fricción: a ecuación de Bernoulli
UD V. RELACIÓNS DIFERENCIAIS PARA UNHA PARTÍCULA FLUÍDA	V.1. O campo de aceleracións dun fluído V.2. Ecuación diferencial de conservación da masa V.3. Ecuación da cantidade de movemento en forma diferencial V.4. Ecuación diferencial do momento cinético V.5. Ecuación diferencial da enerxía V.6. Condicións de contorno para as ecuacións básicas V.7. A función de corrente V.8. Vorticidade e irrotacionalidade V.9. Fluxos irrotacionales non viscosos
UD VI. ANÁLISE DIMENSIONAL E SEMELLANZA	VI.1. Parámetros adimensionais VI.2. Natureza da análise dimensional VI.3. Teorema Pi de Buckinghan. Aplicacións VI.4. Grupos adimensionais de importancia na Mecánica de Fluídos VI.4.1. Significado físico dos números adimensionais VI.5. Semellanza VI.5.1. Semellanza parcial VI.5.2. Efecto de escala VI.6. Medidores en fluídos
UD VII. MOVEMENTO LAMINAR CON VISCOSIDADE DOMINANTE	VII.1. Introdución VII.2. Movemento laminar permanente VII.2.1. Correntes de Hagen-Poiseuille VII.2.2. En condutos de sección circular VII.2.3. Outras seccións VII.3. Efecto de lonxitude finita do tubo VII.4. Perda de carga VII.4.1. Coeficiente de fricción VII.5. Estabilidade de corrente laminar.
UD VIII. MOVEMENTO TURBULENTO	VIII.1 Réximes en función do número de Reynolds VIII.2 Modelización da turbulencia VIII.3 Fluxos internos e fluxos externos VIII.4 Perda de carga en fluxos turbulentos en condutos. VIII.4.1. Diagrama de Nikuradse VIII.4.2. Diagrama de Moody VIII.5 Noción de capa límite VIII.6 Fórmulas empíricas para fluxo en tubaxes
UD IX. INTRODUCCION Á CAPA LÍMITE	IX.1 Noción da capa límite IX.2 Ecuacións da capa límite bidimensional incompresible IX.3 Espesor da capa límite
UD X. MOVEMENTOS DE LIQUIDOS EN CONDUTOS DE SECCION VARIABLE	X.1. Introdución X.2. Perdas locais X.2.1. Perda á entrada dun tubo X.2.2. Perda nun tubo á saída X.2.3. Perda por contracción X.2.4. Perda por ensanche X.2.5. Perda en cóbados X.3. Tubaxes ramificadas X.4. Tubaxes en serie X.5. Tubaxes en paralelo X.6. Redes de tubaxes

PRACTICAS DE LABORATORIO	Práctica PL1. Principio de Arquímedes Obxectivos: Determinar o empuxe que sofren os corpos mergullados en líquidos. Práctica PL2. Medición da presión hidrostática Obxectivos: Medición da presión hidrostática cun manómetro en U. Práctica PL3. Ecuación de Bernoulli Obxectivos: Estudo da presión en tubaxe con treitos de diámetro variable e constante pola que flúe líquido. Os tubos verticais indican a presión estática. Práctica PL4. Demostración da medición de fluxos Obxectivos: Comparación da medida do fluxo por medio de diferentes fluxómetros. Medición do caudal de paso con boquilla/diafragma. Medición do caudal de paso con venturímetro. Medición do caudal de paso con fluxómetro flotador. Calibración de fluxómetros Práctica PL5. Demostración de perdas en tubaxes e conectores Obxectivos: Estudo das perdas de presión en tubaxes e accesorios. Determinación do efecto da velocidade de fluxo na perda de presión. Determinación das perdas de presión e liñas características de apertura dos órganos de peche. Determinación dos índices de resistencia. Estudo do funcionamento e principio de diferentes métodos de medición do caudal. Práctica PL6. Traballo tutelado Obxectivos: A partir de problemas expostos polos propios alumnos, seguindo as directrices establecidas polo profesor, os alumnos divididos en grupos deberán realizar un traballo baseado nun persoal preestablecida baseada no Traballo Fin de Grao. Preténdese que se familiaricen con estrutúraa tipo dun artigo científico, o traballo con formatos, referencias, índices, etc., así como a distribución de tarefas, traballo en equipo, etc. Ademais das sesións de prácticas ás que se alude neste punto, tamén se utilizará tempo de sesións de teoría como complemento para o desenvolvemento do traballo. As prácticas de laboratorio ou de aula de informática programadas poderán variar en contidos e en orde dependendo do material dispoñible para a súa realización, así como das necesidades organizativas do curso académico.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	28	28	56
Prácticas de laboratorio	14	14	28
Exame de preguntas de desenvolvemento	5	7	12
Traballo	15	12	27
Exame de preguntas de desenvolvemento	6	7	13
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Lección maxistral	Nestas sesións, explicaranse detalladamente os contidos teóricos básicos do programa, expondo exemplos aclaratorios cos que profundar na comprensión da materia. Utilizaranse presentacións informáticas e a pizarra. Na medida do posible, proporcionarase copia das diapositivas aos alumnos con anterioridade á exposición, centrando o esforzo do profesor e do alumnado na exposición e comprensión dos coñecementos. De todos os xeitos, as reproducións en papel das diapositivas nunca deben ser consideradas como substitutos dos textos ou apuntamentos, senón como material complementario.

