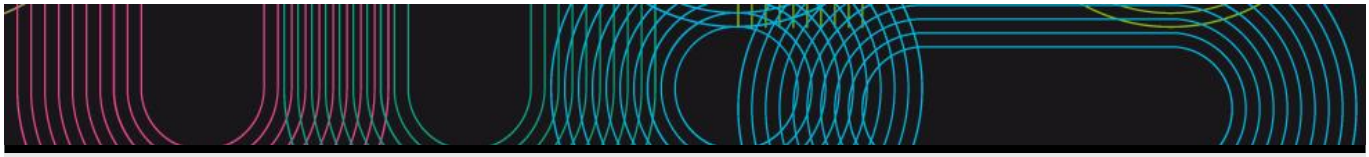

(*)Centro Universitario da Defensa na Escola Naval Militar de Marín (Pontevedra)

(*)Grao en Enxeñaría Mecánica

Subjects

Year 1st

Code	Name	Quadmester	Total Cr.
P52G381V01101	Expresión gráfica: Expresión gráfica	1st	9
P52G381V01102	Física: Física I	1st	6
P52G381V01103	Matemáticas: Cálculo I	1st	6
P52G381V01104	Matemáticas: Álxebra e estatística	2nd	9
P52G381V01105	Empresa: Introdución á xestión empresarial	2nd	6
P52G381V01106	Física: Física II	2nd	6
P52G381V01107	Informática: Informática para a enxeñaría	2nd	6
P52G381V01108	Química: Química	2nd	6

Year 2nd

Code	Name	Quadmester	Total Cr.
P52G381V01201	Matemáticas: cálculo II e ecuacións diferenciais	1st	6
P52G381V01202	Ciencia e tecnoloxía dos materiais	1st	6
P52G381V01203	Termodinámica e transmisión da calor	1st	6
P52G381V01204	Resistencia de materiais	1st	6
P52G381V01205	Fundamentos de electrotecnia	2nd	6
P52G381V01206	Teoría de máquinas e mecanismos	2nd	6
P52G381V01207	Tecnoloxía medioambiental	2nd	6
P52G381V01208	Mecánica de fluídos	2nd	6
P52G381V01209	Inglés I	2nd	6

Year 3rd

Code	Name	Quadmester	Total Cr.
P52G381V01301	Tecnoloxía electrónica	1st	6

P52G381V01302	Enxeñaría dos materiais	1st	6
P52G381V01303	Elasticidade e ampliación de resistencia de materiais	1st	6
P52G381V01304	Enxeñaría gráfica	1st	6
P52G381V01305	Máquinas de fluídos	2nd	6
P52G381V01306	Fundamentos de organización de empresas	2nd	6

Year 4th

Code	Name	Quadmester	Total Cr.
P52G381V01401	Fundamentos de automática	1st	6
P52G381V01402	Fundamentos de sistemas e tecnoloxías de fabricación	1st	6
P52G381V01403	Enxeñaría térmica I	1st	6
P52G381V01404	Teoría de estruturas e construcións industrias	1st	6
P52G381V01405	Deseño de máquinas	2nd	6
P52G381V01406	Inglés II	2nd	6
P52G381V01407	Enxeñaría de fabricación e calidade dimensional	2nd	6
P52G381V01408	Sistemas de radiocomunicacións	2nd	6
P52G381V01409	Máquinas e motores navais	2nd	6
P52G381V01410	Fundamentos de topografía	2nd	6

Year 5th

Code	Name	Quadmester	Total Cr.
P52G381V01501	Oficina técnica	1st	6
P52G381V01502	Sensores navais	1st	6
P52G381V01503	Fundamentos de redes de ordenadores	1st	6
P52G381V01504	Teoría do buque e construción naval	1st	6
P52G381V01505	Automóbiles	1st	6
P52G381V01506	Actividade formativa complementaria	2nd	6
P52G381V01991	Traballo fin de grao	2nd	12

IDENTIFYING DATA				
Graphic expression: Graphic expression				
Subject	Graphic expression: Graphic expression			
Code	P52G381V01101			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Basic education	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Solla Carracelas, María Mercedes			
Lecturers	Casqueiro Placer, Carlos Solla Carracelas, María Mercedes			
E-mail	merchisolla@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course aims to train the students in different aspects of the Graphic Expression in order to give them adequate skills for the management and interpretation of the representation systems most commonly used in the industrial field and its basic techniques to introduce them to the knowledge of the geometric shapes, generation and properties of the most frequent geometric entities, including the acquisition of spatial vision and comprehension to introduce them into the study of technological aspects of Graphic Expression in Engineering as well as into the knowledge and application of Standardization, in both basic and specific aspects. The subject will be developed aiming to enable the student to handle traditional techniques as well as new information and communication technologies.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
CG6	Capacity for handling specifications, regulations and mandatory standards.
CE5	Capacity for spatial vision and knowledge of the techniques of graphic representation, using traditional methods of metric geometry and descriptive geometry, and through the application of computer-aided design.
CT2	Problems resolution.
CT6	Application of computer science in the field of study.
CT9	Apply knowledge.
CT17	Working as a team.

Learning outcomes	Competences		
To know, understand and apply the basic principles and standardization of industrial engineering drawing, while training the development of spatial vision and comprehension.	CG3 CG4	CE5	CT2 CT6
To acquire the capacity for abstract reasoning, and the establishment of efficient strategies and procedures for the resolution of graphic problems within the context of engineering projects.	CG3 CG4	CE5	CT2
Use of a graphic communication between technicians, by means of the realization and interpretation of plans according to the Technical Drawing Standards, involving the use of new technologies	CG6	CE5	CT6 CT9
To assume a favorable attitude for a permanent learning in the profession, being proactive and with a collaborative and committed spirit.	CG4		CT9
Work as a team, developing knowledge based on a critical and responsible technical-cultural exchange.	CG4 CG6		CT9 CT17
ENAEE learning outcome: KNOWLEDGE AND UNDERSTANDING: LO1.1.- knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes [level of achievement (basic (1), intermediate (2) and advanced (3)) for this learning outcome: Intermediate (2)].	CG3	CE5	
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)].	CG4	CE5	CT2 CT9

ENAEE learning outcome: INVESTIGATION AND INNOVATIONS: LO4.1.- ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, to carry out simulation and analysis in order to pursue detailed investigations and research of technical issues in their field of study [Basic (1)].	CG6	
ENAEE learning outcome: INVESTIGATION AND INNOVATIONS: LO4.2.- ability to consult and apply codes of practice and safety regulations in their field of study [Intermediate (2)].	CG6	
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)].		CT6 CT9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.4.- ability to apply norms of engineering practice in their field of study [Intermediate (2)].	CG6	CT9
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large [Intermediate (2)].	CG4	
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)].		CT17

Contents	
Topic	
Informative note:	Due to the circumstances occurred in the 2020-2021 academic year (delay in the incorporation date of new students and the need to dedicate three weeks to a zero level course in mathematical-physical knowledge, which will allow to begin the course with guarantees), a 85% of the 225 hours (corresponding to a subject of 9 ECTS) will be planned: 192 hours.
Section I. Descriptive geometry. Unit 1. Introduction to the representation systems.	1.1. Projective geometry. projective invariants. 1.2. Orthogonal projection system. 1.3. Dihedral system. 1.4. Axonometric system. 1.5. Conic system.
Section I. Descriptive geometry. Unit 2. Dihedral system.	2.1. Representation of point, line, plane and volume. 2.2. Parallelism. Perpendicularity and distances. 2.3. Auxiliary views and changes of plane. 2.4. Intersections.
Section I. Descriptive geometry. Unit 3. Orthogonal projection system.	3.1. Point, straight line and plane. Line of maximum slope on a plane. 3.2. Intersections. Application to covers and roofs. 3.3. Straight lines, surfaces and lands. Generalities and applications.
Section I. Descriptive geometry. Unit 4. Curves of Engineering.	4.1. Involute and evolute. 4.2. Cycloid curve.
Section II. Standardized representation. Unit 1. Introduction - Technical drawing and standardisation.	1.1. Regulation, specification and standards. 1.2. Types of standardization. 1.3. Standardization entities. 1.4. The standardization in the technical drawing. 1.5. Basic standards of technical drawing.
Section II. Standardized representation. Unit 2. Fundamentals of technical drawing	2.1. Visualization and representation of corporeal forms. 2.2. Methods of the first and third dihedral. 2.3. Types of views. 2.4. Sectional drawings. 2.5. Other conventions: intersections, symmetrical parts, interrupted views, repetitive elements, details, etc.
Section II. Standardized representation. Unit 3. Components and methods of dimensioning	3.1. General principles. 3.2. Types of dimensions and methods. 3.3. Dimensioning components. 3.4. Symbols. 3.5. Placing of dimensions. 3.6. Special indications (radius, equidistant elements, etc.) 3.7. Other indications (lost dimensions, particular specifications, etc.). 3.8. Keyways and slots. 3.9. Conicity and tilting. 3.10. Profiles.

Section II. Standardized representation. Unit 4. Representation of standardized elements and assembly drawings.	4.1. Definition of a threaded joint. 4.2. Thread types. 4.3. Conventional representation of threads. 4.4. Representation of assembly drawings. 4.5. Dimensioning of threaded elements. 4.6. Specifications of the most common threads. 4.7. Representation of industrial mechanisms. 4.8. Standards for the elaboration of assembly drawings. 4.9. Identification of different parts. 4.10. Parts list. 4.11. Standard designation of materials. 4.12. Partial drawings (with dimensioning). 4.13. Numbering of plans. 4.14. Representation of standardized mechanical elements. 4.15. Screws, nuts and washers. 4.16. Springs and spring clips. 4.17. Fixed joints. 4.18. Axles and shafts. 4.19. Splines and grooves. 4.20. Bearings. 4.21. Gears, chains and pulleys.
Section II. Standardized representation. Unit 5. Geometric dimensioning and Tolerancing.	5.1. Fundamentals and needs of tolerancing. 5.2. Dimensional tolerances and fits, and representation. 5.3. Geometric tolerances and representation. 5.4. Surface treatments and qualities, and representation.
Section II. Standardized representation. Unit 6. Symbology and schematic representations.	6.1. Introduction and standards. 6.2. Symbology characteristics. 6.3. Types of symbols and codes. 6.4. Standardized symbols. 6.5. Graphic symbols for schemes. 6.6. Typology of schemes according to their nature and application. 6.7. Practical applications of the schematic representations in Engineering.
Practical Activity 1 (CAD 2D)	File formats and management. Setting. Drawing and modification tools (I). Line drawing by coordinates.
Practical Activity 2 (CAD 2D)	Drawing and modification tools (II). Object snap and trace.
Practical Activity 3 (CAD 2D)	Drawing and modification tools (III). Point and line formats.
Practical Activity 4 (CAD 2D)	Layer editing. Text and dimension formats. Scaling.
Practical Activity 5 (CAD 2D)	Presentation and drawing of plans. 2D sketching.
Practical Activity 6 (CAD 2D)	Blocks, attributes and external references.
Practical Activity 7 (CAD 3D)	Basic design procedure: from sketch to solid.
Practical Activity 8 (CAD 3D)	Sketching and modeling tools (I).
Practical Activity 9 (CAD 3D)	Sketching and modeling tools (II).
Practical Activity 10 (CAD 3D)	Assembly drawings
Practical Activity 11 (CAD 3D)	Generation of views and plans.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	38	38	76
Problem solving	6	0	6
Project based learning	0	10	10
Seminars	18	22	40
Practices through ICT	22	22	44
Essay questions exam	16	0	16
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Lecture session. Each thematic unit will be presented by the lecturer, and complemented with the comments of the students based on the assigned bibliography or other relevant information.
Problem solving	Exercises and / or study cases will be raised and solved individually or in groups.
Project based learning	A group project will be developed throughout the semester in which all of the members of the group have to collaborate by contributing and complementing the knowledge needed for its achievement.
Seminars	Intensive course (18 hours) for those students who have failed the subject at first call, prior to the exam in second call. Group tutoring with the lecturer.

Practices through ICT	Computer exercises will be carried out focused on the use of CAD software for the generation of technical drawings and plans.

Personalized assistance

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

Assessment

	Description	Qualification	Evaluated Competencess		
Lecturing	Two evaluation tests/questionaries, in a continuous assessment, of short duration will be carried out throughout the semester. The tests will be carried out, proposed by the lecturer, at the most appropriate times within the classroom sessions of the subject. These two tests will be mandatory and required to pass the subject (percentage in the final qualification: 20%, 10% each assessment).	20	CG3 CG4 CG6	CE5	CT2 CT9
Problem solving	During the semester, different assembly mechanisms will be proposed for their representation in the computer sessions through the use of the CAD 2D/3D software. It will be assessed through two tests within the classroom sessions of the subject (percentage in the final qualification: 20%, 10% each assessment).	20	CG4	CE5	CT2 CT6 CT9
Project based learning	Throughout the semester, the students will carry out a project related to the contents of the subject. The project will be developed in parallel to the subject syllabus and will cover most of the aspects reflected in the topics of the subject. The project will be carried out in small groups of students that will be established during the first three weeks of the term. The assessment of the project will have two components: 1) Project report (75%): same score for all the members of the group. 2) Final presentation (25%): individual score based on the presentation provided by each student.	20	CG3 CG4 CG6	CE5	CT2 CT9 CT17
Practices through ICT	The evaluation of the abilities for using the CAD 2D/3D software is included in the 20% corresponding to the methodology of problems and/or exercises resolution, more specifically for the elaboration of plans and partial drawings of assembly mechanisms.	0	CG4	CE5	CT2 CT6 CT9
Essay questions exam	A final exam will be carried out covering all the contents of the subject, both theoretical and practical, and that may include tests, reasoning questions, exercise solving and development of practical cases. It is required to achieve a minimum score of 4.0 points over 10 possible to pass the subject (percentage in the final qualification: 40%).	40	CG3 CG4 CG6	CE5	CT2 CT9

Other comments on the Evaluation

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

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

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

A numerical rating system with values from 0.0 to 10.0 points will be used according to current legislation (R.D. 1125/2003 of September 5, B.O.E. No. 224 of September 18). The subject will be considered passed when the student achieves a minimum qualification of 5.0 points.

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

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

One of the duties of every university student is to avoid the use or cooperation in fraudulent procedures in the evaluation tests, in the works developed or in official documents of the university (R.D. 1791/2010 of December 30, which approves the regulations of the university students). Therefore, if the lecturer had evidence, at any time, of the violation of the duty stated in the previous paragraph, this is:

- cheating in an exam.

- plagiarize totally or partially a work from any bibliographical source or from any web page,

- present the works of others as their own property,

- the use of any other malicious method in any of the evaluation tests,

The lecturer will inform the facts to the Director of the Center. In the case that the copy was in continuous evaluation, the student involved will be penalised with a final note in continuous evaluation of failed (0,0). If the copy was in Ordinary or Extraordinary Examination, the student will obtain a final rating of failed (0,0) in such call.

Sources of information

Basic Bibliography

IZQUIERDO ASENSI, F., **Geometría descriptiva I (Sistemas y perspectivas)**, 26ª edición, Grefol, 2008

IZQUIERDO ASENSI, F., **Geometría descriptiva II (Líneas y superficies)**, 26ª edición, Grefol, 2008

IZQUIERDO ASENSI, F., **Geometría descriptiva Superior y Aplicada**, 4ª edición, Paraninfo, 1996

LEICEAGA BALTAR, X.A., **Normas básicas de dibujo técnico**, AENOR, 1994

PÉREZ DÍAZ, J.L. Y PALACIOS CUENCA, S., **Expresión gráfica en la ingeniería**, Prentice Hall, 1998

Complementary Bibliography

Asociación Española de Normalización (AENOR), **Normas UNE de Dibujo Técnico**, (versión en vigor), Ed. AENOR,

AURIA J.M., IBÁÑEZ P. Y UBIETO P., **Dibujo Industrial. Conjuntos y despieces**, Thompson, 2000

BRUSOLA F., CALANDÍN E., BAIXAULI J.J. Y HERNANDIS B., **Acotación funcional**, Tébar Flores, 1986

CALANDÍN E., BRUSOLA F. Y BLANES J.G., **Prácticas de acotación funcional**, Tébar Flores, 1988

COMPANY P.P., GOMIS J.M., FERRER I. Y CONTERO M., **Dibujo normalizado**, Servicio de publicaciones de la Universidad Polité, 1997

COMPANY P.P., VERGARA M. Y MONDRAGÓN S., **Dibujo industrial**, Publicacions de la Universitat Jaume I, 2007

DOMÍNGUEZ, M., **Cuadernos de la UNED: doce ejercicios de dibujo y diseño de conjuntos resueltos y comentados**, Universidad Nacional de Educación a Distancia, 1998

GUIRADO J.J., **Introducción al dibujo de ingeniería: esquemas conceptuales básicos**, 3ª edición, Gamesal, 2001

GUIRADO J.J., **Iniciación a la Expresión Gráfica en la Ingeniería: los fundamentos proyectivos de la representación**, Gamesal, 2003

JIMÉNEZ I. Y CALAVERA C., **Sistema diédrico**, Paraninfo, 2011

MIRA J.R., COMPANY P.P. Y GARCÍA J.M., **Ejercicios de dibujo técnico resueltos y comentados**, Servicio de publicaciones de la Universidad Polité, 1987

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

Recommendations

Subjects that continue the syllabus

Graphic engineering/P52G381V01304

Other comments

There are no prerequisites to follow the course, although it is recommended that the student has some knowledge in technical drawing and geometry fundamentals at the level required in high school.
For the appropriate development of the practical classes and seminars, it is recommended that the student has the basic technical drawing tools: 45º and 60º setsquares, scale, compass and pencils or with different hardness.
It would also be advisable for the student to have a computer, with access to the Internet and software applications.

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===

A new methodology will be added: Synchronous online meeting (theory or practical session): it is given through a web videoconference platform. Each virtual classroom contains various display panels and components, whose design can be customised to best suit the needs of the class. In the virtual classroom, the lecturer (and authorised participants) can share their computer screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).

=== ADAPTATION OF THE TESTS ===

The evaluation tests will be carried out by combining the FAITIC-Moodle platform for online teaching and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Física: Física I				
Subject	Física: Física I			
Code	P52G381V01102			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1	1c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Vázquez Carpentier, Alicia			
Lecturers	Vázquez Carpentier, Alicia			
E-mail	avcarpentier@cud.uvigo.es			
Web	http://http://faitic.uvigo.es/			
General description	Os obxectivos fundamentais, que comparten tanto esta materia como a súa sucesora Física II, son por unha banda, a consolidación, co adecuado rigor conceptual e formal, de coñecementos previamente adquiridos, e, por outra, o establecemento das bases necesarias para o estudo ulterior doutras disciplinas, de carácter básico ou fundamental. Todo iso de forma que o obxectivo final non sexa a mera especulación teórica senón a aplicación dos coñecementos adquiridos á tecnoloxía, a través dos oportunos modelos e esquemas físico-matemáticos. Desenvolveranse as aptitudes e destrezas necesarias para a resolución de problemas técnicos relacionados coa Física, practicando a metodoloxía analítico-deductiva propia desta ciencia. O programa da materia Física I do Grao en Enxeñaría Mecánica divídese en catro bloques principais: Introdución, Cinemática, Dinámica e Vibracións e Ondas, os cales se desenvolverán en nove temas tal e como se detalla na programación da materia. Esta materia é clave para entender materias que serán estudadas posteriormente como son Resistencia de Materiais. Mecánica de Fluídos ou Teoría de Máquinas e Mecanismos.			