Prácticas de laboratorio	Nas clases prácticas aplicaranse os conceptos desenvolvidos en cada tema á realización de prácticas de laboratorio. Deseñáronse unha serie de prácticas (PL1 a PL5) acorde co desenvolvemento da materia de teoría co fin de fixar conceptos explicados nesa clase. Metodoloxías integradas Aprendizaxe baseada en proxectos. Algunhas sesións prácticas (PL6: Traballo tutelado) dedicaranse ao seguimento dos traballos expostos aos diversos grupos nos que se divide o alumnado. Proporcionarase sempre material e bibliografía, aínda que tamén se pretende fomentar a capacidade de procura de información, capacidade de síntese, etc.

Atención personalizada

Methodologies	Description
Lección maxistral	Cada alumno, de maneira individual, poderá comentar co profesor calquera problema que lle estea impedindo realizar un seguimento adecuado da materia, co fin de atopar entre ambos algún tipo de solución.
Prácticas de laboratorio	Cada alumno, de maneira individual, poderá comentar co profesor calquera problema que lle estea impedindo realizar un seguimento adecuado da materia, co fin de atopar entre ambos algún tipo de solución.

Avaliación

	Description	Qualification	Training and Learning Results
Prácticas de laboratorio	A avaliación das prácticas de laboratorio (PL1-PL5) levará a cabo mediante cuestionarios expostos a través de Moodle onde se avaliará ao alumno sobre os coñecementos adquiridos en clase e no laboratorio. A nota das memorias de prácticas (MP) será a media das notas de todos os cuestionarios de prácticas realizados.	15	B4 C8 D2 B5 D9 D10
Exame de preguntas de desenvolvemento	Proba final (PF): A proba PF ten como obxectivo a avaliación da aprendizaxe de todos os contidos teóricos seleccionados para a materia. Confeccionaranse para xulgar o que o alumno sabe de toda a materia. En segundo lugar, debe consistir nunha serie de cuestións que primen o razoamento conceptual e lóxico, a fin de verificar a madurez intelectual dos alumnos para obter conclusións a partir das nocións ou as teorías expostas en clase. A proba final de avaliación continua realizarase na semana de avaliación e valorarase sobre 10 puntos. Será necesario obter unha nota maior ou igual a 4 puntos sobre 10 no exame final de avaliación continua para poder optar ao aprobado por avaliación continua.	40	B4 C8 D2 B5 D9 D10
Traballo	Dado que o traballo tutelado debe ser avaliado de maneira que se garanta a exigibilidade individual e a interdependencia positiva (isto é, todos os membros do grupo deben traballar e contribuído ao produto final e deben dominar, minimamente, todos os aspectos do traballo), na sesión de presentación oral e defensa, intervirán todos os membros do grupo e, calquera membro do grupo debe poder responder a preguntas do traballo, independentemente da parte na que estaba especializado. Todos deben demostrar, por tanto, coñecemento profundo do produto entregado, independentemente da parte na que centrasen os seus esforzos.	15	B4 C8 D2 B5 D9 D10
Exame de preguntas de desenvolvemento	Probas parciais (P1 e P2): As probas parciais P1 e P2 teñen como obxectivo a avaliación da aprendizaxe de todos os contidos teóricos seleccionados para a materia. Confeccionaranse para xulgar o que o alumno sabe dunha parte da materia. En segundo lugar, deben consistir nunha serie de cuestións que primen o razoamento conceptual e lóxico, a fin de verificar a madurez intelectual dos alumnos para obter conclusións a partir das nocións ou as teorías expostas en clase. Realizaranse duas (2) probas parciais de avaliación continua. Cada control suporá un 15% na nota de avaliación continua.	30	B4 C8 D2 B5 D9 D10