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

Resultados de aprendizaxe			
Learning outcomes	Competences		
Comprender os conceptos básicos sobre as leis xerais da mecánica e campos e ondas.	CG3	CE2	CT2 CT9 CT10
Coñecer a instrumentación básica para medir magnitudes físicas.	CG3	CE2	CT2 CT9 CT10
Coñecer as técnicas básicas de avaliación de datos experimentais.	CG3	CE2	CT2 CT9 CT10
Desenvolver solucións prácticas a problemas técnicos elementais da enxeñaría nos ámbitos da mecánica e de campos e ondas.	CG3	CE2	CT2 CT9 CT10
RESULTADO DE APRENDIZAXE ENAEE: COÑECEMENTO E COMPRENSIÓN: RA 1.1 Coñecemento e comprensión das matemáticas e outras ciencias básicas inherentes á súa especialidade de enxeñaría, nun nivel que permita adquirir o resto das competencias do título. [Nivel de desenvolvemento (básico(1), adecuado(2) e avanzado(3). Deste sub-resultado:Adecuado(2)].	CG3	CE2	
RESULTADO DE APRENDIZAXE ENAEE: ANÁLISE EN ENXEÑARÍA: RA 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 (Básico(1))		CE2	CT2 CT9
RESULTADO DE APRENDIZAXE ENAEE: INVESTIGACIÓN E INNOVACIÓN: RA 4.3. Capacidade e destreza para proxectar e levar a cabo investigacións experimentais, interpretar resultados e chegar a conclusións no seu campo de estudo (Básico(1)).		CE2	CT9

RESULTADO DE APRENDIZAXE ENAEE: COMUNICACIÓN E TRABALLO EN EQUIPO: RA 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 (Básico(1)).	CT10

Contidos	
Topic	
NOTA INFORMATIVA	Debido a circunstancias sobrevindas no curso 2020-2021 (atraso na data de incorporación dos alumnos de novo ingreso e necesidade de destinar tres semanas a un curso cero de nivelación de coñecementos matemático-físicos que permita iniciar o curso con garantías), programarase o 85% das 150 horas correspondentes a unha materia de 6 ECTS: 128 horas.
1.- MAGNITUDES E MEDIDAS FÍSICAS	1.1 Magnitudes, cantidades, unidades e medidas. 1.2 Homoxeneidade dimensional. 1.3 O Sistema Internacional. Constantes universais e características. 1.4 Teoría de erros.
2.- CÁLCULO VECTORIAL	2.1 Vectores. Tipos. 2.2 Sistemas de Coordenadas. 2.3 Operacións con vectores. 2.4 Campos escalares e vectoriais. 2.5 Campos centrais. Campos newtonianos. 2.6 Teoremas integrais da análise vectorial.
3.- CINEMÁTICA DA PARTÍCULA	3.1 Conceptos fundamentais: vector de posición, velocidade, aceleración. 3.2 Estudo dalgúns tipos de movementos. 3.3 Movemento relativo.
4.- DINÁMICA DA PARTÍCULA	4.1 Forzas e interaccións. 4.2 Principios fundamentais da mecánica: Leis de Newton. 4.3 Principios de conservación. 4.4 Diagramas do sólido libre. 4.5 Aplicacións das Leis de Newton.
5.- TRABALLO E ENERXÍA	5.1 Traballo e potencia. 5.2 Enerxía cinética. 5.3 Enerxía potencial gravitacional e elástica. 5.4 Forzas conservativas e non conservativas. Lei de conservación da enerxía. 5.6 Principio de mínima acción.
6.- DINÁMICA DUN SISTEMA DE PARTÍCULAS	6.1 Centro de masas. Ecuación de movemento do centro de masas. 6.2 Momento lineal dun sistema de partículas. Teorema de conservación. Impulso. 6.3 Momento angular dun sistema de partículas. 6.4 Enerxía cinética dun sistema de partículas. Teorema de conservación. 6.5 Lei de conservación da enerxía dun sistema de partículas. 6.6 Colisións.
7.- ROTACIÓN E DINÁMICA DUN CORPO RÍXIDO	7.1 Cinemática da rotación. 7.2 Enerxía no movemento rotacional. 7.3 Momento de inercia. Teorema de Steiner. 7.4 Dinámica de rotación dun sólido. 7.5 Momento angular. Teorema de conservación. 7.6 Xiróscopos.
8.- EQUILIBRIO ESTÁTICO E ELASTICIDADE	8.1 Condicións de equilibrio. Ligaduras. Centro de gravidade. 8.2 Exemplos de equilibrio estático en sólidos ríxidos. 8.3 Esforzos, deformación e módulos de elasticidade. 8.4 Elasticidade e plasticidade.
9.- VIBRACIÓNS E ONDAS	9.1 Movementos periódicos. 9.2 Movemento armónico simple (m.a.s). 9.3 Forza e enerxía dun oscilador armónico simple. 9.4 O péndulo simple e físico. 9.5 Oscilacións libres amortecidas. 9.6 Oscilacións forzadas. Resonancia. 9.7 Concepto de onda. 9.8 Movemento ondulatorio. Estudo xeral.
PRÁCTICAS DE LABORATORIO	P1 Medida e cálculo de erros. P2 Cinemática. Tiro parabólico. P3 Resolución de problemas. Dinámica da partícula, traballo e enerxía. P4 Dinámica do sólido ríxido. P5 Resolución de problemas. Equilibrio estático.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	24	36	60
Seminario	6	0	6
Prácticas de laboratorio	10	11	21
Traballo tutelado	10	5	15
Exame de preguntas de desenvolvemento	13	13	26
*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.
Seminario	Corresponde a reunións baixo o formato de grupo pequeno. Empregaranse as seguintes metodoloxías de aprendizaxe: resolución de problemas e exercicios e aprendizaxe colaborativa xunto con traballo tutelado. O método didáctico a seguir no desenvolvemento dos seminarios consiste en que o profesor tutela o traballo que realiza o alumnado resolvendo problemas e exercicios prácticos.
Prácticas de laboratorio	Corresponden a sesións laboratorio e sesións de resolución de problemas e exercicios. Nas sesións de laboratorio, para contribuir á adquisición da competencia básica CB3 e a transversal CT10, avaliaranse as sesións de prácticas mediante a elaboración de informes individuais ou mediante cuestionarios relativos ao traballo derivado da sesión de laboratorio. Nas sesións de resolución de problemas e exercicios e co fin de adquirir as competencias CT2 e CT9 o alumno debe resolver, dun modo individual ou tutelado, unha serie de problemas e exercicios prácticos abordando os contidos teóricos da materia.
Traballo tutelado	Corresponden a sesións do curso intensivo de preparación do exame extraordinario, onde o profesor proporá problemas complementarios e actividades que permitan repasar os contidos da materia e atenderá as dúbidas presentadas polos alumnos.

Atención personalizada	
Methodologies	**Description**
Lección maxistral	No ámbito da acción tutorial, o alumnado terá á súa disposición horas de titorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, etc. Nas titorías personalizadas, cada alumno de maneira individual poderá comentar co profesor calquera problema que lle estea impedindo realizar un seguimento axeitado da materia, co fin de atopar entre ambos algún tipo de solución.
Prácticas de laboratorio	Nas sesións destinadas á realización de prácticas de laboratorio, o profesor atenderá deforma personalizada as dúbidas expostas polos alumnos.
Seminario	Nas titorías en grupo, o profesor atenderá de forma personalizada as dúbidas dos alumnos, expondo exercicios complementarios ou outra clase de actividades que redunden no mellor aproveitamento das clases do alumnado.
Traballo tutelado	No desenvolvemento do curso de reforzo o alumnado terá á súa disposición horas de titorías nas que pode consultar calquera dúbida relacionada coa materia. Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos no horario que se publicará na web do centro, así como por medio do correo electrónico ou por medio de outros medios telemáticos (uso do despacho virtual mediante cita previa, videoconferencia, uso de foros de FAITIC, etc.)

Avaliación					
	Description	Qualification	Evaluated Competencess		
Lección maxistral	Avaliación mediante actividades complementarias consistentes na resolución de problemas propostos polo profesor da materia ou outra actividade que se estableza. Pódese solicitar ao alumno que expoña en clase a resolución aos problemas.	15	CG3	CE2	CT2 CT9 CT10
Prácticas de laboratorio	Memorias ou cuestionarios sobre as prácticas e o traballo derivado das mesmas.	15	CG3	CE2	CT2 CT9 CT10

Exame de preguntas de desenvolvemento	Dúas probas escritas intermedias e a proba final de avaliación	70	CG3	CE2	CT2 CT9 CT10

Other comments on the Evaluation

A continuación preséntase a porcentaxe que representa cada unha das partes na nota final do alumno.

Proba Intermedia 1 (PI1)= 15%Proba Intermedia 2 (PI2)= 15%Proba de avaliación de Prácticas (EP) = 15%Actividades Complementarias (AC)= 15%Proba Final (PF) = 40%
A avaliación final do alumno atenderá á suma da puntuación outorgada a cada unha das partes antes comentadas, sendo a súa nota de avaliación continua (NEC): NEC = 0,15·PI1 + 0,15·PI2 + 0,15·EP + 0,15·AC + 0,40·PF
Con todo, esixiranse uns requisitos mínimos e condicións nalgúns dos apartados, que garantan o equilibrio entre todos os tipos de competencias.O alumno deberá presentarse ao exame ordinario de todos os contidos da materia, que suporá o 100% da nota, cando a nota NEC sexa menor que 5 ou obteña unha nota inferior a 4 puntos sobre 10 no exame final de avaliación continua. Neste último caso, a cualificación da avaliación continua será o mínimo da nota de avaliación continua calculada coa fórmula anterior e 4 puntos.En calquera caso, ao alumno que supere a avaliación continua, ofréceselle a oportunidade de presentarse ao exame ordinario para subir nota.
A continuación, detállanse as medidas a adoptar se se detecta fraude académica nalgunha das probas avaliables.-Avaliación continua

- Durante o proceso de avaliación continua, se se detecta fraude académica nalgunha das probas avaliables, tanto de teoría como de laboratorio, este feito suporá para todos os implicados unha cualificación de 0 en devandita proba.
- No caso de que o feito se produza durante a realización do exame final de avaliación continua, iso suporá para todos os implicados a cualificación de 0 na convocatoria en vigor, debendo presentarse obrigatoriamente ao exame extraordinario para superar a materia.

-Exames ordinario e extraordinario

- No caso de que o feito se produza durante a realización dos exames ordinario ou extraordinario, iso suporá para todos os implicados a cualificación de 0 na convocatoria en vigor.

Bibliografía. Fontes de información

Basic Bibliography

W. Sears, M.W. Zemansky, H.D. Young, R.A. Freedman, **Física Universitaria, V1**, 12,

Complementary Bibliography

F.A. González, **La Física en problemas**, 1,
S. Burbano, **Física General: Problemas**, 27,
F.A. González, **Problemas de Física**,
J.A. Fidalgo, M.R. Rodriguez, **1000 Problemas de Física General**, 5,

Recomendacións

Other comments

Para cursar con éxito esta materia o alumno debe de seguir as seguintes recomendacións e posuír as seguintes capacidades:
1. Asistencia activa ás clases, tanto teóricas como prácticas.
2. Manter un estudo diario mínimo.
3. Cultivar o razoamento e o enxeño na aprendizaxe da materia, máis que os procedementos de simple memorización.
4. Capacidade para aprender a resolver problemas físicos partindo dunha boa base teórica e de suficiente práctica no manexo de ferramentas matemáticas básicas. É esencial que o alumno domine os aspectos básicos de cálculo integral e diferencial para a superación da materia.

Plan de Continxencias

Description

Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución o determine atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou

parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

A continuación, reflíctense os apartados da presente guía docente que sufrirán modificación no caso ter que abordar a docencia en modalidade virtual:

6.3 Programación: créditos prácticos
As prácticas de Física I poden adaptarse facilmente para a súa realización fóra dun laboratorio pola súa orientación a aspectos físicos próximos á experiencia diaria (movemento, oscilacións, rotacións dos corpos...). É por iso que para cada práctica (aquelas que non estean orientadas á resolución de exercicios), no caso de que o alumno deba realizala pola súa conta, o profesor facilitará unha guía específica para orientar ao alumno para que sexa capaz de alcanzar os obxectivos de cada sesión. As instrucións non serán pechadas para estimular a creatividade do alumno na procura de solucións prácticas.
Práctica 1. Medida e cálculo de erros
Modalidade non presencial: O alumno realizarán unha práctica similar por conta propia e coa guía do profesor con materiais que teña en casa.
Práctica 2. Cinemática. Tiro parabólico
Modalidade non presencial: O alumno realizarán unha práctica similar por conta propia e coa guía do profesor con materiais que teña en casa e con software libre para analizar os datos.
Prácticas 4. Dinámica do sólido ríxido
Modalidade non presencial: O alumno realizarán unha práctica similar por conta propia e coa guía do profesor con materiais que teña en casa.

8. METODOLOXÍA DOCENTE
Engádese unha nova metodoloxía docente:
Sesión maxistral e/ou sesión práctica virtual síncrona: impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

10. AVALIACIÓN
As probas de avaliación realizaranse, en caso de paso a docencia virtual, combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Matemáticas: Cálculo I				
Subject	Matemáticas: Cálculo I			
Code	P52G381V01103			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1	1c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Guzmán Crespo, Francisco Javier			
Lecturers	Guzmán Crespo, Francisco Javier			
E-mail	fguzcre@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	O obxectivo xeral desta materia é que o alumno adquira o dominio das técnicas básicas do cálculo diferencial e integral nunha variable e do cálculo diferencial en varias variables, que son necesarias para outras materias que debe cursar na titulación.			

Competencias	
Code	
CG3	Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
CG4	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.
CE1	Capacidade para a resolución dos problemas matemáticos que poidan presentarse na enxeñaría. Aptitude para aplicar os coñecementos sobre: álxebra lineal; xeometría; xeometría diferencial; cálculo diferencial e integral; ecuacións diferenciais e en derivadas parciais; métodos numéricos; algorítmica numérica; estatística e optimización.
CT1	Análise e síntese.
CT2	Resolución de problemas.
CT6	Aplicación da informática no ámbito de estudo.
CT9	Aplicar coñecementos.
CT14	Creatividade.
CT16	Razoamento crítico.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Comprensión dos coñecementos básicos de cálculo diferencial dunha e de varias variables.	CG3	CE1	CT1
Comprensión dos coñecementos básicos de cálculo integral de funcións dunha variable.	CG3	CE1	CT1
Manexo das técnicas de cálculo diferencial para a localización de extremos, a aproximación local de funcións e a resolución numérica de sistemas de ecuacións.	CG3 CG4	CE1	CT2 CT9 CT14 CT16
Manexo das técnicas de cálculo integral para o cálculo de áreas, volumes e superficies.	CG3 CG4	CE1	CT1 CT2 CT9 CT14 CT16
Utilización de ferramentas informáticas para resolver problemas de cálculo diferencial e de cálculo integral.	CG4	CE1	CT2 CT6 CT9 CT16
Resultado de aprendizaxe ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.1.- Coñecemento e comprensión das matemáticas e outras ciencias básicas inherentes á súa especialidade de enxeñaría, nun nivel que permita adquirir o resto das competencias do título [nivel de desenvolvemento (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CG3	CE1	
Resultado de aprendizaxe ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.2.- 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 (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CG4	CE1	CT1 CT2 CT9 CT14 CT16

Resultado de aprendizaxe ENAEE: INVESTIGACIÓN E INNOVACIÓN: RA4.3.- 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 (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CT9

Contidos	
Topic	
NOTA INFORMATIVA	Debido a circunstancias sobrevindas no curso 2020-2021 (atraso na data de incorporación dos alumnos de novo ingreso e necesidade de destinar tres semanas a un curso cero de nivelación de coñecementos matemático-físicos que permita iniciar o curso con garantías), programarase o 85% das 150 horas correspondentes a unha materia de 6 ECTS: 128 horas.
Tema 1. Sucesións e Series.	O principio de indución. Os números reais. Definición e conceptos básicos de sucesións. Converxencia de sucesións. Criterios de converxencia e cálculo de límites. Definición e conceptos básicos de series. Converxencia de series Criterios de converxencia para series
Tema 2. Límites e continuidade en R.	Teorema de Bolzano. Método Bisección.
Tema 3. Cálculo diferencial en R.	Optimización. Teorema de Rolle. Teorema do valor medio. Polinomio de Taylor. Método de Newton-Raphson
Tema 4.Cálculo integral nunha variable.	Propiedades da integral indefinida. Métodos fundamentais de integración. A integral definida. Aplicacións da integral definida.
Tema 5. Límites e continuidade de funcións de varias variables reais.	O espazo euclídeo Rn. Concepto de función de varias variables. Límite dunha función de varias variables. Continuidade de funcións de varias variables. Propiedades das funcións continuas.
Tema 6. Cálculo diferencial de funcións de varias variables reais.	Derivadas direccionales. Derivadas parciais. Vector gradiente e matriz de Jacobi. Diferenciabilidad dunha función de varias variables reais. Condicións para a diferenciabilidad. Diferenciabilidad de orde superior. Matriz de *Hesse. Polinomio de Taylor. Comportamento local de funcións diferenciables. Operadores diferenciables.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	24	18	42
Resolución de problemas	6	6	12
Prácticas con apoio das TIC	4	4	8
Traballo tutelado	6	0	6
Seminario	12	10	22
Resolución de problemas e/ou exercicios	4	4	8
Exame de preguntas de desenvolvemento	9	21	30
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Lección maxistral	O profesor exporá nas clases teóricas os contidos da materia. Os alumnos poderán consultar referencias bibliográficas para o seguimento da materia así como os apuntamentos da materia.
Resolución de problemas	Nas clases de problemas, o profesor resolverá problemas tipo. O alumno disporá dunha copia das solucións de todos os exercicios que se realizan ou propoñen en devanditas clases.

Prácticas con apoio das TIC	Nas prácticas de laboratorio utilizarase a ferramenta informática Matlab para aplicar a casos prácticos os conceptos expostos nas clases de teoría. O alumno disporá de apuntamentos e guións de prácticas.
Traballo tutelado	Nas horas de traballo tutelado, o alumno terá a posibilidade de expor dúbidas sobre a materia que serán resoltas polo profesor. Adicionalmente, estas horas poderán ser empregadas para a resolución de dúbidas relacionadas coas prácticas de laboratorio. En ningún caso empregaranse estas horas para avanzar materia ou para a realización de probas de avaliación.
Seminario	Curso intensivo de 12 horas para aqueles alumnos que suspenderon a materia en primeira convocatoria, previo ao exame en segunda convocatoria. Tutorías grupales co profesor.

Atención personalizada

Methodologies	Description
Lección maxistral	Nas sesións maxistrais, o profesor resolverá as dúbidas expostas polos alumnos referentes aos conceptos teóricos expostos nese momento
Resolución de problemas	Nas sesións destinadas á resolución de exercicios e problemas, o profesor atenderá de forma personalizada as dúbidas expostas polos alumnos.
Prácticas con apoio das TIC	Nas sesións destinadas á realización de prácticas de informática, o profesor atenderá de forma personalizada as dúbidas expostas polos alumnos.
Seminario	Nas tutorías en grupo, o profesor atenderá de forma personalizada as dúbidas dos alumnos, expondo exercicios complementarios ou outra clase de actividades que redunden no mellor aproveitamento das clases do alumnado. Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos, tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.

Avaliación

	Description	Qualification	Evaluated Competencess		
Prácticas con apoio das TIC	Realizarase unha práctica de Matlab sobre os contidos da materia. A práctica é un 15% da nota de avaliación continua. Tamén se realizarám actividades complementarias. Ditas actividades son un 15% da nota de avaliación continua.	30	CG3 CG4	CE1	CT2 CT6 CT9
Resolución de problemas e/ou exercicios	Realizarase dous exames parciais, o primeiro do tema 1 e o segundo dos temas 2, 3 e 4. Cada un dos exames é un 15% da nota de avaliación continua	30	CG3 CG4	CE1	CT2 CT9 CT16
Exame de preguntas de desenvolvemento	Realizarase un exame final de todos os contidos da materia. O peso na avaliación continua será dun 50%	40	CG3 CG4	CE1	CT1 CT2 CT14 CT16

Other comments on the Evaluation

O alumno deberá presentarse ao exame ordinario de todos os contidos da materia, que suporá o 100% da nota, no caso de que a nota final de avaliación continua sexa inferior a 5 (NEC menor que 5). Adicionalmente, deberá 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.

Nos casos anteriores, a nota final de avaliación continua será: mín{NEC, 4}.

En calquera caso, o alumno que supere a avaliación continua, terá a posibilidade de presentarse ao exame ordinario para subir nota.

A avaliación dos alumnos en segunda e sucesivas convocatorias consistirá nun exame sobre os contidos da materia que suporá o 100% da nota.

COMPROMISO ÉTICO : Espérase que os alumnos teñan un comportamento ético adecuado. Si detéctase un comportamento pouco ético (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros) penalizarase ao alumno coa imposibilidade de superar a materia pola modalidade de avaliación continua (na que obterá unha cualificación de 0.0). Si este tipo de comportamento detéctase en exame ordinario ou extraordinario, o alumno obterá en devandito exame unha cualificación de 0.0.

Bibliografía. Fontes de información

Basic Bibliography

J. Burgos, **Cálculo Infinitesimal de una variable**, McGraw Hill,

J. Burgos, **Cálculo Infinitesimal de varias variables**, McGraw Hill,

J.L. Bradley, K.J. Smith, **Cálculo (Volúmenes 1 y 2)**, Prentice Hall Iberia,

R. Larson, R.P. Hostetler, B.H. Edwards, **Cálculo I y II**, McGrawHill,

Complementary Bibliography

Recomendacións

Other comments

Recoméndase ao alumnado da materia Cálculo I repasar os contidos de trigonometría e de cálculo diferencial e integral correspondentes ao bacharelato.

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo *COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

METODOLOXÍA DOCENTE
No caso da impartición da docencia en modalidade non presencial a actividade docente impartirase mediante Campus Remoto e seguirase usando a plataforma de teledocencia Faitic.

AVALIACIÓN
As probas de avaliación realizaranse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Matemáticas: Álxebra e estatística				
Subject	Matemáticas: Álxebra e estatística			
Code	P52G381V01104			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	9	Basic education	1	2c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	González-Cela Echevarría, Gerardo			
Lecturers	Alvarez Hernandez, Maria González-Cela Echevarría, Gerardo Guzmán Crespo, Francisco Javier			
E-mail	gerarcela@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	O obxectivo que se persegue con esta materia é que o alumno adquira o dominio das técnicas básicas da Álxebra Lineal e da Estatística que son necesarias noutras materias que debe cursar posteriormente na titulación.			

Competencias	
Code	
CG3	Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
CE1	Capacidade para a resolución dos problemas matemáticos que poidan presentarse na enxeñaría. Aptitude para aplicar os coñecementos sobre: álxebra lineal; xeometría; xeometría diferencial; cálculo diferencial e integral; ecuacións diferenciais e en derivadas parciais; métodos numéricos; algorítmica numérica; estatística e optimización.
CT2	Resolución de problemas.
CT5	Xestión da información.
CT6	Aplicación da informática no ámbito de estudo.
CT9	Aplicar coñecementos.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Adquirir os coñecementos básicos sobre matrices, espazos vectoriales e aplicacións lineais.	CG3	CE1	
Manexar as operacións de cálculo matricial e resolver problemas relacionados cos sistemas de ecuacións lineais a través do seu uso	CG3	CE1	CT2
Comprender os fundamentos sobre autovectores e autovalores, espazos vectoriales con produto escalar e formas cuadráticas utilizados noutras materias e resolver problemas básicos relativos a estes temas.	CG3	CE1	CT2 CT9
Adquirir destrezas no manexo e análise exploratorio de bases de datos.	CG3	CE1	CT5
Ser capaz de modelar as situacións de incerteza mediante o cálculo de probabilidades.	CG3	CE1	CT2
Coñecer as técnicas e modelos estatísticos básicos na súa aplicación ao ámbito industrial e realizar inferencias a partir de mostras de datos.	CG3	CE1	CT2 CT5 CT9
Utilizar ferramentas informáticas para resolver problemas dos contidos da materia.	CG3		CT2 CT6
Resultado de aprendizaxe ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.1 - Coñecemento e comprensión das matemáticas e outras ciencias básicas inherentes á sua especialidade de enxeñaría, nun nivel que permita adquirir o resto das competencias do título [nivel de desenvolvemento (básico (1), adecuado (2) e avanzado (3)) do sub-resultado: Adecuado (2)].	CG3	CE1	
Resultado de aprendizaxe ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.2 - A capacidade de identificar, formular e resolver problemas de enxeñaría na sua especialidade; elexir e aplicar de forma adecuada métodos analíticos, de cálculo e experimentales xa establecidos; recoñecer a importancia das restriccions sociais, de saúde e seguridade, ambientais, económicas e industriais [Adecuado (2)].		CE1	CT2 CT9
Resultado de aprendizaxe ENAEE: APLICACIÓN PRÁCTICA DA ENXEÑARÍA: RA5.2 - Competencia práctica para resolver problemas complexos, realizar proxectos complexos de enxeñaría e levar a cabo investigacións propias da sua especialidade [Básico (1)].			CT2 CT9
Resultado de aprendizaxe ENAEE: COMUNICACIÓN E TRABALLO EN EQUIPO: RA7.1 - Capacidade para comunicar eficazmente información, ideas, problemas e solucions no ámbito de enxeñaría e coa sociedade en xeral [Adecuado (2)].			CT5

Resultado de aprendizaxe ENAEE: COMUNICACIÓN E TRABALLO EN EQUIPO: RA7.1 - 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 [Adecuado (2)].	CT5

Contidos	
Topic	
NOTA INFORMATIVA:	Debido a circunstancias sobrevindas no curso 2020-2021 (atraso na data de incorporación dos alumnos de novo ingreso e necesidade de destinar tres semanas a un curso cero de nivelación de coñecementos matemático-físicos que permita iniciar o curso con garantías), programarase o 85% das 225 horas correspondentes a unha materia de 9 ECTS: 192 horas.
Tema 1 (Álxebra). Matrices e sistemas de ecuacións lineais	Matrices. Operacións. Matrices elementais. Forma graduada e graduada reducida. Rango dunha matriz. Matrices inversibles. Cálculo da matriz inversa. Determinante dunha matriz cadrada. Propiedades e cálculo. Sistemas homoxéneos e non homoxéneos. Existencia de solucións.
Tema 2 (Álxebra). Espazos vectoriales e aplicacións lineais	Espazos e subespacios vectoriales. Sistemas de xeradores. Independencia lineal. Bases e dimensión. Sistemas de coordenadas. Cambio de base. Aplicacións lineais. Matriz asociada. Núcleo e rango dunha aplicación lineal.
Tema 3 (Álxebra). Autovalores e autovectores	Autovalores e autovectores. Polinomio característico. Matrices diagonalizables. Polinomios anuladores. Teorema de Cayley-Hamilton. Funcións de matrices. Matriz exponencial dunha matriz cadrada.
Tema 4 (Álxebra). Espazos vectoriales con produto escalar. Formas cuadráticas	Espazos vectoriales con produto escalar. Ortogonalidad. Bases ortonormales. Proceso de ortonormalización de Gram-Schmidt. Diagonalización ortogonal de matrices simétricas. Formas cuadráticas reais. Clasificación. Criterio de Sylvester.
Tema 1 (Estatística). Estatística descritiva e regresión	Concepto e usos da estatística. Variables e atributos. Tipos de variables. Representacións e gráficos. Medidas de localización ou posición. Medidas de dispersión. Análise de datos bivariantes. Regresión lineal. Correlación.
Tema 2 (Estatística). Probabilidade	Concepto e propiedades. Probabilidade condicionada e independencia de sucesos. Teorema de Bayes.
Tema 3 (Estatística). Variables aleatorias discretas e continuas	Concepto. Tipos. Función de distribución dunha variable aleatoria. Variables aleatorias discretas e continuas. Características dunha variable aleatoria. Distribucións notables: Binomial, xeométrica, Poisson, hipergeométrica, uniforme, exponencial, normal. Teorema central do límite.
Tema 4 (Estatística). Inferencia estatística	Conceptos xerais. Distribucións na mostraxe. Estimación puntual. Estimación por intervalos de confianza. Contrastes de hipóteses.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	32	32	64
Resolución de problemas	14	14	28
Prácticas con apoio das TIC	9	10	19
Traballo tutelado	12	0	12
Seminario	18	13	31
Resolución de problemas e/ou exercicios	4	4	8
Exame de preguntas de desenvolvemento	12	18	30
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description

Lección maxistral	O profesor exporá nas clases teóricas os contidos da materia. Os alumnos poderán consultar referencias bibliográficas para o seguimento da materia así como os apuntamentos da materia.
Resolución de problemas	Nas clases de problemas, o profesor resolverá problemas e exercicios tipo. O alumno disporá dunha copia das solucións de todos os exercicios que se realizan ou propoñen nas devanditas clases.
Prácticas con apoio das TIC	Nas prácticas de laboratorio utilizaranse as ferramentas informáticas Matlab e Excel para aplicar a casos prácticos os conceptos expostos nas clases de teoría. O alumno disporá de apuntamentos e guións de prácticas.
Traballo tutelado	Nas titorías en grupo (chamadas internamente seminarios), o alumno terá a posibilidade de expor dúbidas sobre a materia que serán resoltas polo profesor. Adicionalmente, estas titorías poderán ser empregadas para a resolución de dúbidas relacionadas coas prácticas de laboratorio. En ningún caso empregaranse estas sesións para avanzar materia ou para a realización de probas de avaliación.
Seminario	Curso intensivo de 18 horas para aqueles alumnos que suspenderon a materia na primeira convocatoria, previo ó exame en segunda convocatoria.

Atención personalizada

Methodologies	Description
Lección maxistral	Nas sesións maxistrais, o profesor resolverá as dúbidas expostas polos alumnos referentes aos conceptos teóricos expostos nese momento.
Resolución de problemas	Nas sesións destinadas á resolución de exercicios e problemas, o profesor atenderá de forma personalizada as dúbidas expostas polos alumnos.
Prácticas con apoio das TIC	Nas sesións destinadas á realización de prácticas de informática, o profesor atenderá de forma personalizada as dúbidas expostas polos alumnos.
Seminario	No curso intensivo, o profesor atenderá de forma personalizada as dúbidas dos alumnos, expondo exercicios complementarios ou outra clase de actividades que redunden no mellor aproveitamento das clases do alumnado.
Traballo tutelado	Nas tutorías en grupo, o profesor atenderá de forma personalizada as dúbidas dos alumnos, expondo exercicios complementarios ou outra clase de actividades que redunden no mellor aproveitamento das clases do alumnado. Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos, tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.

Avaliación

	Description	Qualification	Evaluated Competencess		
Resolución de problemas e/ou exercicios	Bloque de Álxebra. Realizaranse dous exames parciais dos Temas 1 e 2 (30%).Práctica de Álxebra con Matlab (15%). Actividades complementarias de entrega de exercicios de Álxebra (15%) Bloque de Estatística. Realizaranse dous exames parciais dos Temas 1 e 2 (30%). Práctica de Estatística con Excel (15%). Actividades complementarias de entrega de exercicios de Estatística (15%)	60	CG3	CE1	CT2 CT5 CT9
Exame de preguntas de desenvolvemento	Realizarase un exame final de avaliación continua conxunto da parte de Álxebra e da parte de Estatística. O exame final de avaliación continua será obrigatorio e puntuado sobre 10 puntos.	40	CG3	CE1	CT2 CT5 CT6 CT9

Other comments on the Evaluation

OBSERVACIÓNS XERAIS SOBRE O CÁLCULO DA NOTA:

O cálculo da nota de cada un dos apartados anteriores obterase realizando unha media ponderada entre a nota do Bloque de Álxebra (60%) e o Bloque de Estatística (40%).

No caso de que un alumno non alcance un 4.0 nalgún dos bloques (Álxebra e Estatística) do exame final de avaliación continua ou non asista a algún dos puntuables descritos na sección de avaliación, deberá presentarse ao exame ordinario para superar a materia.

Tanto no exame ordinario como no extraordinario (exame de xullo) avaliaranse todas as competencias da materia.

Para superar a materia, é necesario alcanzar un 5 en cada un dos Bloques (Álxebra e Estatística) por separado, sendo 4.5 a nota máxima dun alumno que teña un bloque suspenso.

COMPROMISO ÉTICO:

Espérase que os alumnos teñan un comportamento ético adecuado. Si detéctase un comportamento pouco ético (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros) penalizarase automaticamente cunha cualificación de 0.0 na convocatoria en curso.

Bibliografía. Fontes de información

Basic Bibliography

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

Nakos, George; Joyner, David, **Álgebra lineal con aplicaciones**, 1ª, Thomson, 1999

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

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

Complementary Bibliography

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

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

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

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

Recomendacións

Other comments

Recoméndase ao alumnado da materia Álxebra e Estatística cursar a materia Cálculo I e repasar as propiedades das funcións trigonométricas, operacións con polinomios, operacións con números complexos e os coñecementos básicos de estatística correspondentes ao bacharelato.

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

=== ADAPTACIÓN DAS METODOLOXÍAS ===
Engadiríase unha nova metodoloxía docente:
Sesión maxistral e sesión práctica virtual síncrona: Impártese a través dunha plataforma de videoconferencia web. Cada sala contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na sala de reunións, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

=== ADAPTACIÓN DA AVALIACIÓN ===
As probas de avaliación realizaranse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Empresa: Introdución á xestión empresarial				
Subject	Empresa: Introdución á xestión empresarial			
Code	P52G381V01105			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1	2c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Puente Luna, Iván			
Lecturers	Arce Fariña, María Elena Puente Luna, Iván			
E-mail	ipuente@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Esta materia enmárcase dentro do módulo de Formación Básica e nela preténdese dar aos alumnos unha visión global das empresas, adquirindo unha serie de coñecementos que lle aproximen á realidade empresarial para a súa aplicación práctica. Preténdese que os alumnos sexan capaces de elixir a forma xurídica máis adecuada ás necesidades dun proxecto empresarial, analizando a contorna da actividade e que así sexan capaces de deseñar a estrutura organizativa máis adecuada para a consecución dos obxectivos a través da xestión das persoas que a integran, tomando decisións acordes co nivel de información dispoñible. Así mesmo, preténdese que poidan elixir o financiamento máis conveniente e utilizar técnicas de produción e mercadotecnia. Búscase alcanzar estes obxectivos para proseguir e abordar a formación noutras materias de cursos posteriores e para poder exercer as capacidades desenvolvidas coa aprendizaxe da materia e, de forma específica, búscase que o enxeñeiro e Oficial da Armada coñeza os ámbitos xurídico-económicos para desempeñar correctamente os seus labores como administrador de fondos públicos.			

Competencias	
Code	
CG9	Capacidade de organización e planificación no ámbito da empresa, e outras institucións e organizacións.
CE6	Coñecemento adecuado do concepto de empresa e marco institucional e xurídico da empresa. Organización e xestión de empresas.
CT1	Análise e síntese.
CT2	Resolución de problemas.
CT7	Capacidade para organizar e planificar.
CT11	Capacidad para comprender o significado e aplicación da perspectiva de xénero nos distintos ámbitos de coñecemento e na práctica profesional co obxectivo de acadar unha sociedade máis xusta e igualitaria.
CT18	Traballo nun contexto internacional.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Coñecer o papel da empresa no eido da actividade económica ea súa contribución a un desenvolvemento máis equitativo da sociedade.		CE6	CT11 CT18
Comprender os aspectos básicos que caracterizan aos distintos tipos de empresa.		CE6	CT1 CT18
Coñecer o marco xurídico dos distintos tipos de empresas.		CE6	CT1
Coñecer os aspectos máis relevantes da organización e a xestión na empresa.	CG9	CE6	CT1 CT18
Adquirir habilidades sobre os procesos que afectan á xestión empresarial.	CG9	CE6	CT2 CT7 CT18
Resultado de aprendizaxe ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.3.- Ser conscientes do contexto multidisciplinar da enxeñaría. [Adecuado (2)].	CG9		
Resultado de aprendizaxe ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.1.- 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. [Básico (1)].			CT2

Resultado de aprendizaxe ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.2.- 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. [Adecuado (2)]			CT1 CT11
Resultado de aprendizaxe ENAEE: PROXECTOS DE ENXEÑARÍA: RA3.1.- 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. [Básico (1)].			CT2 CT7 CT11
Resultado de aprendizaxe ENAEE: APLICACIÓN PRÁCTICA DA ENXEÑARÍA: RA5.5.- Coñecemento das implicacións sociais, de saúde e seguridade, ambientais, económicas e industriais da práctica da enxeñaría [Básico (1)].			CT11
Resultado de aprendizaxe ENAEE: APLICACIÓN PRÁCTICA DA ENXEÑARÍA: RA5.6.- Ideas xerais sobre cuestións económicas, de organización e de xestión (como xestión de proxectos, xestión do risco e do cambio) no contexto industrial e de empresa. [Adecuado (2)].	CG9	CE6	
Resultado de aprendizaxe ENAEE: ELABORACIÓN DE XUÍZOS: RA6.1.- Capacidade de recoller e interpretar datos e manexar conceptos complexos dentro da súa especialidade, para emitir xuízos que impliquen reflexión sobre temas éticos e sociais [Básico (1)].	CG9		CT11
Resultado de aprendizaxe ENAEE: ELABORACIÓN DE XUÍZOS: RA6.2.- Capacidade de xestionar complexas actividades técnicas ou profesionais ou proxectos da súa especialidade, responsabilizándose da toma de decisións [Básico (1)].	CG9		
Resultado de aprendizaxe ENAEE: COMUNICACIÓN E TRABALLO EN EQUIPO: RA7.1.- Capacidade para comunicar eficazmente información, ideas, problemas e solucións no ámbito de enxeñaría e coa sociedade en xeral [Adecuado (2)].			CT1

Contidos	
Topic	
NOTA INFORMATIVA:	Debido a circunstancias sobrevidas no curso 2020-2021 (atraso na data de incorporación dos alumnos de novo ingreso e necesidade de destinar tres semanas a un curso cero de nivelación de coñecementos matemático-físicos que permita iniciar o curso con garantías), programarase o 85% das 150 horas correspondentes a unha materia de 6 ECTS: 128 horas.
Tema 1: A EMPRESA	1.1 Concepto da empresa. 1.2 Marco institucional e xurídico. 1.3 Tipos de empresa. 1.4 Obxectivos da empresa.
Tema 2: DIRECCIÓN ESTRATÉXICA	2.1 A importancia do medio ambiente. 2.2 Tipos de ambientes. 2.3 Análise do medio ambiente xeral e do ambiente competitivo. 2.4 Avaliación do atractivo dun sector ou mercado: Modelo das cinco forzas competitivas de Michael Porter. 2.5 Niveis de xestión e funcións directivas. 2.6 O proceso estratéxico e os tipos de estratexias.
Tema 3: O SISTEMA FINANCIEIRO (PARTE I). ESTRUTURA ECONÓMICA E FINANCIEIRA DA EMPRESA	3.1 A importancia da xestión económico-financeira na empresa. 3.2 Estrutura económica e financeira da compañía: Activos, Custo neto e Responsabilidade. 3.3 Situacións patrimoniais: equilibrio. 3.4 Concepto de contas anuais. 3.5 Diagnóstico económico-financeiro a través da análise de saldo: informes de xestión. 3.6 Capital operativo ou fondo de rotación.
Tema 4: O SISTEMA FINANCIEIRO (PARTE II). OS RESULTADOS DA EMPRESA	4.1 Diagnóstico económico-financeiro a través da análise de ratios. 4.2 Liquidez. 4.3 Solvencia. 4.4 Rentabilidade económica e rendibilidade financeira.
Tema 5: O SISTEMA FINANCIEIRO (PARTE III). INVERSIÓN	5.1 Concepto de investimento. 5.2 Clases de investimentos.
Tema 6: O SISTEMA FINANCIEIRO (PARTE IV). FINANCIACIÓN	6.1 Concepto de financiamento. 6.2 Tipos de orzamentos de financiamento. 6.3 Métodos ou criterios de selección e avaliación. 6.4 Mínimo ou medio período de maduración.
Tema 7: O SISTEMA DE PRODUCIÓN (PARTE I). ASPECTOS XERAIS	7.1 Conceptos asociados á produción. 7.2 Antecedentes. 7.3 Decisións asociadas á función de produción. 7.4 Técnicas para aumentar a produtividade. 7.5 Técnicas de seguridade industrial.