Other comments on the Evaluation

Para superar a materia por Avaliación Continua a nota final (NEC) deberá ser maior ou igual a 5 e calcularase do seguinte modo:

NEC = 0,40·PF +0,15·P1 +0,15 P2+ 0,10·TT+0,10·ES + 0,10·MP
O alumno deberá presentarse ao exame ordinario de todos os contidos da materia, que suporá o 100% da nota, si a nota final de avaliación continua é menor que 5 puntos sobre 10.Tamén terá que presentarse ao exame ordinario nos seguintes supostos:
- A non realización ou entrega dalgún dos puntuables anteriores.
- Obter unha nota inferior a 4 puntos sobre 10 no exame final de avaliación continua.- Obter menos dun 5 sobre 10 na avaliación do traballo tutelado.
En calquera destes supostos, a cualificación da avaliación continua será o mínimo da nota de avaliación continua e 4 puntos (o alumno neste caso obterá como máximo 4 puntos). En calquera caso, o alumno que supere a avaliación continua, terá a posibilidade de presentarse ao exame ordinario para subir nota.
COMPROMISO ÉTICO No caso de que se detecte fraude académica por parte dun alumno ou grupo de alumnos seguiranse as seguintes normas:- Si a fraude académica prodúcese nalgunha das memorias de prácticas, a nota total de prácticas será cero independentemente da obtida no resto das mesmas.- Si a fraude académica prodúcese nalgunha das probas intermedias de control ou no exame de avaliación continua, o alumno suspenderá a avaliación continua cun cero e deberá presentarse directamente á convocatoria ordinaria.- Si o alumno comete a fraude académica nunha convocatoria oficial (ordinaria ou extraordinaria) suspenderá dita convocatoria cun cero.

Bibliografía. Fontes de información

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Recomendacións

Other comments

Para cursar con éxito esta materia o alumno debe seguir as seguintes recomendacións:
- Asistencia regular e activa ás clases, tanto teóricas como prácticas.
- Manter un estudo diario mínimo.

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

IDENTIFYING DATA				
English I				
Subject	English I			
Code	P52G381V01209			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	English			
Department				
Coordinator	Douglas , Heidi Jennifer Diane			
Lecturers	Douglas , Heidi Jennifer Diane Gómez Garrido, Sandra Hawthorne , Kaye Louise Muradás Sanromán, Macarena			
E-mail	externo.hdouglas@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	In this subject, students are expected to improve their mastery of the four basic skills of English (listening, speaking, reading, writing) at B1+ Level CEFR (Common European Framework of Reference for Languages) in order to foster the use of the language in the professional military environment.			

Skills
Code
B10 Ability to work in a multidisciplinary and multilingual environment.
C34 CITN4 To promote, through speaking and writing in Spanish and English, communication skills to ease the transmission and understanding of orders, ideas and concepts.
D4 Oral and written proficiency in a foreign language.
D5 Information Management.
D7 Ability to organize and plan.
D8 Decision making.
D9 Apply knowledge.
D15 Objectification, identification and organization.
D17 Working as a team.
D18 Working in an international context.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
OVERALL ORAL PRODUCTION To sustain a straightforward description of one of a variety of subjects within his/her field of interest, presenting it as a linear sequence of points. SUSTAINED MONOLOGUE: DESCRIBING EXPERIENCE To give straightforward descriptions on a variety of familiar subjects within his/her field of interest. SUSTAINED MONOLOGUE: PUTTING A CASE To develop an argument well enough to be followed without difficulty most of the time. ADDRESSING AUDIENCES To give a prepared straightforward presentation on a familiar topic within his/her field which is clear enough to be followed without difficulty most of the time, and in which the main points are explained with reasonable precision. To take follow up questions, but s/he may have to ask for repetition if the speech was rapid. OVERALL SPOKEN INTERACTION To communicate with some confidence on familiar routine and non-routine matters related to his/her interests and professional field. To exchange, check and confirm information, deal with less routine situations and explain why something is a problem. To express thoughts on more abstract, cultural topics such as films, books, music, etc.	B10	C34	D4 D5 D7 D8 D9 D15 D17 D18