Tema 8: O SISTEMA DE PRODUCIÓN (PARTE II). CUSTOS DE PRODUCIÓN	8.1 Concepto de custo. 8.2 Clasificación dos custos. 8.3 O custo da producción. 8.4 O estado de resultados. 8.5 O limiar de rendibilidade ou bloqueo.
Tema 9: O SISTEMA DE COMERCIALIZACIÓN	9.1 Introdución e conceptos básicos. 9.2 Obxectivos. 9.3 Comportamento do consumidor. 9.4 Plan de comercialización.
Tema 10: O SISTEMA DE ADMINISTRACIÓN (PARTE I). XESTIÓN DE ADQUISICIÓNS	10.1 Definición e características dos proxectos de enxeñería. 10.2 Directrices para a xestión de proxectos. 10.3 O proceso de xestión de adquisición (contratación). 10.4 Especificacións técnicas e administrativas.
Tema 11: O SISTEMA DE ADMINISTRACIÓN (PARTE II). PLANIFICACIÓN E CONTROL	11.1 Concepto de natureza e planificación. 11.2 O proceso de planificación nunha empresa. 11.3 Principios para unha planificación eficaz. 11.4 Natureza e concepto de control. 11.5 Tipos de control.
Tema 12: O SISTEMA DE ADMINISTRACIÓN (PARTE III). XESTIÓN DE RRHH	12.1 Conceptos. 12.2 Cultura e liderado. 12.3 Estrutura das organizacións. 12.4 Busca, selección e contratación. 12.5 Formación e adestramento. 12.6 Valoración e retribución. 12.7 Xestión de talentos.
Tema 13: O SISTEMA DE ADMINISTRACIÓN (PARTE IV). RESPONSABILIDADE SOCIAL CORPORATIVA E SOSTIBILIDADE CORPORATIVA	13.1 Introdución e conceptos básicos. 13.2 Principais impactos ambientais derivados das accións e proxectos empresariais. 13.3 Beneficios da RSE para a organización. 13.4 Investimento socialmente responsable. 13.5 O CSR aplicouse á Defensa. O caso particular da Armada Española. 13.6 Exemplos de aplicación da RSE nas empresas.
PROGRAMACIÓN DE CRÉDITOS PRÁCTICOS	Práctica 1: A empresa e dirección estratéxica. Obxectivos e desenvolvemento: preténdese que o alumno resolva problemas relacionados cos ambientes xerais e competitivos, así como a súa introdución no caso do Modelo das cinco forzas competitivas de Michael Porter. Práctica 2: Análise de estados financeiros. Obxectivos e desenvolvemento: o alumno deberá realizar un diagnóstico económico-financeiro dunha empresa analizando o seu equilibrio e escribindo un informe de resultados. Práctica 3: Financiamento e investimento. Obxectivos e desenvolvemento: O principal obxectivo desta práctica é a familiarización do alumno co financiamento e o investimento da empresa que aplique os sistemas de financiamento, así como a determinación da rentabilidade dun proxecto de investimento VAN e TIR. Práctica 4:A empresa como un conxunto de subsistemas diferenciados. Obxectivos e desenvolvemento: Preténdese que o alumno teña coñecemento da necesidade dunha empresa para ter un conxunto multidisciplinar de expertos técnicos en diferentes campos para poder implementar decisións estratéxicas que lle permitan adaptarse ao ambiente turbulento e polo tanto sobrevivir e / ou aumentar a súa competitividade. Práctica 5: Desenvolvemento e Exposición do caso práctico. Obxectivos e desenvolvemento: Desenvolvemento e presentación oral, por grupos, do Caso Práctico presentado previamente nun seminario da materia: "Aplicación do Modelo de Competitividade das cinco forzas de Porter para avaliar o atractivo dun sector e identificar as súas ameazas e oportunidades". Na sesión de presentación, todos os membros do grupo intervirán e os profesores valorarán individualmente o traballo, a participación eo alcance do coñecemento de cada alumno na sesión de defensa (a través dunha rúbrica deseñada para ese efecto).

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	20	30	50
Estudo de casos	5	5	10
Prácticas de laboratorio	10	10	20
Seminario	17	17	34
Exame de preguntas de desenvolvemento	14	0	14

*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 búscase presentar, detalladamente, os fundamentos básicos do contido dos temas programados, que proporcionen ao alumno os coñecementos necesarios para avanzar na súa aprendizaxe. Desenvolveranse tanto nas clases de Teoría como ao comezo das clases prácticas (pois será necesario desenvolver pequenas sesións maxistrais que introduzan conceptos e trasladen o que se pretende do traballo que a continuación han de desenvolver os alumnos).
Estudo de casos	Dentro das clases de aula, unha das súas dúas metodoloxías docentes (ademais das clases maxistrais) serán as sesións participativas. Nelas, de modo complementario e para reforzar conceptos, realízase, en certas situacións puntuais detectadas como adecuadas, un diagnóstico de situacións reais (estudo de caso) desde o punto de vista empresarial. Para iso analízanse noticias de actualidade de medios de comunicación especializados (en forma de artigos e vídeos), pretendendo xerar un clima participativo, reflexivo e de debate por parte dos alumnos na aula, o cal achega ao profesor información relativa acerca da comprensión de coñecementos. En función da metodoloxía anterior, os alumnos aprecian a aplicación directa e inmediata dos contidos da materia e indúcese o interese pola materia. Por outra banda, o desenvolvemento dos seminarios da materia enfocarase, xa de modo exclusivo, á análise de comentarios de texto e estudo de casos que aborden contidos da materia que se consideren enriquecedores para o alumno, así como profundar en noticias de actualidade. Evidentemente, búscase, de modo primordial, a participación do alumno mediante a xeración de foros de discusión e debate, así como a súa achega de ideas e demostración de coñecementos adquiridos nas clases teóricas.
Prácticas de laboratorio	As prácticas de laboratorio consistirán na resolución de problemas (dirixidos a afianzar os conceptos teóricos abordados nas sesións na aula) contando co apoio directo tutelado e personalizado (traballos de aula) en todo momento polo profesor, para a resolución de dúbidas e achega de consellos derivados da súa experiencia empresarial real. Proporase, na maioría das prácticas, a súa realización en grupo (preferiblemente de dous alumnos) para estimular a colaboración e o enfoque dos diferentes temas sendo máis enriquecedor para o alumno, tentando que o traballo sexa unha acción conxunta dos membros e non individual. Por outra banda, en función da temática da práctica, os alumnos han de presentar en grupo o traballo realizado durante a mesma (presentacións); estas presentacións serán observadas polos demais grupos, xerándose clima de aprendizaxe continua, obxectivo das clases prácticas. A práctica 6 supón, como se indica posteriormente, un caso especial (traballo tutelado); pois, realizada por grupos, na súa presentación han de intervir todos os integrantes de cada un deles e os profesores avaliarán individualmente o traballo, participación e alcance de coñecementos de cada alumno na sesión de defensa (mediante unha rúbrica deseñada para tal fin).
Seminario	O desenvolvemento dos seminarios da materia enfocarase, xa de modo exclusivo, á análise de comentarios de texto e estudo de casos que aborden contidos da materia que se consideren enriquecedores para o alumno, así como profundar en noticias de actualidade. Evidentemente, búscase, de modo primordial, a participación do alumno mediante a xeración de foros de discusión e debate, así como a súa achega de ideas e demostración de coñecementos adquiridos nas clases teóricas. Inclúese neste apartado o Curso intensivo de 15 horas para aqueles alumnos que suspenderon a materia en primeira convocatoria, previo ao exame en segunda convocatoria, ademais de tutorías grupales co profesor.

Atención personalizada	
Methodologies	**Description**

Seminario	No ámbito da acción titorial, distínguense accións de tutoría académica así como de tutoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de tutorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, co desenvolvemento dos temas, casos prácticos, comentarios de texto, etc. As tutorías poden ser individualizadas, pero fomentaranse tutorías grupales para a resolución de problemas relacionados coas actividades a realizar en grupo, ou simplemente para informar ao docente da evolución do traballo colaborativo. Nas tutorías personalizadas, 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. Conxugando ambos os tipos de acción titorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade. Os profesores da materia atenderán persoalmente ás dúbidas e consultas dos estudantes, tanto de xeito presencial, segundo o horario que se publicará na páxina web do centro, como a través dos medios telemáticos (correo electrónico, videoconferencia, foros FAITIC, etc.) baixo a modalidade de cita previa.

Avaliación

	Description	Qualification	Evaluated Competencess
Prácticas de laboratorio	Caso Práctico (CP): realizado por grupos e en cuxa presentación han de intervir todos os integrantes de cada un deles. O enunciado do caso achegarase nunha hora de seminario por parte dos profesores: "Aplicación do Modelo de competitividade das cinco forzas de Porter para avaliar o atractivo dun sector". Os alumnos comezarán nese momento a súa resolución e continuarán coa mesma, así como a súa exposición, na práctica P5 programada na presente Guía Docente. Na sesión de presentación intervirán todos os membros do grupo e os profesores avaliarán individualmente o traballo, participación e alcance de coñecementos de cada alumno na sesión de defensa (mediante unha rúbrica deseñada para tal fin). A exposición celebrarase coa presenza dun profesor do CUD doutro campo docente distinto ó da organización empresarial.	15	CG9 CE6 CT1 CT2 CT7 CT11 CT18
Seminario	Avaliación da participación e seguimento por parte do alumno dos comentarios de textos e noticias de actualidade que se desenvolverán nos Seminarios, así como do cumprimento dos obxectivos das clases prácticas.	15	CG9 CE6 CT1 CT2 CT7 CT18
Exame de preguntas de desenvolvemento	Avaliación do nivel de coñecementos mediante preguntas de desenvolvemento, tanto de conceptos teóricos como de problemas. Realizaranse dúas probas parciais de avaliación continua cuxo contido está en función da materia impartida e unha proba final de avaliación continua (que representará o 40% da nota final).	70	CG9 CE6 CT1 CT2 CT7 CT11 CT18

Other comments on the Evaluation

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. Realizaranse duas (2) probas parciais de avaliación continua. Cada control suporá un 15% na nota de avaliación continua e non eliminarán materia en relación coa proba final. O alumno deberá presentarse ao exame ordinario de todos os contidos da materia, que suporá o 100% da nota, se a nota final de avaliación continua é menor que 5 puntos sobre 10. O alumno tamén terá que presentarse ao exame ordinario se obtén unha nota inferior a 4 puntos sobre 10 no exame final de avaliación continua. Entón, a cualificación da avaliación continua será o mínimo da nota de avaliación continua obtida e 4 puntos (o alumno neste caso obterá como máximo 4 puntos). En calquera caso, o alumno que superase a avaliación continua, terá a posibilidade de presentarse ao exame ordinario para subir nota.

Características da Proba Final (PF):

A proba final de Avaliación Continua, na que se avaliarán os coñecementos teóricos e prácticos, está encamiñada á avaliación da aprendizaxe de todos os contidos seleccionados para a materia e confeccionarase atendendo ás seguintes características:

- En primeiro lugar, debe ser completa, é dicir, aspirará a cubrir toda a materia impartida, ben de forma teórica ou práctica (incluíndo a parte docente impartida desde a realización do segundo parcial), posto que se trata de xulgar o que o alumno sabe da materia, non dunha parte dela.

- En segundo lugar, debe constar dunha serie de cuestións que primen o razoamento conceptual e lóxico, a fin de verificar a madurez intelectual adquirida polos alumnos para obter conclusións a partir das nocións ou as teorías expostas na clase.

Condicionantes da obtención da nota individual do Caso Práctico (CP):

Durante o desenvolvemento da materia proporase a realización dun Caso Práctico por grupos, para o que os profesores achegarán documentación de diferentes ámbitos da materia. A solución do CP obrigará aos alumnos á aplicación de conceptos explicados en clase. O enunciado do CP achegarase nunha hora de seminario por parte dos profesores: "Aplicación do Modelo de competitividade das cinco forzas de Porter para avaliar o atractivo dun sector". Os alumnos comezarán nese momento a súa resolución e continuarán coa mesma, así como a súa exposición, na práctica P5 programada na presente Guía Docente. Valorarase tanto a memoria presentada como a exposición.

Dado que o traballo debe ser avaliado de maneira que se garanta a exigibilidad individual e a interdependencia positiva (isto é, todos os membros do grupo deben traballar e contribuír ao produto final e deben dominar, minimamente, todos os aspectos do proxecto), na sesión de presentación oral, intervirán todos os membros do grupo e, na sesión de defensa, calquera membro do grupo debe poder responder a preguntas do proxecto, 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. É dicir, cada grupo ha de expor a posible solución e nesta exposición ha de participar cada compoñente do devandito grupo, abordando a parte temática que se lle encomendou dentro do CP. Deste xeito, a porcentaxe da nota que recibirá cada alumno obterase en función do seu grao de participación, achega de ideas, exposición, aplicación de conceptos técnicos, etc. á hora de expor as cuestións do CP. Por tanto, e a modo de resumo, na sesión de presentación do CP intervirán todos os membros do grupo e os profesores avaliarán individualmente o traballo, participación e alcance de coñecementos de cada alumno na sesión de defensa (mediante unha rúbrica deseñada para tal fin). A exposición realizarase coa presenza dun profesor do CUD doutro campo docente distinto ó da organización empresarial.

Condicionantes da obtención a nota individual da Avaliación en Seminarios e Prácticas (SP):

O desenvolvemento dos seminarios da materia enfocarase, principalmente, á análise de comentarios de texto que se consideren enriquecedores para o alumno, así como aquelas noticias de actualidade (sobre todo de prensa escrita do ámbito empresarial) que aborden contidos da materia. Evidentemente, búscase a participación do alumno, discusión, debate, achega de ideas e coñecementos, etc. Así mesmo, buscarase o cumprimento dos obxectivos das clases prácticas. O conxunto de aspectos anteriores indicados permitirán aos profesores a formulación da nota individual de cada alumno.

COMPROMISO ÉTICO: Espérase que os alumnos teñan un comportamento ético adecuado. Se se detecta un comportamento pouco ético (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros) penalizarase ao alumno coa imposibilidade de superar a materia pola modalidade de avaliación continua (na que obterá unha cualificación de 0.0). Se este tipo de comportamento detéctase en exame ordinario ou extraordinario, o alumno obterá na devandita convocatoria unha cualificación en acta de 0.0.

Bibliografía. Fontes de información

Basic Bibliography

GONZÁLEZ DOMINGUEZ, FCO. JOSÉ; GANAZA VARGAS, JUAN DOMINGO, **Principios y Fundamentos de la Gestión de Empresas.**, 3ª ed, Pirámide, 2010

RODRIGO ILLERA, CARLOS, **Administración y Funciones de Empresa.**, 1ª ed, Sanz y Torres, 2008

RODRIGO ILLERA, CARLOS, **Ejercicios de Administración y Funciones de Empresa.**, 1ª ed, Sanz y Torres, 2008

AREA MALLO, PASCUAL, **Economía de la Defensa.**, Ministerio de Defensa, 2009

HERNÁNDEZ OLIVENCIA, A., ALEMÁN ARTILES, V., SOTO RODIL, J. C., AIZPURU DIAZ DE TERÁN, J. J., **Gestión y Administración Militar.**, Ministerio de Defensa, 1999

Complementary Bibliography

FANJUL, JOSÉ LUIS.; CASTAÑO, F. J., **Proyecto Empresarial.**, 1ª ed, Editex, 2001

GONZÁLEZ GONZÁLEZ, MANUEL JESÚS; PÉREZ ZABALETA, AMALIA; CASTEJÓN MONTIJANO, RAFAEL; MÉNDEZ PÉREZ, E, **Introducción a la Economía.**, 3ª ed, Pearson Educación, S.A, 2004

GREGORY MANKIW, NICHOLAS, **Principios de Economía.**, 4ª ed, Thomson, 2007

HERRERO PALOMO, JULIÁN, **Administración, gestión y comercialización en la pequeña Empresa.**, 1ª ed, Thomson Paraninfo, 2003

MÉNDEZ PÉREZ, ESTER; PÉREZ ZABALETA, AMALIA, CASTEJÓN MONTIJANO, RAFAEL; GONZÁLEZ GONZÁLEZ, MANUEL J, **Introducción a la Economía. Ejercicios y Prácticas.**, 3ª ed, Pearson Educación, S.A., 2004

MUÑIZ GONZÁLEZ, RAFAEL, **Marketing en el siglo XXI.**, 3ª ed, Centro de Estudios Financieros (CEF), 2010

SANTESMASES MESTRE, MIGUEL, **Marketing: conceptos y estrategias.**, 6ª ed, Pirámide, 2012

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

CRUELLES RUIZ, JOSÉ AGUSTÍN, **Stocks, Procesos y Dirección de operaciones.**, 1ª ed, Ed. Marcombo, 2012

CRUELLES RUIZ, JOSÉ AGUSTÍN, **Mejora de métodos y tiempos de fabricación.**, 1ª ed, Ed. Marcombo, 2012

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

Recomendacións

Other comments

Esta materia non ten ningún tipo de prerrequisito nin se presupón coñecemento previo algún sobre a materia. Os coñecementos e destrezas que se adquiren ao ser cursada, permitirán desenvolver con máis facilidade a materia de terceiro curso Fundamentos de Organización de Empresas.
Para que se poida cursar con éxito a materia é recomendable que os alumnos posúan: capacidade de comprensión escrita e oral ben desenvolvida, capacidade de abstracción e síntese da información, destrezas para o traballo en grupo e para a comunicación grupal.

Plan de Continxencias

Description

Ante a incerta e imprevisible evolución da alerta sanitaria provocada pola COVID- 19, a Universidade establece una planificación extraordinaria que se activará no momento en que as administracións e a propia institución o determinen atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou non totalmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun xeito mais áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes DOCNET.

A continuación, recóllense os apartados desta guía docente que sufrirán modificacións no caso de ter que abordarse o ensino virtual:

a) Sección 8 (METODOLOXÍA DOCENTE)
Engádense dúas novas metodoloxías de ensino:

8.4. Sesión maxistral e / ou sesión práctica virtual sincrónica
Impártese a través dunha plataforma de videoconferencia web. Cada sala contén varios paneis de exposición e compoñentes, cuxo deseño pódese personalizar para adaptarse mellor ás necesidades da clase. Na aula virtual, os profesores (e os participantes autorizados) poden compartir a pantalla ou ficheiros no seu equipo, empregar unha pizarra, chat, transmisión de audio e vídeo ou participar en actividades interactivas en liña (enquisas, preguntas, etc.).

8.5 Foros de discusión
Actividades desenvolvidas nun ambiente virtual para resolver dúbidas e / ou debatir sobre cuestións que xorden durante o estudo da materia.

b) Sección 10 (AVALIACIÓN DO APRENDIZAXE)
As probas de avaliación realizaranse mediante plataformas de teledocencia.

Notas:
- No caso de impartirse na modalidade non presencial, a actividade docente impartirase combinando a plataforma FAITIC - Moodle de ensino a distancia e o Campus Remoto da Universidade de Vigo, para garantir a accesibilidade dos estudantes aos contidos docentes.
- Non procede a modificación dos CONTIDOS a impartir.

IDENTIFYING DATA				
Física: Física II				
Subject	Física: Física II			
Code	P52G381V01106			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1	2c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Vázquez Carpentier, Alicia			
Lecturers	Cocheteux Lourido, Roberto Ramón Vázquez Carpentier, Alicia			
E-mail	avcarpentier@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Os obxectivos fundamentais, que comparten tanto esta materia como a súa predecesora Física I, son por unha banda, a consolidación, co adecuado rigor conceptual e formal, de coñecementos previamente adquiridos, e, por outra, o establecemento das bases necesarias para o estudo ulterior doutras disciplinas, de carácter básico ou fundamental. Todo iso de forma que o obxectivo final non sexa a mera especulación teórica senón a aplicación dos coñecementos adquiridos á tecnoloxía, a través dos oportunos modelos e esquemas físico-matemáticos. Desenvolveranse as aptitudes e destrezas necesarias para a resolución de problemas técnicos relacionados coa Física, practicando a metodoloxía analítico-deductiva propia desta ciencia. O programa da materia Física II do Grao en Enxeñaría Mecánica divídese en dous grandes bloques: Termodinámica e Electricidade e Magnetismo, os cales se desenvolverán en oito temas tal e como se detalla na programación da materia. Esta materia é clave para entender materias que serán estudadas posteriormente como son Termodinámica e Transmisión de Calor, Enxeñaría Térmica I, Fundamentos de Electrotecnia ou Tecnoloxía Electrónica. O primeiro bloque articúlase en sete capítulos que seguirán un desenvolvemento case-cronolóxico do electromagnetismo clásico. Do mesmo xeito que neste primeiro bloque, no segundo bloque desenvolverase unha parte da formulación clásica da Termodinámica resumida en tres apartados.			

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

Resultados de aprendizaxe			
Learning outcomes	Competences		
Comprender os conceptos básicos sobre leis xerais do electromagnetismo e da termodinámica.	CG3	CE2	CT2 CT9 CT10
Coñecer a instrumentación básica para medir magnitudes físicas.	CG3	CE2	CT2 CT9 CT10
Coñecer as técnicas básicas de avaliación de datos experimentais.	CG3	CE2	CT2 CT9 CT10
Desenvolver solucións prácticas a problemas técnicos elementais da enxeñaría nos ámbitos do electromagnetismo e da termodinámica.	CG3	CE2	CT2 CT9 CT10
Resultado de aprendizaxe ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.- Coñecemento e comprensión das matemáticas e outras ciencias básicas inherentes a súa especialidade de enxeñería nun nivel que permita adquirir o resto das competencias do título. Axeitado (2)	CG3	CE2	
Resultado de aprendizaxe ENAEE: ANÁLISE EN ENXEÑERÍA: RA2.- A capacidade de identificar, formular e resolver problemas de enxeñería na súa especialidade; escoller e aplicar de xeito axeitado métodos analíticos, de cálculo e experimentais xa establecidos; recoñecer a importancia das restricción sociais, da saúde e seguridade, ambientais, económicas e industriais. Axeitado (2).		CE2	CT2 CT9
Resultado de aprendizaxe ENAEE: INVESTIGACIÓN E INNOVACIÓN: RA3.- Capacidade e destreza para proxectar e levar a cabo investigacións experimentais, interpretar resultados e chegar a conclusións no seu campo de estudio. Básico (1).		CE2	CT9

Contidos	
Topic	
NOTA INFORMATIVA	Debido a circunstancias sobrevindas no curso 2020-2021 (atraso na data de incorporación dos alumnos de novo ingreso e necesidade de destinar tres semanas a un curso cero de nivelación de coñecementos matemático-físicos que permita iniciar o curso con garantías), programarase o 85% das 150 horas correspondentes a unha materia de 6 ECTS: 128 horas.
1. CAMPO ELÉCTRICO I	1.1. Carga eléctrica. Natureza e unidades. Materiais condutores e illantes. 1.2. Forzas electrostáticas. Lei de Coulomb. Campo eléctrico: Definición e unidades. Campo eléctrico orixinado por cargas puntuais. 1.3. Campo eléctrico orixinado por distribucións de carga. Fluxo electrostático. Aplicación do teorema de Gauss á determinación de campos electrostáticos en configuracións típicas. 1.4. Traballo da forza electrostática. Enerxía potencial electrostática. Potencial eléctrico: Definición e unidades. Superficies equipotenciales. 1.5. Potencial eléctrico orixinado por cargas puntuais ou distribucións de carga. Campo eléctrico e potencial en condutores e illantes. Caso de configuracións típicas.
2. CAMPO ELÉCTRICO II	2.1. Vectores campo eléctrico, polarización e desprazamento eléctrico. Permitividade relativa. 2.2. Capacidade electrostática. Definición e unidades. Condensadores. 2.3. Capacidade de condensadores. Análise particular dos casos plano, cilíndrico e esférico. 2.4. Enerxía electrostática.
3. CORRENTE ELÉCTRICA	3.1. Transporte de cargas baixo diferenzas de potencial. Intensidade e densidade de corrente. Definición e unidades. 3.2. Condutividade e resistividade. Conductancia e resistencia. Definición e unidades. Lei de Ohm.
4. CAMPO MAGNÉTICO I	4.1. Fontes do campo magnético. Campo de indución magnética orixinado por unha carga en movemento e un elemento de corrente. Lei de Biot-Savart. 4.2. Cálculo do campo de indución magnética orixinado por configuracións sinxelas de corrente: Condutor recto de gran lonxitude a unha distancia dada e expira circular de corrente nos puntos do seu eixo. 4.3. Forza mutua entre condutores rectos paralelos. Definición do Amperio no Sistema Internacional. 4.4. Lei de Ampère. Aplicacións: Solenoide moi longo e solenoide toroidal. 4.5. Campos magnéticos en medios materiais. Susceptibilidade magnética e vectores magnetización e intensidade de campo magnético. 4.6. Distintos tipos de materiais atendendo ao valor do seu susceptibilidade magnética.
5. CAMPO MAGNÉTICO II	5.1. Introdución ao magnetismo. Magnetismo natural. Experiencia de Oersted. Forza de Lorentz. 5.2. Análise de casos particulares de movemento de cargas en campos magnéticos. Aplicacións. 5.3. Forza magnética sobre condutores que transportan correntes. Momento de forzas sobre expiras de corrente. Momento magnético dipolar dunha expira. 5.4. Aplicacións: Motor de corrente continua, bomba electromagnética e efecto Hall.
6. INDUCIÓN ELECTROMAGNÉTICA	6.1. Forza electromotriz inducida por variacións do fluxo de campo magnético. Introdución experimental. Lei de indución de Faraday-Henry e lei de Lenz. 6.2. Forza electromotriz inducida polo movemento de correntes no seo de campos magnéticos. Aplicacións: Dinamos e alternadores. 6.3. Indución mutua entre expiras. Autoinducción. Coeficientes de autoinducción e indución mutua. Unidades. 6.4. Enerxía almacenada polo campo magnético. Formulación en termos de fluxos magnéticos e intensidades. Aplicacións.
7. ONDAS ELECTROMAGNÉTICAS	7.1. Revisión da lei de Ampère. 7.2. Ecuacións de Maxwell. 7.3. Vector de Poynting. 7.4. Onda plana electromagnética. Propiedades.
8. PRIMEIRO PRINCIPIO DA TERMODINÁMICA	8.1. Sistemas termodinámicos. 8.2. Traballo. Traballo realizado ao cambiar de volume. 8.3. Primeira lei da termodinámica. 8.4. Transformacións termodinámicas. 8.5. Termodinámica dos gases ideais.

9. SEGUNDO PRINCIPIO DA TERMODINÁMICA	9.1. Máquinas térmicas. 9.2. A segunda lei da termodinámica. 9.3. Ciclos térmicos. 9.4. O ciclo de Carnot. 9.5. Entropía e interpretación física. 9.6. O teorema de Nerst. A terceira lei da Termodinámica. 9.7. Móbil perpetuo de primeira e segunda especie.
LABORATORIO	1.- Instrumentos e métodos de medidas eléctricas. 2.- Condensadores. 3.- Campo eléctrico I. 4.- Indución electromagnética. 5.- Relación P-V nun gas pechado.

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	24	36	60
Prácticas de laboratorio	10	11	21
Traballo tutelado	10	5	15
Seminario	6	0	6
Exame de preguntas de desenvolvemento	13	13	26

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

Metodoloxía docente

	Description
Lección maxistral	O profesor exporá nas clases teóricas os contidos da materia. Para o seu desenvolvemento proxectaranse presentacións e utilizarase o encerado simultaneamente. Puntualmente recorrerase ao emprego de medios informáticos. O alumno disporá de copias do material proxectado, para facilitar a toma de notas e o seguimento das sesións. Os alumnos poderán ademais consultar textos básicos para o seguimento da materia. A participación fomentarase con preguntas, técnicas de motivación como erros intencionados, solucións incompletas, etc. Cada sesión terá unha duración de 1 h e implica unha atención personalizada en grupos.
Prácticas de laboratorio	Nestas clases prácticas utilizaranse os medios dispoñibles no laboratorio do centro. Para algunha das sesións será necesario empregar a ferramenta informática MATLAB para manexar unha serie de ferramentas de ensaio de conceptos introducidos nas sesións teóricas. Con respecto ás clases prácticas de laboratorio, o alumno debe ter en conta as seguintes directivas, as cales serán de obrigatorio cumprimento: - As sesións prácticas son obrigatorias e de carácter presencial, - Débese entregar o informe correspondente a cada unha das prácticas de laboratorio programadas. Contémplase o caso de que o informe sexa entregado en branco co nome ou os nomes dos alumnos (considérase como entregado e con cualificación 0), - Os alumnos que non cumpran algún dos dous requisitos anteriores non poderán superar o laboratorio, - O momento de entrega das prácticas será establecido polo profesor en cada sesión.
Traballo tutelado	O alumno deberá confeccionar un documento sobre un dos temas propostos relacionados cos contidos da materia. Ofertaranse uns temas de actualidade onde o alumno poida entender a aplicación directa dos principios físicos que se estudan. Durante o transcurso do cuadrimestre, proporase ao alumno unha serie de exercicios sobre os contidos da materia que deberá resolver de forma autónoma. A elaboración destas actividades complementarias non é obrigatoria, pero en caso de non realizalas o alumno terá unha valoración de cero puntos neste apartado.
Seminario	Posto que a acción titorial afróntase como unha actuación de apoio grupal ao proceso de aprendizaxe do alumno, as titorías realizaranse preferentemente en seminarios e baixo o formato de reunións de grupo pequenos. Nos seminarios inclúense dous tipos de actividades presenciais: resolución de problemas e exercicios (os problemas serán propostos polo docente; ademais o traballo en grupos reducidos fomenta unha maior participación do alumnado), e titoría en grupos (tal e como aparece reflectido na memoria de grao, as actividades formativas deben fomentar unha aprendizaxe colaborativa; neste sentido os debates dirixidos polo docente en pequenos grupos de discusión presentaranse como unha técnica eficaz de aprendizaxe colaborativa que favorece o intercambio de ideas e estimula a motivación). Ao terminar o curso impartirase unha serie de seminarios en formato de curso intensivo (10 horas) para que os alumnos que non superasen a materia poidan repasar os conceptos fundamentais e realizar máis exercicios baixo a supervisión do profesor.

Atención personalizada

Methodologies	Description

Traballo tutelado	Nas titorías personalizadas, cada alumno, de maneira individual, poderá comentar co profesor calquera problema que lle estea impedindo realizar un seguimento axeitado da materia, co fin de atopar entre ambos algún tipo de solución. O profesor da materia atenderá persoalmente as dúbidas e consultas dos alumnos, tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de correo electrónico ou a través doutros medios telemáticos (uso do despacho virtual mediante cita previa, videoconferencia, uso de foros de FAITIC, etc.).

Avaliación

	Description	Qualification	Evaluated Competencess
Lección maxistral	Probas de avaliación continua (P1 e P2): Realizaranse ao longo do cuadrimestre. As probas realizaranse nas clases teóricas a proposta dos profesores. A realización da proba será obrigatoria e esixible para superar a materia.	30	CG3 CE2 CT2 CT9 CT10
Prácticas de laboratorio	Avaliación de prácticas de laboratorio (EP): Ao longo do cuadrimestre, en determinadas sesións de prácticas exporanse problemas ou exercicios para a súa resolución polos alumnos (de modo individual ou en grupo) e posterior entrega ao profesor, que os avaliará de acordo cos criterios que con anterioridade se comunicaron aos alumnos. As memorias non entregadas contarán cun cero para facer media. A nota desta compoñente será a media das notas de todas as memorias. Algunhas prácticas avaliaranse mediante a realización de pequenos cuestionarios avaliables relacionados co traballo realizado durante a práctica e a súa posterior análise.	15	CG3 CE2 CT2 CT9 CT10
Seminario	Actividades complementarias: durante o transcurso da asignatura proporanse actividades (problemas, traballos complementarios ...) co obxectivo de que os alumnos os resolvan de forma autónoma e os expoña na aula. Valoraranse tanto a resolución como a explicación do proceso resolutivo ademais das capacidades de expresión oral, comprensión e exposición en público.	15	CG3 CE2 CT2 CT9 CT10
Exame de preguntas de desenvolvemento	Exame final de avaliación continua (PF): Realizarase un exame final que abarcará a totalidade dos contidos da materia, tanto teóricos como prácticos. Esíxese alcanzar unha cualificación mínima de 4 puntos sobre 10 posibles para poder optar ao aprobado por avaliación continua.	40	CG3 CE2 CT2 CT9 CT10

Other comments on the Evaluation

A avaliación final do alumno atenderá á suma da puntuación outorgada a cada unha das partes antes comentadas, sendo a súa nota de avaluación continua (NEC):

$NEC = 0.15 \cdot P1 + 0.15 \cdot P2 + 0.15 \cdot EP + 0.15 \cdot AC + 0.40 \cdot PF$

Ademais, debido a que a materia está dividida en dous grandes bloques temáticos ben diferenciados (electromagnetismo e termodinámica), esixirase unha nota mínima de 4 en cada un dos bloques para poder facer media. A porcentaxe correspondente a cada bloque nos exámenes ordinario e extraordinario virá determinada pola proporción de horas de teoría impartidas en cada bloque. Por este motivo, o bloque de electromagnetismo suporá un 78% da nota final e o bloque de termodinámica suporá o 22% restante.

Por tanto, esixiranse uns requisitos mínimos e condicións nalgúns dos apartados que garantan o equilibrio entre todos os tipos de competencias.

O alumno deberá presentarse ao exame ordinario de todos os contidos da materia, que suponá o 100% da nota, nos seguintes supostos:

A. Non alcanzar a nota mínima establecida en cada un dos bloques ou na proba final de avaliación continua.

B. Obter unha nota inferior a 5 puntos sobre 10 na nota de avaluación continua. (*NEC inferior a 5*).

A calificación da avaliación continua do alumno que incumpra o suposto A, será o mínimo entre *NEC* e 4 puntos.

Unha vez finalizado o segundo cuadrimestre, organizarase un curso intensivo de 10 horas de duración para preparar o exame extraordinario.

A continuación, detállanse as medidas a adoptar se se detéctase fraude académico nalgunha das probas avaliables.

- Avaluación continua

- Durante o proceso de avaluación continua, se se detéctase fraude académico nalgunha das probas avaliables, tanto de teoría como de laboratorio, este feito suporá para todos os implicados unha calificación de 0 na devandita proba.
- No caso de que o feito se produza durante a realización do exame final de avaluación continua, iso suporá para todos os implicados a calificación de 0 na convocatoria en vigor, debendo presentarse obrigatoriamente ao exame extraordinario para superar a materia.

- Exámenes ordinario e extraordinario

- No caso de que o feito se produza durante a realización dos exámenes ordinario ou extraordinario, iso suporá para todos os implicados a calificación de 0 na convocatoria en vigor.

Bibliografía. Fontes de información

Basic Bibliography

Young H.D., Freedman R.A., **Física Universitaria, V1 y V2**, 13, Pearson Educación, 2013

De Juana J., **Física General (VOL. II)**, 2, Pearson Educación, 2007

Fernández J.L., Pérez-Amor M. J., **Guía para la resolución de problemas de electromagnetismo. Problemas resueltos.**, 1, Reverté, 2012

Fidalgo J. A. y Fernández M. R., **1000 Problemas de física general**, 8, Everest S. A., 2004

González F.A., **La Física en problemas**, 1, Tébar Flores, 2002

Pellicer J., Manzanares J.A., **100 problemas de Termodinámica**, 1, Alianza Editorial, 1996

Complementary Bibliography

Serway R. A., Jewett J. W., **Física para ciencias e ingeniería V1 y V2s**, 7, Cengage Learning, 2008

Tipler P., Mosca, B., **Física para la ciencia y la tecnología, V1 y V2**, 6, Reverté, 2010

Wangsness R. K., **Campos electromagnéticos**, 1, Limusa, 2001

Recomendacións

Other comments

A materia de Física II constitúe un elemento de ligazón entre os coñecementos que sobre o seu contido adquiríronse en etapas anteriores e os que haberán de asimilarse en fases máis avanzadas. Esta disciplina, de carácter fundamental, proporciona a base conceptual necesaria para proseguir, no seu caso, o estudo doutras materias de análogo carácter e, en xeral, daqueloutras conexas específicas do plan de estudos da correspondente titulación. É por iso que para cursar con éxito esta materia o alumno debe ter:
- nocións básicas adquiridas nas materias de Física e Matemáticas en cursos previos de Bacharelato ou equivalentes (recoméndase o seu repaso)
- capacidade de comprensión escrita e oral
- capacidade de abstracción, cálculo básico e síntese da información
- destrezas para o traballo en grupo e para a comunicación grupal

Plan de Continxencias

Description

Ante a incerta e imprevisible evolución da alerta sanitaria provocada pola COVID- 19, a Universidade establece una planificación extraordinaria que se activará no momento en que as administracións e a propia institución o determinen atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou non totalmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun xeito mais áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes DOCNET.

A continuación, móstranse os apartados da presente guía docente que sufrirán modificación no caso de ter que abordar a docencia en modalidad virtual:

6.2 PROGRAMACIÓN: CRÉDITOS PRÁCTICOS
As prácticas, cando se realicen en Modalidade non presencial: O alumno traballará sobre material gráfico facilitado polo profesor. Cando sexa posible proporáselle un exercicio práctico relacionado co tema para que poida realizar pola súa conta e con material disponible nunha casa.

8. METODOLOXÍA DOCENTE
Engádese unha nova metodoloxía docente:

Sesión maxistral e/ou sesión práctica virtual síncrona: impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar un encerado, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

10. AVALIACIÓN

As probas de avaliación realizaranse, en caso de paso a docencia virtual, combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Computer science: Computing for engineering				
Subject	Computer science: Computing for engineering			
Code	P52G381V01107			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Rodelgo Lacruz, Miguel			
Lecturers	Barragáns Martínez, Ana Belén Fernández Gavilanes, Milagros Rodelgo Lacruz, Miguel			
E-mail	mrodelgo@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course belongs to the module of Basic Formation, and its main goal is providing to the students an overview of the world of the computers. The course is focused on making the students to learn how a computer works internally, from hardware and software perspective, as well as to design programs employing a high level language. It is proposed a course of computing and conceptual programming sufficiently general, oriented to provide to the student a perspective of designer and programmer of small applications. Although the course is not oriented to the study of a particular operating system or programming language, it does necessary employ a concrete language in the realization of the practical activities, becoming the learning of this language a secondary aim of the course.			

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

Learning outcomes	Competences		
Computer and operating system skills.	CG3 CG4	CE3	CT2 CT5 CT6 CT7
Basic understanding of how computers work	CG3	CE3	CT1 CT6
Database fundamentals	CG3	CE3	CT5 CT6
Capability to implement simple algorythims using a programming language	CG3 CG4	CE3	CT1 CT2 CT5 CT6 CT7 CT17
Structured and modular programming fundamentals	CG3	CE3	CT6 CT7
Skills regarding the use of computer tools for engineering	CG3 CG4	CE3	CT5 CT6

ENAEE learning outcome: KNOWLEDFE AND UNDERSTANDING: LO1.1- Knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes [Intermediate (2)].	CG3	CE3	
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)].	CG4	CE3	CT1 CT2
ENAEE learning outcome: ENGINEERING DESIGN: LO3.2.- Ability to design using some awareness of the forefront of their engineering specialisation [Intermediate (2)].	CG4	CE3	CT1 CT2
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.2.- Practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Intermediate (2)].	CG4	CE3	CT2
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)].			CT7 CT17

Contents	
Topic	
INFORMATION NOTE	Due to circumstances that have arisen in the 2020-2021 academic year (delay in the date of incorporation of new students and the need to spend three weeks on a zero level course of mathematical-physical knowledge to allow the course to begin with guarantees), 85% of the 150 hours corresponding to a subject of 6 ECTS will be programmed: 128 hours.
Concepts and basic programming techniques applied to engineering	Objectives and development: This topic aims to explore the concepts and basic programming techniques and algorithms, as well as modular and structured programming methodologies. Topic index: Introduction to programming. Programming methodologies. - Modular programming. - Structured programming. Algorithms and its description. Programming languages. Phases in the development of a program. Conclusions.
Introduction to C programming language	Objectives and development: Once the student has mastered the basic concepts of programming, this unit introduces the C programming language. Most of this unit will be addressed in the practical sessions of the course. Topic index: Data types - Variables. - Expressions. - Operators. Structure of a C program. - Style in programming. - Basic instructions. - Sequential structure. The conditional structure. - Simple conditional structure. - Multi-conditional structure. The repetitive structure. - Repetitive structures controlled by condition. - Repetitive structures controlled by counter. Strings and arrays. - Strings. - Vectors and matrices. Structured programming. Modules and subroutines. - Definition of functions. - Passing parameters by value and by reference. Files. - Input and output with format. - Handling files. Conclusions.