OVERALL WRITTEN PRODUCTION To write straightforward connected texts on a range of familiar subjects within his/her field of interest, by linking a series of shorter discrete elements into a linear sequence. REPORTS AND ESSAYS To write short, simple essays on topics of interest. To summarise, report and give his/her opinion about accumulated factual information on familiar routine and non-routine matters within his/her field with some confidence.	B10	C34	D4 D5 D7 D8 D9 D15 D17 D18
OVERALL LISTENING COMPREHENSION To understand straightforward factual information about common everyday or job related topics, identifying both general messages and specific details, provided speech is clearly articulated in a generally familiar accent. UNDERSTANDING CONVERSATION BETWEEN NATIVE SPEAKERS To generally follow the main points of extended discussion around him/her, provided speech is clearly articulated in standard dialect. LISTENING AS A MEMBER OF A LIVE AUDIENCE To follow a lecture or talk within his/her own field, provided the subject matter is familiar and the presentation straightforward and clearly structured. LISTENING TO ANNOUNCEMENTS AND INSTRUCTIONS To understand simple technical information, such as operating instructions for everyday equipment. LISTENING TO AUDIO MEDIA AND RECORDINGS To understand the information content of the majority of recorded or broadcast audio material on topics of personal interest delivered in clear standard speech.	B10	C34	D4 D5 D7 D8 D9 D15 D17 D18
OVERALL READING COMPREHENSION To read straightforward factual texts on subjects related to his/her field of interest with a satisfactory level of comprehension. READING FOR ORIENTATION To scan longer texts in order to locate desired information, and gather information from different parts of a text, or from different texts in order to fulfil a specific task. READING INSTRUCTIONS To understand clearly written, straightforward instructions for a piece of equipment.	B10	C34	D4 D5 D7 D8 D9 D15 D17 D18
ENAEE Learning Outcome: KNOWLEDGE AND UNDERSTANDING: LO1.3.- Critical awareness of the wider multidisciplinary context of engineering [Intermediate (2)].	B10		
ENAEE Learning Outcome: INVESTIGATIONS: LO4.1.-Ability to conduct searches of literature, to consult and critically use databases and other appropriate sources of information, to carry out simulation in order to pursue detailed investigations and research of technical issues in their field of study [Intermediate (2)].			D5
ENAEE Learning Outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- Ability to communicate effectively information, ideas, problems and solutions within the engineering community and society at large [Intermediate (2)].		C34	D4 D18
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)].		C34	D4 D7 D8 D17 D18
ENAEE Learning Outcome: LIFELONG LEARNING: LO8.1.- Ability to recognise the need for and to engage in independent lifelong learning [Basic (1)].			D8
ENAEE Learning Outcome: LIFELONG LEARNING: LO8.2.- Ability to follow developments in science and technology [Basic (1)].			D8

Contents	
Topic	
Unit 1	1.1. Questions and answers 1.2. It's a mystery
Unit 2	2.1. Doctor, doctor 2.2. Act your age
Unit 3	3.1. Fasten your seat belts 3.2. A really good ending?
Unit 4	4.1. Stormy weather 4.2. A risky business

Unit 5	5.1. I'm a survivor 5.2. Wish you were here

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	22	20	42
Mentored work	22	20	42
Essay questions exam	33	21	54
Essay	0	4	4
Oral exam	4	4	8

*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 communicative approach is based on the idea that language learning successfully comes through interspersing different didactic methods. Theory lessons will consist of checking the theoretical knowledge students have and, consequently, teaching the contents designed for completing the knowledge students have previously acquired.
Mentored work	Theory lessons will be completed with practical sessions in which different activities will be done in order to develop students' competence in the four linguistic skills and, therefore, reach the abovementioned goals.