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

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	12	24	36
Practices through ICT	14	21	35
Project based learning	10	12	22
Seminars	10	0	10
Problem solving	6	0	6
Systematic observation	0	0	0
Essay questions exam	11	4	15
Essay questions exam	2	2	4

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

Methodologies

	Description

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

Personalized assistance

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

Assessment

	Description	Qualification	Evaluated Competencess

Project based learning	The assessment of the programming project (practice 6) will be done by means of the following collection of strategies employed to value the process of project based learning: - Assessment of initial design of the project: 5% (Competencies CG3, CG4, CE3, CT1, CT6, CT7, CT17). - Delivered final product (code and report): 20% (Competencies CG3, CG4, CE3, CT1, CT2, CT5, CT6, CT7, CT17). - Improvements carried out over the initial specification of the project: 5% (Competencies CG3, CG4, CE3, CT1, CT2, CT5, CT6, CT7, CT17). - Project defense (personal interview): 10% (Competencies CG4, CE3, CT6, CT17). Since the project has to be evaluated so that it is guaranteed the individual work as well as the positive interdependence (this is, all the members of the group must have worked and contributed to the final product and have to control all the aspects of the project), in the session of oral presentation, all the members of the group will intervene and, in the defence session, any member of the group must be able to answer to any question regarding the project, independently of the part in which they were specialised. All of them must show, therefore, deep knowledge of the delivered product, independently of the part on which they had focused their efforts.	40	CG3 CG4	CE3	CT1 CT2 CT5 CT6 CT7 CT17
Systematic observation	The participation and attitude of the student will be assessed during all the semester in theoretical classes and seminars as well as contributions in the online teaching platform.	5	CG4		CT2 CT6 CT7
Essay questions exam	Written exam: theoretical questions and problems The main goal of this exam is to assess the learning of all of the theoretical contents of the course. This exam must be complete, i.e., it will cover all of the contents, since the main goal is to assess what students know about the subject in general, not of a part of it. Second, the exam has to consist in a series of questions that make the conceptual and logical reasoning prevail, in order to verify the intellectual maturity of the students to obtain conclusions from the notions or the exposed theories in class.	35	CG3 CG4	CE3	CT1 CT2 CT6
Essay questions exam	The evaluation of the practices (with the exception of the practice 6 - project of programming) will be carried out through an examination of questions where it will be assessed the knowledge acquired by the student in the laboratory. This way, the instructor will ask about any aspect related to the practices implementation.	20	CG3 CG4	CE3	CT1 CT2 CT6

Other comments on the Evaluation

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

The final assessment of student will be the sum of the punctuation awarded to each one of the before commented parts, being their grade of continuous evaluation (CEG): CEG = 0,35 * THEORY EXAM GRADE + 0,4 * PROJECT GRADE + 0,2 * PRACTICAL EXAM GRADE + 0,05 * PARTICIPATION.
However, some minimum requirements in any of the sections will be demanded to guarantee the balance between all the types of competencies. Those requirements are: 1. To get at least a 5 over 10 in the project evaluation. 2. To get at least a 4 over 10 in the theory exam.
Those students that do not fulfil any of the previous requirements, will have to attend to the ordinary examination to be able to pass the course, and their grade of continuous evaluation will be calculated as follows: FINAL_CEG = min(4,CEG).
All those students that wish to improve their qualification (obtained by continuous evaluation) will be able to attend to the ordinary exam. So much in the ordinary exam as in the extraordinary (July) all the competencies of the course will be evaluated. Thus, said examinations will include a practical programming test in the laboratory. Once finished the second semester, an intensive course (10 hours long) is organized to prepare the extraordinary exam.
ETHICAL COMMITMENT: it is expected that the students show an appropriate ethical behaviour. If any unethical behaviour (cheating, plagiarism, use of unauthorized electronic devices or others) is detected, the student will be punished with the impossibility to pass the course by continuous evaluation (where she/he would obtain a qualification of 0.0). If this type of behaviour occurs in ordinary or extraordinary exams, the student will obtain a qualification in the academic record of 0.0.

Sources of information

Basic Bibliography

Osvaldo Cairó, **Fundamentos de Programación: Piensa en C**, 978-9702608103, Pearson Prentice Hall, 2006

Complementary Bibliography

A. Silberschatz, P. Galvin, y G. Gagne, **Operating Systems Concepts**, 978-0470128725, 8ª edición, John Wiley & Sons, 2008

Gregorio Fernández Fernández, **Curso de Ordenadores. Conceptos básicos de arquitectura y sistemas operativos**, 84-7402-304-1, 5ª Edición, 2ª Edición en el Servicio de Publicaciones de la E.T.S.I. Telecomunicación. UPM, 2004

Recommendations

Other comments

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

Contingency plan

Description

In case the situation caused by COVID-19 results in the suspension of on-site activity, the following aspects must be considered.

ADAPTATION OF THE CONTENTS

The modification of the theoretical contents of the course is not considered necessary, given that the theoretical and seminar classes could be carried out by telematic means in a similar way to face to face.

The practices would be adapted in time and complexity to the situation of non physical attendance to be carried out by means of e-learning platforms, in a similar way to the face to face one.

The virtual machine, which is provided to the students, will allow them to work autonomously, especially in the programming project, and to carry out the practices remotely.

ADAPTATION OF TEACHING METHODOLOGIES

The following teaching methodology will be included:

Synchronous virtual masterclasses/practices: It is given through a web video-conference platform. Each virtual classroom contains various display panels and components, that can be customized to best suit the needs of the class. In the virtual classroom, the teacher (and those authorized participants) can share their computer screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).

Theoretical and seminar classes will be conducted via participatory video conferencing. For the practical sessions, the same platform will be used with the support of the virtual machine distributed to the students.

ADAPTATION OF THE EVALUATION

The modification of the evaluation system is not considered necessary, but its format should be changed, since it would be carried out remotely by telematic means combining the FAITIC-Moodle e-learning platform and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Química: Química				
Subject	Química: Química			
Code	P52G381V01108			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	1	2c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Urrejola Madriñán, Santiago Rafael			
Lecturers	Alfonsín Pérez, Víctor Ángel Devesa Rey, Rosa Urrejola Madriñán, Santiago Rafael			
E-mail	urrejola@cud.uvigo.es			
Web	http://faitic.uvigo.es/			
General description	A Química é unha disciplina científica que estuda tanto a composición, estrutura e propiedades da materia, como os cambios que esta experimenta durante as reaccións químicas e a súa relación coa enerxía. Desde o punto de vista da titulación, a enxeñaría aplica os coñecementos químicos á produción de forma económica de materiais e produtos químicos especiais co mínimo impacto adverso sobre o medio ambiente. Esta materia de primeiro curso de grao en enxeñaría mecánica pretende explicar ao alumno as bases da química que poida aplicar ao longo da súa vida profesional. O obxectivo global desta materia é introducir os conceptos teóricos básicos que permitan ao alumnado comprender a natureza da materia, pasando dos átomos ás moléculas e destas aos estados de agregación (sólidos, gases e líquidos), introducindo as forzas intermoleculares. Achegaranse os fundamentos de cinética química e termodinámica necesarios para poder comprender as reaccións e equilibrios químicos. E por último, introduciranse conceptos básicos de química orgánica e inorgánica, así como diferentes aplicacións industriais da química.			

Competencias	
Code	
CG3	Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
CE4	Capacidade para comprender e aplicar os principios de coñecementos básicos da química xeral, química orgánica e inorgánica, e as súas aplicacións na enxeñaría.
CT2	Resolución de problemas.
CT10	Aprendizaxe e traballo autónomos.
CT17	Traballo en equipo.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Coñecer as bases químicas sobre as que se apoian as tecnoloxías industriais. En concreto, o alumno adquirirá coñecementos básicos de química, química xeral, química orgánica e inorgánica e as súas aplicacións na enxeñaría, que lle permitirá aplicar os conceptos básicos e leis fundamentais da química. O alumno recibirá unha formación teórico-práctica que lle permitirá realizar con aproveitamento as prácticas de laboratorio e resolver problemas básicos relativos a esta materia.	CG3	CE4	CT2 CT10 CT17
Resultado de aprendizaxe ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.1- Coñecemento e comprensión das matemáticas e outras ciencias básicas inherentes á súa especialidade de enxeñaría, nun nivel que permita adquirir o resto das competencias do título.[Nivel de desenvolvemento Adecuado (2)]	CG3	CE4	
Resultado de aprendizaxe ENAEE:COMUNICACIÓN E TRABALLO EN EQUIPO: RA7.2- 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)]			CT10 CT17
Resultado de aprendizaxe ENAEE:FORMACIÓN CONTINUA: RA8.1- 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 Adecuado (2)]			CT10
Resultado de aprendizaxe *ENAEE:FORMACIÓN CONTINUA: RA8.2- Capacidade para estar ao día nas novidades en ciencia e tecnoloxía.[Nivel de desenvolvemento Adecuado (2)]			CT10

Contidos
Topic

NOTA informativa	Debido a circunstancias sobrevindas no curso 2020-2021 (atraso na data de incorporación dos alumnos de novo ingreso e necesidade de destinar tres semanas a un curso cero de nivelación de coñecementos matemático-físicos que permita iniciar o curso con garantías), programarase o 85% das 150 horas correspondentes a unha materia de 6 *ECTS: 128 horas.
BLOQUE 1 (B1): QUÍMICA ELEMENTAL (6 horas) B1-1. Teoría atómica e estrutura da materia.(2 horas)	Introdución á estrutura atómica. Periodicidade das estruturas. Características do átomo: Número atómico e masa atómica. Isótopos. Períodos e grupos. A clasificación de Mendeléev. Periodicidade das propiedades: Volume atómico, enerxía de ionización, afinidade electrónica e electronegatividade. Química nuclear.
BLOQUE 1 (B1): QUÍMICA ELEMENTAL (6 horas) B1-2. Enlace Químico.(2 horas)	Introdución ó enlace químico. Enlace covalente: Notación de Lewis. Teoría do enlace de valencia. Enlace iónico. O enlace metálico.
BLOQUE 1 (B1): QUÍMICA ELEMENTAL (6 horas) B1-3. Estados de agregación. (2 horas)	Gases perfectos. Gases reais. Ecuación de estado. Forzas intermoleculares. Características dos líquidos. Tensión superficial e viscosidade. Cambios de estado: Fusión, evaporación e sublimación. Disolucións: Mecanismo, clasificación e propiedades coligativas. Solubilidade de gases en líquidos. Mesturas coloidais. Tipos de sólidos. Puntos de fusión, diagramas de fases. Outras propiedades mecánicas. Propiedades eléctricas: condutores, illantes e semiconductores. Propiedades magnéticas.
BLOQUE 2 (B2): Reaccións e procesos Químicos. (17 horas) B2-1 Reaccións Químicas.(12 horas)	Aspectos estequiométricos. Aspectos enerxéticos: termoquímica. Aspectos cinéticos. Introdución ao equilibrio químico. Reaccións acedo-base e pH Equilibrio de solubilidade.
BLOQUE 2 (B2): Reaccións e procesos Químicos. (17 horas) B2-2 Reaccións Químicas.(5 horas)	Reaccións redox. Pilas e potencial. Corrosión e tratamentos superficiais. Sensores electroquímicos
BLOQUE 3 (B3) Introducción a Química Industrial. (1 hora) B3-1 Introducción a Enxeñería Química.(0.5 hora)	Conceptos básicos de Enxeñería Química Instrumentación e análise na Enxeñería Química
BLOQUE 3 (B3) Introdución á Química Industrial. (1 hora) B3-2 Industria Química. Química Inorgánica e Química Orgánica.(0.5 hora)	Principios Básicos de Química Orgánica e Inorgánica. Petróleo e derivados: Petroquímica O Carbón: Carboquímica
PRÁCTICAS DE LABORATORIO. (2 horas) PL1: Coñecemento do material de laboratorio e das normas de seguridade. Preparación de disolucións	Esta primeira práctica ten como obxectivo que o alumno coñeza e recoñeza o material de uso habitual nun laboratorio de química, así como que aprenda as normas de seguridade que lle permitan traballar no laboratorio co mínimo risco posible. O alumno preparará diferentes disolucións co fin de familiarizarse co material de laboratorio e coas técnicas experimentais aplicadas. Así mesmo, preténdese que o alumno adquira certa habilidade cos cálculos matemáticos precisos.
PRÁCTICAS DE LABORATORIO (2 horas) PL2: Volumetría ácido-base: Curva de valoración	As volumetrías acedo-base son de gran utilidade para determinar, con exactitude, a concentración dunha disolución aceda/básica por adición dunha base ou dun acedo de concentración coñecida. Concretamente realizarase a valoración dunha base forte cun acedo forte, para a cal se irán engadindo diferentes cantidades de acedo e medindo o pH da disolución resultante. Desta forma obterase a correspondente "curva de valoración" e extraeranse as conclusións pertinentes.
PRÁCTICAS DE LABORATORIO (2 horas) PL3: Separación dun produto por filtración a baleiro	Aproveitando a diferente solubilidade das especies obtidas por reacción química entre dúas sales solubles, procédese á separación daquelas mediante a técnica da filtración a baleiro. Desta forma o alumno familiarizarase, non só con esta técnica, senón tamén coa de secado, pois unha vez illado o precipitado deberá secalo e obter a correspondente curva de secado.

PRÁCTICAS DE LABORATORIO (2 horas) PL4: Equilibrio químico: Principio de Le Chatelier	Estudaranse dúas reaccións reversibles que presentan como vantaxe a gran facilidade con que se detecta a presenza de reactivos e de produtos, motivada por cambios de cor ou pola aparición dun precipitado.
PRÁCTICAS DE LABORATORIO (2 horas) PL: Redox e procesos Electroquímicos: Electrolise	Coa finalidade de que o alumno se familiarice cos cambios químicos inducidos pola corrente eléctrica e coas relacións cuantitativas implicadas, este realizará as seguintes experiencias: Electrolise do CuSO4(ac) acuoso e electrolise do NaCl(ac).
Outras Posibles prácticas	Establecemento da estequiometría dunha reacción química Esta práctica ten como obxectivo establecer a estequiometría dunha reacción química aplicando o método das variacións continuas, consistente en medir unha propiedade Cinética química. O alumno determinará experimentalmente a ecuación de velocidade dunha reacción sinxela, e comprobará a influencia da concentración e da temperatura sobre a velocidade de reacción. Destilación O obxectivo desta práctica é a separación dos compoñentes dunha mestura líquida aproveitando o diferente punto de ebulición dos mesmos. Esta práctica suporá a primeira toma de contacto do alumno cunha das operacións básicas de maior importancia industrial. Carboquímica: Determinación da riqueza dun carbón A finalidade desta práctica é determinar a riqueza dunha mostra de carbón comercial, someténdoa a unha reacción de combustión. A partir da masa das cinzas e mediante un sinxelo cálculo estequiométrico avalíase a cantidade de impurezas existentes na mostra inicial e, consecuentemente, a súa riqueza. Webquest *Instrumentación e análise en Enxeñeira Química
ACTIVIDADES DE SEMINARIO (1 hora cada un). A planificación dos seminarios farase corresponder co desenvolvemento da teoría e as clases de laboratorio.	S1 Teoría atómica e enlaces S2. Estados de agregación S3. Termoquímica S4. Acedo-base S5. Solubilidade S6. Redox

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	24	36	60
Resolución de problemas	6	6	12
Seminario	12	11	23
Exame de preguntas obxectivas	4	0	4
Exame de preguntas obxectivas	9	0	9
Práctica de laboratorio	10	10	20
*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	DESCRICIÓN: Nas clases de teoría explícanse os fundamentos de cada tema. Os alumnos dispoñen por adiantado dun libro de texto onde se atopa desenvolvido o tema que se está estudando, ademais da información da web que contén o arquivo coa presentación do tema. Ás clases de teoría recoméndaselles dedicar entre media hora e unha hora dependendo dos contidos.
Resolución de problemas	DESCRICIÓN: Nos seminarios aos alumnos propónselles unha serie boletíns de problemas que teñen que resolver en grupo. Elabórase o material docente que teñen que utilizar, e discutiranse as diferentes alternativas traballando en grupo e farase unha posta en común das alternativas estudadas. O alumno deberá resolver exercicios e problemas que serán corrixidos e avaliados polo profesor/a.
Seminario	Nos seminarios aos alumnos propónselles unha serie boletíns de problemas que teñen que resolver en grupo. Elabórase o material docente que teñen que utilizar, e discutiranse as diferentes alternativas traballando en grupo e farase unha posta en común das alternativas estudadas. O alumno deberá resolver exercicios e problemas que serán corrixidos e avaliados polo profesor/a.

Atención personalizada	
Methodologies	**Description**

Seminario	A atención ao alumno realizarase de modo personalizado ben nas horas de tutorías segundo o horario que se publicará na páxina web do centro, como a través de correo electrónico. No ámbito da acción tutorial, distínguense accións de tutoría académica, así como de tutoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de tutorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, contidos e exercicios, etc. As tutorías poden ser individualizadas, pero fomentaranse tutorías grupais para a resolución de problemas relacionados coas actividades a realizar en grupo. Nas tutorías personalizadas, 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. Conxugando ambos os tipos de acción tutorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade. Os profesores da materia atenderán as dúbidas e consultas dos alumnos en persoa ou por medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) no horario que se publicará na web do centro ou baixo a modalidade de cita previa.

Avaliación

	Description	Qualification	Evaluated Competencess		
Exame de preguntas obxectivas	PROBAS INTERMEDIAS Avaliaranse todos os coñecementos adquiridos ata o momento mediante a realización de dúas probas intermedias. (Porcentaxe da nota final: 10% proba 1 e 20% proba 2)	30	CG3	CE4	CT2 CT10
Exame de preguntas obxectivas	PROBA ESCRITA GLOBAL Constará dunha parte de conceptos teóricos e unha parte de problemas. É condición necesaria para superar a materia por avaliación continua obter un mínimo de 4 puntos. A nota do alumno que non supere este mínimo será a suma ponderada das notas obtidas ata ese momento, a condición de que esta non supere o 5. Nese caso a nota será dun 4.	40	CG3	CE4	CT2 CT10
Práctica de laboratorio	Traballo de prácticas (15% da nota final) Se avaliarán as actividades levadas a cabo no laboratorio, a resolución de cuestións do guión de prácticas, a actitude e orde no laboratorio e a resolución de cuestionarios acerca das prácticas realizadas, que poderán facerse presencialmente ou a través da plataforma virtual da materia. Traballo de seminario (15% da nota final) ou Se divide en dous partes: tarefas de seminario (10% da avaliación continua) e actividades de avaliación continua en aula (test, resolución de problemas) (5% da avaliación continua)	30	CG3	CE4	CT2 CT10 CT17

Other comments on the Evaluation

EXAMES ORDINARIO E EXTRAORDINARIO

Co fin de evaluar todas as competencias nos exames ordinario e extraordinario, estes incluirán, ademais de cuestións de teoría e parte de problemas, preguntas da parte de laboratorio. Non se esixirán notas mínimas en cada un dos ítems evaluados para superar a asignatura e a avaliación considerarase positiva cando se alcance unha puntuación de 5 puntos sobre 10.

COMPROMISO ÉTICO

A detección de copia en todo tipo de actividade puntuable (exames parciais ou finais, traballos de laboratorio, problemas ou cuestións, test, etc.) será penalizada cun cero no ítem evaluado e supoñerá, naquelas avaliacións nas que se requiraunha nota mínima para superar a asignatura, que o alumno non poderá ser evaluado por avaliación continua. Dita sanción afectará tanto aos alumnos que copien durante as probas de avaliación, como a aqueles que faciliten a copia.

Así mesmo, serán igualmente sancionados aqueles alumnos que utilicen material non autorizado durante as probas de avaliación (calculadoras programables ou outros dispositivos electrónicos, documentos, apuntes, etc.).

A detección de copia nas avaliacións ordinarias e extraordinarias será penalizada cun cero, debendo o alumno presentarse á seguinte convocatoria.

A detección de copia supoñerá a expulsión inmediata do aula na xornada na que sexa detectada.

Bibliografía. Fontes de información

Basic Bibliography

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

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

Complementary Bibliography

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

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

Reboiras, M.D, **Cuestiones de opción múltiple de química general**, 1, Ed. Abecedario, 2010
Quiñoá, E., Riguera, R. y Vila, J.M:, **Nomenclatura y formulación de los compuestos inorgánicos**, 1, Ed. McGraw Hill, 2006
Fernández, M. R. y col., **1000 Problemas de Química General**, 1, Ed. Everest, 2007
Masterton, W.L. y Hurley C.N., **Química, Principios y Reacciones**, 4, Ed. Thomson, 2003
López Cancio, J.A., **Problemas de Química**, 1, Ed. Prentice Hall, 2001

Recomendacións

Other comments

Cursar e superar a materia de química en segundo de bacharelato ou, na súa falta, superar a proba específica de acceso ao grao.
Recoméndase ter coñecementos de formulación.

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo *COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

A continuación, se reg¡flexanan os apartados da presente guía docente que sufrirán modicacións no caso ter que abordar a docencia en modalidade virtual:

6. CONTIDOS
A totalidade das prácticas realízanse en laboratorio e utilízase instrumentación e reactivos propios dun laboratorio de química. Na medida do posible, estas prácticas serán substituídas por tarefas demostrativas e non aplicadas, empregando visitas virtuais, vídeos e outros medios audiovisuais que permitan ao alumno obter as competencias necesarias de ditas prácticas.
Co fin de avalialas substituiranse por traballos nos que o alumno se lle exporá un problema real de laboratorio e teña que describir o material e modus operandi, ademais de realizar os cálculos para describir o problema.
8. METODOLOXÍA DOCENTE
Engádese unha nova metodoloxía docente:
Sesión maxistral e/ou sesión práctica virtual síncrona: Impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.)
10. AVALIACIÓN
As probas de avaliación realizaranse combinando a plataforma de teledocencia FAITIC-*Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Matemáticas: cálculo II e ecuacións diferenciais				
Subject	Matemáticas: cálculo II e ecuacións diferenciais			
Code	P52G381V01201			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Basic education	2	1c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Alvarez Hernandez, Maria			
Lecturers	Alvarez Hernandez, Maria			
E-mail	maria.alvarez@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	O obxectivo que se persegue con esta materia é que o alumno coñeza as técnicas básicas do cálculo integral en varias variables, cálculo vectorial, ecuacións diferenciais ordinarias e as súas aplicacións.			

Competencias	
Code	
CG3	Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
CG4	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.
CE1	Capacidade para a resolución dos problemas matemáticos que poidan presentarse na enxeñaría. Aptitude para aplicar os coñecementos sobre: álxebra lineal; xeometría; xeometría diferencial; cálculo diferencial e integral; ecuacións diferenciais e en derivadas parciais; métodos numéricos; algorítmica numérica; estatística e optimización.
CT1	Análise e síntese.
CT2	Resolución de problemas.
CT3	Comunicación oral e escrita de coñecementos.
CT6	Aplicación da informática no ámbito de estudo.
CT9	Aplicar coñecementos.
CT15	Obxectivación, identificación e organización.
CT16	Razoamento crítico.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Comprensión dos conceptos básicos do cálculo integral en varias variables.	CG3	CE1	CT1
Coñecemento das principais técnicas de integración de funcións de varias variables	CG3 CG4	CE1	CT1 CT2 CT9
Coñecemento dos principais resultados do cálculo vectorial e aplicacións.	CG3 CG4	CE1	CT1 CT2 CT9
RESULTADOS DE APRENDIZAXE ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.1 - Coñecemento e comprensión das matemáticas e outras ciencias básicas inherentes á sua especialidade de enxeñaría, nun nivel que permita adquirir o resto das competencias do título [nivel de desenvolvemento (básico (1), adecuado (2) e avanzado (3)) deste su-resultado: Adecuado (2)].	CG3	CE1	
Comprensión da importancia do cálculo integral, cálculo vectorial e das ecuacións diferenciais para o estudo do mundo físico.		CE1	CT9 CT16
Aplicación dos coñecementos de cálculo integral, cálculo vectorial e de ecuacións diferenciais.		CE1	CT2 CT6 CT9 CT16
Adquisición da capacidade necesaria para utilizar estes coñecementos na resolución manual e informática de cuestións, exercicios e problemas.		CE1	CT1 CT2 CT3 CT6 CT9 CT15 CT16
Adquisición dos coñecementos básicos para a resolución de ecuacións e sistemas diferenciais lineais.	CG3	CE1	

RESULTADO DE APRENDIZAXE ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.2 - 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 [Adecuado (2)].	CG4	CE1	CT1 CT2 CT9 CT16
RESULTADOS DE APRENDIZAXE ENAEE: INVESTIGACIÓN E INNOVACIÓN: RA4.3 - Capacidade e destreza para proxectar e levar a cabo investigacións experimentais, interpretar resultados e chegar a conclusións no seu campo de estudo [Adecuado (2)].			CT9

Contidos	
Topic	
Integración en varias variables.	Curvas e superficies. Integración no plano. Integración no espazo. Cambio de variables. Aplicacións xeométricas e físicas da integral múltiple.
Cálculo vectorial	Integración de campos ao longo dunha curva. Integración de campos sobre unha superficie. Teoremas clásicos do cálculo vectorial. Aplicacións.
Ecuacións diferenciais	Conceptos xerais. Métodos de resolución de ecuacións diferenciais ordinarias de primeira orde. Ecuacións diferenciais lineais de segunda orde. Sistemas de ecuacións diferenciais lineais.
Métodos numéricos para problemas de valor inicial	Métodos de Euler e de Runge-Kutta.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	28	28	56
Resolución de problemas	10	10	20
Traballo tutelado	7	0	7
Prácticas con apoio das TIC	3	2	5
Seminario	14	14	28
Resolución de problemas e/ou exercicios	4	4	8
Práctica de laboratorio	1	1	2
Exame de preguntas de desenvolvemento	9	15	24
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Lección maxistral	O profesor exporá nas clases teóricas os contidos da materia. Os alumnos terán textos básicos de referencia para o seguimento da materia.
Resolución de problemas	O profesor resolverá problemas e exercicios e o alumno terá que resolver exercicios similares para adquirir as capacidades necesarias.
Traballo tutelado	O alumno deberá resolver exercicios e problemas que serán corrixidos polo profesor. Os exercicios serán abordados en grupos e traballarase sobre eles en esas horas.
Prácticas con apoio das TIC	O profesor resolverá problemas e exercicios de forma manual e/ou mediante o uso de ferramentas informáticas e o alumno terá que resolver exercicios similares para adquirir as capacidades necesarias.
Seminario	Curso intensivo de 14 horas para aqueles alumnos que suspenderon a materia en primeira convocatoria, previo ao exame en segunda convocatoria.

Atención personalizada	
Methodologies	**Description**
Resolución de problemas	Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos, tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa. Nas sesións destinadas á resolución de exercicios e problemas, o profesor atenderá de forma personalizada as dúbidas expostas polos alumnos.
Prácticas con apoio das TIC	Nas sesións destinadas á realización de prácticas de informática, o profesor atenderá de forma personalizada as dúbidas expostas polos alumnos.
Traballo tutelado	Nas tutorías en grupo, o profesor atenderá de forma personalizada as dúbidas dos alumnos, expondo exercicios complementarios ou outra clase de actividades que redunden no mellor aproveitamento das clases do alumnado.
Seminario	No curso intensivo, o profesor atenderá de forma personalizada as dúbidas dos alumnos, expondo exercicios complementarios ou outra clase de actividades que redunden no mellor aproveitamento das clases do alumnado.

Avaliación					
	Description	Qualification	Evaluated Competencess		
Resolución de problemas	Realizarase unha actividade complementaria consistente na resolución de exercicios.	15	CG3 CG4	CE1	CT1 CT2 CT3 CT6 CT9 CT15 CT16
Resolución de problemas e/ou exercicios	Realizaranse dous exames parciais dos Temas 1 e 2.	30	CG3 CG4	CE1	CT1 CT2 CT3 CT9 CT15 CT16
Práctica de laboratorio	Realizaranse unha práctica de resolución de problemas con Matlab	15	CG3 CG4	CE1	CT2 CT6 CT9
Exame de preguntas de desenvolvemento	Realizarase un exame final de avaliación continua sobre os contidos de toda a materia.	40	CG3 CG4	CE1	CT1 CT2 CT3 CT9 CT15 CT16

Other comments on the Evaluation

OBSERVACIÓNS XERAIS SOBRE O CÁLCULO DA NOTA:

A avaliación continua consistirá na realización de dúas probas escritas, para os dous primeiros temas, cun peso do 15% cada un, unha práctica de Laboratorio de Matlab puntuable, cun peso dun 15% e unha entrega de exercicios a desenvolver, cun peso dun 15%, sendo o peso do exame final do 40%.

O alumno deberá presentarse ao exame ordinario de todos os contidos da materia, que suporá o 100% da nota, 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 unha nota inferior a 5 puntos na avaliación continua.

Nas circunstancias descritas nos dous primeiros apartados da anterior listaxe, a nota de avaliación continua será asignada como o valor mínimo entre un 4.5 e a nota calculada segundo as ponderacións descritas previamente.

En calquera caso, o alumno que supere a avaliación continua terá a posibilidade de presentarse ao exame ordinario para subir nota. A avaliación dos alumnos en segunda e sucesivas convocatorias consistirá nun exame sobre os contidos da materia que suporá o 100% da nota.

COMPROMISO ÉTICO:

Espérase que os alumnos teñan un comportamento ético adecuado. Se se detecta un comportamento pouco ético (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros) penalizarase automaticamente cunha cualificación de 0.0 na convocatoria en curso.

Bibliografía. Fontes de información

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

Recomendacións

Subjects that it is recommended to have taken before

Matemáticas: Álxebra e estatística/P52G381V01104
Matemáticas: Cálculo I/P52G381V01103

Other comments

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

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Modificacións en caso de situacións extraordinarias que impliquen a suspensión da actividade académica presencial

=== ADAPTACIÓN DAS METODOLOXÍAS ===
Sesión maxistral e sesión práctica virtual síncrona: Impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes e un deseño que podese personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar un encerado, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

=== ADAPTACIÓN DA AVALIACIÓN ===
As probas de avaliación realizaríanse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Materials science and technology				
Subject	Materials science and technology			
Code	P52G381V01202			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Alfonsín Pérez, Víctor Ángel			
Lecturers	Alfonsín Pérez, Víctor Ángel Maceiras Castro, María del Rocío			
E-mail	valfonsin@cud.uvigo.es			
Web	http://faitic.uvigo.es			
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			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
CG6	Capacity for handling specifications, regulations and mandatory standards.
CE9	Knowledge of the fundamentals of the science, technology and chemistry of materials. Understand the relationship between microstructure, the synthesis, processing and properties of materials.
CT1	Analysis and synthesis
CT5	Information Management.
CT9	Apply knowledge.
CT10	Self learning and work.

Learning outcomes	Competences		
Understanding the mechanical behavior of metallic, ceramic, plastics and composites materials	CG4 CG6		
Knowing how the properties can be modified using mechanical processes and thermal treatments	CG4	CE9	CT9
Knowing the basic techniques of the structural characterization of materials	CG3 CG6	CE9	
Ability in the handling of diagrams and graphics			CT1 CT5
Ability in performing experiments	CG6	CE9	CT10
To analyse the obtained results and their conclusions			CT1 CT9
Ability to apply standards of material testing	CG6		CT1 CT9
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)].	CG3	CE9	
ENAEE LEARNING OUTCOME. KNOWLEDGE AND UNDERSTANDING: LO1.3 - Awareness of the wider multidisciplinary context of engineering [Intermediate (2)].		CE9	

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)].	CG4		CT1 CT9
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)].	CG6		CT5
ENAEE LEARNING OUTCOME. INVESTIGATIONS: LO4.2.- Ability to consult and apply codes of practice and safety regulations in their field of study; [Basic (1)]	CG6		
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)].		CE9	CT9
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)].			CT9
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)].	CG4		CT9
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)].		CE9	CT9
ENAEE LEARNING OUTCOME. ENGINEERING PRACTICE: LO5.4.- Ability to apply norms of engineering practice in their field of study. [Basic (1)].	CG6		CT9
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)].	CG6		
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)].	CG4		CT1 CT5
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)].			CT10

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 and solidification process	Diffusion mechanisms. Fick's laws. Diffusion factors. Industrial applications of diffusion processes: synthesis, doping of semiconductors, solidification (nucleation and growth). Basic concepts
Equilibrium phase diagrams (I). Introduction	Gibbs law. Lever rule. Binary equilibrium diagrams. Types. Invariant solidification reactions.
Equilibrium phase diagrams (II): Solid state phase transformations in equilibrium	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.
Hardness tests	Hardness: Concept. Shore test. Macrohardness test: Brinell, Rockwell and Vickers. Microhardness test: Vickers y Knoop. Standarization. Comparison between different test procedures.
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.
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 5. Phase diagrams.	Development of phase diagrams for a binary alloy using the cooling curves.
Laboratory session 6. Synthesis and properties	Addition and condensation polymerization. Characteristics observation. Observation of temperature increase behaviour

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	39	65
Laboratory practical	14	7	21
Problem solving	7	7	14
Seminars	15	0	15
Objective questions exam	1	2	3
Problem and/or exercise solving	1	2	3
Report of practices, practicum and external practices	0	7	7
Essay questions exam	3	4	7
Essay questions exam	3	2	5
Essay questions exam	3	2	5
Essay	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. 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	

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, FAITIC forums, etc. .) by previous appointment.
Seminars	

Assessment

	Description	Qualification	Evaluated Competencess		
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	CG3 CG4 CG6	CE9	CT1 CT5 CT9 CT10
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	CG3 CG4 CG6	CE9	CT1 CT5 CT9 CT10
Report of practices, practicum and external practices	Attendance, participation and reports that will be delivered periodically	15	CG3 CG4 CG6	CE9	CT1 CT5 CT9 CT10
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	CG3 CG4 CG6	CE9	CT1 CT5 CT9 CT10
Essay	An individual work corresponding to the activities carried out in seminars will be carried out (5%). A collaborative work in groups related to the contents of the subject will also be carried out (5%), considering the communication and the capacity for teamwork .	10	CG4	CE9	CT1 CT5 CT9

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**, Cuarta, McGraw-Hill, 2006

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 know the basic fundamentals of Physics and General Chemistry.

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

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== MODIFICATIONS IN CASE OF VIRTUAL TEACHING ===
CONTENTS
Due to the experimental nature of the practices of the subject (PL2, PL3, PL4, PL5, PL6 and PL7), the majority of the sessions of Materials Science and Technology are carried out, in part, in laboratories by the students using specific equipment and reactives difficult to access for students.
In order that the student acquire most of the knowledge and skills necessary to pass this part of the subject, the use of demonstration videos supported by virtual classrooms will be offered to the students, where the teacher can explain the processes that the student made in the face-to-face case.
In addition, a large number of these practices (PL2, PL3, PL6, PL7) require a part of work in non-experimental practice sessions, which the student can do without being in person in the laboratory. The teacher will facilitate the experimental part so that the student can easily complete various practices.

TEACHING METHODOLOGY
A new teaching methodology is added:
Master session and / or synchronous online meeting (theory or practical session): It is taught through a web video conferencing platform. Each virtual classroom contains a variety of display panels and components, its layout can be customized to the needs of the classroom. In the virtual classroom, teachers (and those authorized participants) can share their team's screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.)

EVALUATION
The evaluation tests will be carried out by combining the FAITIC-Moodle remote teaching platform and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Termodinámica e transmisión da calor				
Subject	Termodinámica e transmisión da calor			
Code	P52G381V01203			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2	1c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Lareo Calviño, Guillermo			
Lecturers	Cacabelos Reyes, Antón González Gil, Lorena Lareo Calviño, Guillermo			
E-mail	guillermo@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Na práctica totalidade dos procesos industriais requírese a aplicación dos Principios da Termodinámica e da Transferencia de Calor. O coñecemento destes principios é básico en Enxeñaría Térmica. Por exemplo, para a realización dunha análise enerxética (con determinación do rendemento enerxético e esergxético) de sistemas de potencia para a xeración de electricidade (ciclo combinado con turbina de vapor e de gas), un ciclo de potencia mecánica, un ciclo en bomba de calor, etc. O coñecemento de si un proceso termodinámico pode ocorrer ou non na realidade é imprescindible para o deseño de novos procesos, así como o coñecemento das máximas prestacións que se poden obter nos diferentes dispositivos que compoñen unha instalación enerxética, e cales son as causas que imposibilitan obter esas máximas prestacións. Ademais, o estudo das propiedades termodinámicas dos fluídos de traballo que circulan polos dispositivos, auga, aire, refrigerantes, gases e mestura de gases, é indispensable para analizar o comportamento dos sistemas térmicos. Así mesmo, o estudo do procedemento a seguir para a análise enerxética de instalacións enerxéticas de sistemas de refrixeración, acondicionamento de aire e en procesos de combustión é de gran interese. Doutra banda, é interesante para o alumno coñecer os mecanismos polos cales se produce a transferencia da enerxía, principalmente debido a unha diferenza de temperaturas, centrándose en determinar a maneira e a velocidade á que se produce ese intercambio de enerxía. Neste sentido preséntanse o tres modos de transferencia de calor e os modelos matemáticos que permiten calcular as velocidades de transferencia de calor. Así se pretende que os alumnos sexan capaces de expor e resolver problemas enxeñeriles de transferencia de calor mediante o uso de ecuacións alxebraicas. Tamén se pretende que os alumnos coñezan outros métodos matematicamente máis complexos de resolución de problemas de transferencia de calor e saiban onde atopalos e como usalos en caso de necesitalos.			

Competencias	
Code	
CG4	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.
CG5	Coñecementos para a realización de medicións, cálculos, valoracións, taxacións, peritaxes, estudos, informes, planes de labores e outros traballos análogos.
CG6	Capacidade para o manexo de especificacións, regulamentos e normas de obrigado cumprimento.
CG7	Capacidade para analizar e valorar o impacto social e ambiental das solucións técnicas.
CG11	Coñecemento, comprensión e capacidade para aplicar a lexislación necesaria no exercicio da profesión de Enxeñeiro Técnico Industrial.
CE7	Coñecementos de termodinámica aplicada e transmisión de calor. Principios básicos e a súa aplicación á resolución de problemas de enxeñaría.
CT2	Resolución de problemas.
CT7	Capacidade para organizar e planificar.
CT9	Aplicar coñecementos.
CT10	Aprendizaxe e traballo autónomos.
CT17	Traballo en equipo.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Capacidade para coñecer, entender e utilizar os principios e fundamentos da termodinámica aplicada	CG4 CG5 CG6 CG7	CE7	CT2 CT7 CT9 CT10 CT17

Capacidade para coñecer e entender os principios e fundamentos da transmisión da calor	CG5 CG6 CG7 CG11	CE7	CT2 CT7 CT9 CT10 CT17
Capacidade para coñecer e entender os principios e fundamentos de equipos e xeradores térmicos	CG4 CG6 CG7 CG11	CE7	CT2 CT7 CT9 CT10 CT17
Analizar o funcionamento de sistemas térmicos, como sistemas de bomba de calor e ciclos de refrixeración ou ciclos de potencia, identificando compoñentes, así como os ciclos empregados para obter altas prestacións	CG4 CG5 CG6 CG7 CG11	CE7	CT2 CT7 CT9 CT17
Resultado de aprendizaxe ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.2 - 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 (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Avanzado (3)].		CE7	
Resultado de aprendizaxe ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.2 - 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. [Avanzado (3)].	CG4 CG7		CT2 CT9
Resultado de aprendizaxe ENAEE: INVESTIGACIÓN E INNOVACIÓN: RA4.1 - Capacidade para realizar procuras bibliográficas, consultar e utilizar con criterio basees de datos e outras fontes de información, para levar a cabo simulación e análise co obxectivo de realizar investigacións sobre temas técnicos da súa especialidade. [Básico (1)].	CG6 CG11		
Resultado de aprendizaxe ENAEE: INVESTIGACIÓN E INNOVACIÓN: RA4.2 Capacidade para consultar e aplicar códigos de boa práctica e de seguridade da súa especialidade. [Básico (1)].	CG6 CG7 CG11		
Resultado de aprendizaxe ENAEE: INVESTIGACIÓN E INNOVACIÓN: RA4.3 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 (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].		CE7	CT9
Resultado de aprendizaxe ENAEE: APLICACIÓN PRÁCTICA DA ENXEÑARÍA: RA5.4 - Capacidade para aplicar normas da práctica da enxeñaría da súa especialidade. [nivel de desenvolvemento (básico (1),adecuado (2) e avanzado (3)) deste sub-resultado: Básico (1)].	CG6 CG7 CG11		CT9
Resultado de aprendizaxe ENAEE: APLICACIÓN PRÁCTICA DA ENXEÑARÍA: RA5.5 -Coñecemento das implicacións sociais, de saúde e seguridade, ambientais, económicas e industriais da práctica da enxeñaría. [Básico (1)]	CG7		
Resultado de aprendizaxe ENAEE: ELABORACIÓN DE XUÍZOS: RA6.1 - Capacidade de recoller e interpretar datos e manexar conceptos complexos dentro da súa especialidade, para emitir xuízos que impliquen reflexión sobre temas éticos e sociais. [Básico (1)].	CG6 CG7 CG11		

Contidos

Topic	
BLOQUE 1 (B1) Propiedades de sustancias puras, simples e compresibles	B1-1. Repaso de conceptos básicos e definicións: -O uso da termodinámica -Definición dos sistemas -Descrición dos sistemas e do seu comportamento -Medida da temperatura. Principio cero -Calor e calor específica -Cambio de fase e calor latente -Mecanismos de transferencia de calor -Gas ideal. Ecuacións de estado -Primeiro principio da termodinámica -Transformacións termodinámicas dun gas ideal -Segundo principio da termodinámica B1-2. Propiedades dunha sustancia pura, simple e compresible: -Definición do estado termodinámico -A relación p-v-T -O cálculo das propiedades termodinámicas -O modelo de gas ideal -Enerxía interna, entalpía e calores específicas de gases ideais -Cálculo de variación de enerxía interna e de entalpía en gases ideais -Procesos politrópicos dun gas ideal

BLOQUE 2 (B2) Análise enerxética de sistemas segundo o 1º e 2º Principio	B2-1. Análise enerxética nun volume de control: -Conservación da masa para un volume de control -Conservación da enerxía para un volume de control -Análise de volumes de control en estado estacionario -Análise de transitorios B2-2. O segundo principio da Termodinámica: -Utilización do 2º principio -Formulacións do 2º principio -Identificación de irreversibilidades -Aplicación do 2º principio aos ciclos termodinámicos -A escala Kelvin de temperatura -Medidas de rendemento máximo para ciclos que operan entre dous focos térmicos -O ciclo de Carnot B2-3. A entropía e a súa utilización -A desigualdade de Clausius -Definición de variación de entropía -Obtención de valores de entropía -Variación de entropía en procesos internamente reversibles -Balance de entropía para sistemas pechados -Balance de entropía para volumes de control -Procesos isoentrópicos -Rendementos isoentrópicos de turbinas, tobeiras, compresores e bombas -Transferencia de calor e traballo en procesos de fluxo estacionario internamente reversibles B2-4. Análise exergética -Introdución á exerxía -Definición de exerxía -Balance de exerxía para un sistema pechado -Exerxía de fluxo -Balance de exerxía para volumes de control -Eficiencia exerxética (segundo principio)
BLOQUE 3 (B3) Introdución á análise termodinámica de motores e máquinas térmicas	B3-1 Instalacións de produción de potencia: -Introdución ás instalacións de produción de potencia -Produción de potencia mediante vapor vs produción de potencia mediante gas -Ciclo combinado B3-2 Introdución á produción de potencia mediante vapor: -Instalacións de potencia con vapor: o ciclo de Rankine B3-3 Instalacións de produción de potencia mediante turbinas de gas: -As centrais de turbinas de gas: O ciclo de Brayton B3-4. Ciclos de gas en motores alternativos de combustión interna B3-5 Ciclos termodinámicos de refrixeración: -Refrixeración. Máquina frigorífica e bomba de calor.