Personalized assistance	
Methodologies	**Description**
Mentored work	The teachers will answer their students' questions themselves, both in the office, at the time published on the website of the college, and through the use of web-based technology (e-mail, videoconferences, MooVi forums, etc.) on appointment.
Tests	**Description**
Oral exam	

Assessment					
	Description	Qualification	Training and Learning Results		
Essay questions exam	Taking into account both the methodologies and the different activities done throughout the whole term (whose main objective is the acquisition of the learning outcomes), the following is the percentage of the global mark corresponding to each part of the exam: Reading - 20% Listening - 20% Writing - 30% Speaking - 30% Global - 100% Exams (2 per term) 70% Exam 1 - 30% Exam 2 - 40%	70	B10	C34	D4 D8 D9 D15 D17 D18
Essay	Activity 1 (15%)	15	B10	C34	D4 D5 D7 D8 D9 D15 D17 D18
Oral exam	Activity 2 (15%)	15	B10	C34	D4 D5 D7 D8 D9 D15 D17 D18

Other comments on the Evaluation

The main goal of the subject is to assess the learning of all of the contents. Exams must be complete, i. e., they will cover all of the contents, since the main goal is to assess what students know about the subject in general, not about a part of it. The mid-term exam will be worth 30% of the overall mark of the continuous assessment, and the final exam will be worth 40% since the latter covers all of the contents taught throughout the term. Moreover, in the final exam, it will be necessary to fulfil the following condition:

1. Obtain at least 40% on each of the four parts of the exam, corresponding to the four linguistic skills.
If the student does not fulfil the abovementioned requirement, the mark of the part of the exam where the student has got the highest mark will become the mark of the final exam and, therefore, of the continuous assessment. This mark will never be higher than 3/10 (3 out of 10) since this is the highest possible mark in each of the two parts of the exam whose marks are the highest (writing and speaking). To pass the subject via continuous assessment, the student should get at least 5 points as a whole.
Ordinary and/or extraordinary exam
In order to pass this exam, it will be necessary to fulfil the following condition:
1. Pass (get at least half of the points on) each of the four parts of the exam, corresponding to the four linguistic skills.
If the student does not fulfil the abovementioned requirement, the mark of the part of the exam where the student has got the highest mark will become the mark of the exam and, therefore, of the assessment. This mark will never be higher than 3/10 (3 out of 10) since this is the highest possible mark in each of the two parts of the exam whose marks are the highest (writing and speaking).
Both in the exams which make up the continuous assessment (mid-term exam and final exam) and in the ordinary and extraordinary exams, all of the students, independently of the class group (1, 2, 3 or 4) they belong to, are being assessed of the same compulsory subject of the Degree in Mechanical Engineering of the Defense College, English I. Consequently, for the speaking part of the exam, students will be grouped by following objective and consistent criteria. Although, if possible, the grouping of students to do the abovementioned part of the exam will aim to be similar to class groups, this will not be compulsory.
IMPORTANT NOTES:1. During the time students are sitting exams, they will be banned from using electronic devices (except the student on duty, who will put her/his mobile on the desk, in sight of the teachers invigilating the exam at issue). If the teachers invigilating the exam realise that a student (except the student on duty, who will be allowed to have the regulatory mobile) has, handles or uses an electronic device, her/his mark will be 0 in the exam as a whole and, if they do so during the ordinary/extraordinary exam, their mark will be 0 in the assessment as a whole. Under no circumstances will there be any special permission to allow the students to have electronic devices during the time they will be sitting exams.
2. The organisation of exam procedures, which is published both on the "orden diaria" and the virtual platform of the subject, will be only and exclusively designed by the coordinator of the subject, who will have reached an agreement with the governing body of the Defense College. Under no circumstances will there be any changes derived from decisions made by people different from the coordinator or the members of the governing body of the Defense College. The mark of those students who do not fulfil the abovementioned requirements will be 0 on the exam and, if they do not fulfil the above mentioned requirements during the ordinary/extraordinary exam, their mark will be 0 on the assessment as a whole.

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The British Army,
The Royal Air Force,
The British Forces Broadcasting Service,
US Department of Defence Dictionary of Military and Associated Terms,
US-based military English website,
Military definitions,
The National Army Museum,
Airforce magazine,

Recommendations

Subjects that continue the syllabus

English II/P52G381V01406

Other comments

To take this subject, students are highly encouraged to have taken the subject English Language of the Naval College. Both the knowledge and skills acquired once students have taken the subject will allow them to be able to succeed in subjects taken later, because at the end of the academic year students are expected to be able to acquire CEFR Level B1+.
Therefore, to be able to succeed, it is advisable to have the following skills:
-Reading and listening skill
-Writing and speaking skill
-Skill to think abstractly and summarise information
-Skills for group work and communication