BLOQUE 4 (B4) Conceptos e principios fundamentais en transmisión de calor	B4-1 Introdución á transmisión de calor e á condución: -Mecanismos de *trasmisión de calor. Condución, convección e radiación. -Requirimentos de conservación da enerxía. -Análise de problemas de transferencia de calor. -Conductividade térmica. -Ecuación de difusión de calor. B4-2 Condución en réxime estacionario e en réxime transitorio: -Condución unidimensional en réxime estacionario. Parede plana. Sistemas radiais: cilindro e esfera. -Condución estacionaria con xeración de enerxía térmica. -Condución en superficies estendidas. -Condución bidimensional. -Condución en estado transitorio. B4-3 Introdución á convección: Convección forzada e convección libre. -Capas límites de convección: hidráulica e térmica. Fluxo laminar e turbulento. -Ecuacións fundamentais da convección. -Análise Dimensional. -Convección forzada e convección libre ou natural. -Convección forzada en fluxo externo -Convección forzada en fluxo interno. -Convección libre B4-4 Intercambiadores de calor -Intercambiadores de calor. Consideracións xerais. -Clasificación dos intercambiadores de calor. -Tipos de intercambiadores e características. -Coeficiente global de transferencia de calor. -Distribución de temperaturas en equicorriente, contracorriente e fluxos cruzados. -Fluxo de calor intercambiada. Diferenza de temperaturas logarítmica media. -Método da diferenza de temperaturas logarítmica media (DTLM) -Método da eficiencia-número de unidades de transferencia (Epsilon-N.O.T.) B4-5 Introdución á radiación. -Conceptos fundamentais. Definicións: intensidade de radiación, potencia emisiva, irradiación e radiosidade. -Radiación de corpo negro. Distribución de Planck. Emisividad, absortividad e reflectividad superficiais. -Lei de Kirchhoff. Superficies grises. -Intercambio radiativo entre superficies. Factor de forma de radiación. Relacións entre os factores de forma. -Intercambio de radiación de corpo negro. -Intercambio de radiación entre superficies grises difusas nun recinto.

CONTIDOS PRÁCTICOS	PL 1. Equivalente mecánico da calor Nesta práctica preténdese determinar o equivalente mecánico da calor, é dicir, a relación entre a unidade de enerxía joule (julio) e a unidade de calor caloría. Mediante esta experiencia simulada, preténdese pór de manifesto a gran cantidade de enerxía que é necesario transformar en calor para elevar apreciablemente a temperatura dun volume pequeno de auga. PL 2. Dilatación térmica lineal de sólidos Estudo da dilatación térmica lineal en tubos delgados de ferro, latón e aluminio e estimación dos coeficientes de dilatación de devanditos materiais para a súa comparación posterior. PL 3. Iniciación a técnicas termográficas Preténdese iniciar ao alumno na utilización de cámaras termográficas como ferramenta aplicada ao estudo de illamentos en edificacións e mantemento predictivo. PL 4. Conductividad térmica de metais Determinarase o fluxo de calor que se produce a través de barras metálicas en forma de U cuxos extremos se mergullan en auga fría e quente a partir do incremento de temperatura observado na auga fría. Observarase así mesmo que a contía do fluxo calorífico depende da composición do material, así como da súa sección transversal e a súa lonxitude. PL 5. Determinación de propiedades de illantes Preténdese observar as propiedades térmicas de diferentes materiais illantes para o manexo e a comprensión de conceptos como illamento térmico, conductividade térmica e capacidade calorífica. PL 6. Intercambiador de calor de dobre tubo Determinarase o coeficiente de transferencia dun intercambiador de calor de dobre tubo en contracorriente e equicorrente. Validación dos métodos DTLM e Epsilon-NUT. PL 7. Enerxías alternativas. Estudo dun colector solar. Preténdese iniciar ao alumno no estudo dun colector solar, analizar a enerxía recibida por radiación e facer un balance enerxético da enerxía aproveitada para ACS ou calefacción.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	28	34.5	62.5
Prácticas de laboratorio	14	15	29
Seminario	15	15	30
Resolución de problemas	7	0	7
Resolución de problemas e/ou exercicios	5	3	8
Exame de preguntas de desenvolvemento	6	7.5	13.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Lección maxistral	Nas clases de teoría explícanse os fundamentos de cada tema. Os alumnos dispoñen na bibliografía dos libros de texto recomendados onde se atopa desenvolvido o tema que se está estudando, ademais da información da web que contén o arquivo coa presentación do tema.
Prácticas de laboratorio	Nas clases prácticas aplicaranse os conceptos desenvolvidos en cada tema á resolución de problemas. Deseñáronse unha serie de prácticas acorde co desenvolvemento da materia de teoría co fin de fixar conceptos explicados nesa clase e así o alumno vaia desenvolvendo a súa habilidade para expor solucións técnicas, e ir desenvolvendo a súa creatividade
Seminario	Trátase dun curso intensivo que se realiza ao final do mes de xullo destinado aos alumnos que non superaron a materia en primeira convocatoria, cuxos obxectivos son por unha banda, a consolidación, co adecuado rigor conceptual e formal, de coñecementos previamente adquiridos ao longo do curso, e, por outra, o establecemento das bases necesarias para o estudo ulterior doutras disciplinas, de carácter básico ou fundamental. Realízase de forma presencial en en sesións de traballo en clase. Alí abordarase a resolución de dúbidas e problemas relacionados cos contidos teóricos da materia.
Resolución de problemas	Ao alumno proporánselle exercicios e problemas que deberá resolver e que serán corrixidos e avaliados polo profesor/a. Actividade na que se formulan problemas e/ou exercicios relacionados coa materia. O alumno debe desenvolver a análise e resolución dos problemas e/ou exercicios de forma autónoma.

Atención personalizada

Methodologies	Description
Lección maxistral	Nas clases de teoría explícanse os fundamentos de cada tema. Os alumnos dispoñen na bibliografía dos libros de texto recomendados onde se atopa desenvolvido o tema que se está estudando, ademais da información da web que contén o arquivo coa presentación do tema.
Prácticas de laboratorio	Nas clases prácticas aplicaranse os conceptos desenvolvidos en cada tema á resolución de problemas. Deseñáronse unha serie de prácticas acorde co desenvolvemento da materia de teoría co fin de fixar conceptos explicados nesa clase e así o alumno vaia desenvolvendo a súa habilidade para expor solucións técnicas, e ir desenvolvendo a súa creatividade
Resolución de problemas	Ao alumno proporánselle exercicios e problemas que deberá resolver e que serán corrixidos e avaliados polo profesor/a.
Seminario	O desenvolvemento do curso estrutúrase en sesións dunha hora de clases teórico-prácticas. Os métodos didácticos adoptados baséanse maioritariamente na participación activa do alumno, protagonista destas sesións presenciais. O método didáctico a seguir consiste en que o profesor repasará brevemente conceptos teóricos relativos ás unidades das que se compón a presente materia e proporá de forma individualizada a resolución de problemas a todos e cada un dos alumnos. Así mesmo, o profesor tutelará o traballo que realice cada alumno de maneira individual. A metodoloxía empregada pode verse, dado o reducido número de alumnos, como unha acción tutorial continua, de apoio constante por parte do profesor ao proceso de aprendizaxe do alumno. Os profesores da materia atenderán as dúbidas e consultas dos alumnos de forma síncrona en despachos físicos ou virtuais baixo a modalidade de concertación previa ou *asíncrona por medios telemáticos (correo electrónico, foros de FAITIC, etc.).

Avaliación

	Description	Qualification	Evaluated Competencess		
Prácticas de laboratorio	Nas prácticas desenvolveranse as competencias en expresión oral e escrita coa presentación de informes de prácticas polos alumnos. Para obter a avaliación positiva, o alumno deberá realizar o 100% das sesións de prácticas de laboratorio, e ter unha participación activa no desenvolvemento das mesmas	20	CG4	CE7	CT2 CT7 CT9 CT10 CT17
Resolución de problemas e/ou exercicios	A nota correspondente á Avaliación Continua estará baseada en probas escritas de resposta curta Resultados de aprendizaxe: Capacidade para coñecer, entender e utilizar os principios e fundamenots da termodinámica aplicada e a transmisión de calor Aquí inclúense as Probas Parciais (PP,30%) e Probas de Avaluacion en Seminarios (ES,10%)	40	CG4 CG5 CG6 CG7 CG11	CE7	CT2 CT7 CT9 CT10
Exame de preguntas de desenvolvemento	A nota correspondente á Avaliación Continua estará baseada en probas escritas de resposta longa Aquí inclúese a proba final (PF,40%)	40	CG4 CG5 CG6 CG7 CG11	CE7	CT2 CT7 CT9 CT10

Other comments on the Evaluation

As probas PF, PP e ES teñen 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 (PF), ou dunha parte dela (PP, ES). 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 ondas teorías expostas en clase.
A avaliación en seminarios (ES) e das prácticas de laboratorio (CP) levará acabo mediante cuestionarios expostos a través Moodle,onde se avaliará ao alumno sobre los coñecementos adquiridos en clase e no laboratorio. En particular, os cuestionarios de prácticas de laboratorio deberán incluír no seu contido fontes de información, como referencias bibliográficas de calidade que axuden á comprensión da problemática exposta. A nota de cada memoria de prácticas será sobre 10 puntos. A nota das memorias de prácticas será a media das notas de todas as prácticas realizadas.
A proba final de avaliación continua realizarase na semana de avaliación e valorarase sobre10 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.Realizaranse duas (2)probas parciais de avaliación continua. Cada control suporá un 15% na nota de avaliación continua.Para superar a materia por Avaliación Continua a nota final (NEC) deberá ser maior ou igual a 5 e calcularase do seguinte modo:NEC = 0,4·PF +0,3·PP + 0,1·ES + 0,2·CPO 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.

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.

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 o devandito 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 a fraude académica ten lugar nunha convocatoria oficial (ordinaria ou extraordinaria) suspenderá dita convocatoria cun cero.

Bibliografía. Fontes de información

Basic Bibliography

Çengel, Yunus y Boles, Michael, **Termodinámica**, 7ª, McGraw-Hill, 2011

Complementary Bibliography

Moran M.J. y Shapiro H.N., **Fundamentos de Termodinámica Técnica**, Reverté, 1999

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

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

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

Çengel Y.A., y Ghajar A.J., **Transferencia de Calor y Masa. fundamentos y aplicaciones**, McGraw-Hill, 2011

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

Çengel, Yunus A., **Heat and mass transfer: a practical approach**, McGraw-Hill, 2006

Kreith J. y Bohn M.S, **Principios de Transferencia de Calor**, 6ª, Thomson, 2002

Mills A.F., **Transferencia de calor**, Irwin,

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

Agüera Soriano, J, **Termodinámica Lógica y Motores Térmicos**, Ciencia 3, S.A.,

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, 1990

Lacalle, Nieto, **Problemas de Termodinámica**, Publicaciones E.T.S.I.I,

Aguirrezabalaga López de Eguilaz, Valentín; Prieto González, M. M., **Transferencia de calor: problemas**, Serv., Publicaciones Universidad de Oviedo, 2006

Manuel Vázquez, **Problemas resueltos de Termodinámica Técnica, 1er y 2º Principio**, Serv. Publicaciones Universidad de Vigo,

Recomendacións

Subjects that continue the syllabus

Enxeñaría térmica I/P52G381V01403

Subjects that it is recommended to have taken before

Física: Física I/P52G381V01102
Matemáticas: Cálculo I/P52G381V01103
Química: Química/P52G381V01108

Other comments

A materia Termodinámica e Transmisión de Calor constitúe o estudo de sistemas térmicos e enerxéticos, como base a utilizar para o desenvolvemento doutras competencias dentro do campo da enxeñaría térmica. Esta disciplina require da base conceptual necesaria para a súa correcta comprensión. É por iso que para cursar con éxito esta materia o alumno debe:

Cursar e superado as materias de primeiro curso Química, Física I, así como Cálculo I.

Ter coñecementos de termodinámica e transferencia de calor adquiridos na materia Física II do primeiro curso do grao de Enxeñaría Mecánica (recoméndase a seu repaso).

Ter capacidade de comprensión escrita e oral.

Ter capacidade de abstracción, cálculo básico e síntese da información.

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

No caso de que por circunstancias extraordinarias suspéndase a actividade presencial, proponse as seguintes modificacións aos apartados descritos anteriormente:
- Apartado 6. Contidos
Neste apartado proponse a substitución das prácticas descritas no apartado 6, que en lugar de realizarsepresencialmente basearanse en información e documentación exposta a través da plataforma Moodle, manténdose a avaliación de ditas prácticas coa realización de cuestionarios (CP) a través de dita plataforma: Estas prácticas coas seguintes:
PL 1. Equivalente mecánico da calor
Estudo do equivalente mecánico da calor baseándose en esquemas, vídeos e información web.
PL 2. Dilatación térmica lineal de sólidos
Estudo da dilatación térmica lineal de sólidos baseándose en esquemas, vídeos e información web.
PL 3. Iniciación a técnicas *termográficas
Estudo da iniciación a técnicas termográficas baseándose en esquemas, vídeos e información web.
PL 4. Conductividade térmica de metais
Estudo da conductividade térmica de metais baseándose en esquemas, vídeos e información web.
PL 5. Determinación de propiedades de illantes
Estudo da conductividade térmica de illantes baseándose en esquemas, vídeos e información web.
PL 6. Intercambiador de calor de dobre tubo
Estudo dun intercambiador de calor de dobre tubo baseándose en esquemas, vídeos e información web.
PL 7. Enerxías alternativas. Estudo dun colector solar.
Estudo dun colector solar baseándose en esquemas, vídeos e información web.

- Apartado 8. Metodoloxías docentes
Neste apartado detállase unha nova metodoloxía docente:
Sesión maxistral e/ou sesión práctica virtual síncrona. Impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).
- Apartado 10. Avaliación
Nun escenario de docencia virtual, as probas de avaliación realizaranse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Resistencia de materiais				
Subject	Resistencia de materiais			
Code	P52G381V01204			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2	1c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Rodríguez Rodríguez, Francisco Javier			
Lecturers	Regueiro Pereira, Araceli Suárez García, Andrés			
E-mail	fjavierrodriguez@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Nesta materia abórdase o estudo do comportamento dos materiais reais en relación coas súas características de resistencia, rixidez e estabilidade, con vistas á comprobación ou dimensionamiento dos elementos que forman as estruturas e as máquinas.			

Competencias	
Code	
CG3	Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
CG4	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.
CE14	Coñecemento e utilización dos principios da resistencia de materiais.
CT1	Análise e síntese.
CT2	Resolución de problemas.
CT9	Aplicar coñecementos.
CT10	Aprendizaxe e traballo autónomos.
CT16	Razoamento crítico.
CT17	Traballo en equipo.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Coñecer as diferenzas entre sólido ríxido e sólido elástico	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16 CT17
Coñecer os estados de tensións e de deformacións nun sólido deformable e a relación entre eles.	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16 CT17
Aplicar o coñecemento adquirido á determinación dos valores máximos da tensión nun punto dun sólido deformable.	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16 CT17
Coñecer os principios básicos que rexen a Resistencia de Materiais.	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16 CT17

Coñecer as relacións entre as diferentes solicitacións e as tensións que estas orixinan.	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16 CT17
Aplicar os coñecementos adquiridos á determinación de solicitacións.	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16 CT17
Aplicar o coñecemento adquirido sobre tensións ao cálculo das mesmas en elementos varra	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16 CT17
Coñecer os fundamentos das deformacións dos elementos barra	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16 CT17
Aplicar os coñecementos adquiridos ao dimensionamento de elementos barra	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16 CT17
RESULTADO DE APRENDIZAXE ENAEE: COÑECEMENTO E COMPRENSIÓN. RA 1.2: Coñecemento e comprensión das disciplinas de enxeñaría propias da súa especialidade, no nivel necesario para adquirir o resto das competencias do título, incluíndo nocións dos últimos adiantos. Nivel de desenvolvemento: Adecuado (2). NOTA: Os posibles valores do nivel de desenvolvemento son: Básico (1), Adecuado (2) e Avanzado (3).	CG3	CE14	
RESULTADO DE APRENDIZAXE ENAEE: ANÁLISE EN ENXEÑARÍA. RA 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).	CG4		CT1 CT2 CT9 CT16
RESULTADO DE APRENDIZAXE ENAEE: INVESTIGACIÓN E INNOVACIÓN. RA 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: Básico (1).		CE14	CT9

Contidos

Topic	
1. Reforzo de conceptos de estática. Sólido elástico. Tensións e deformacións.	1.1. Equilibrio estático: - Condicións de equilibrio - Centros de gravidade - Momentos de inercia 1.2. Introdución ao estudo da resistencia de materiais: - Obxecto e finalidade da resistencia de materiais - Concepto de sólido elástico - Definición de prisma mecánico - Equilibrio estático e equilibrio elástico - Solicitacións sobre unha sección dun prisma mecánico 1.3. Tensións e deformacións: - Estado tensional dun prisma mecánico - Estado de deformación dun prisma mecánico - Principios xerais da resistencia de materiais - Relacións entre os estados tensional e de deformación - Tipos de solicitacións exteriores sobre un prisma mecánico - Reaccións nas ligaduras. Tipos de apoios - Sistemas isostáticos e hiperestáticos - Coeficiente de seguridade. Tensión admisible.

2. Tracción-Compresión	2.1. Tracción ou compresión monoaxial: - Introdución - Esforzo normal e estado tensional - Concentración de tensións - Estado de deformacións 2.2. Tensións e deformacións - Varra prismática sometida a tracción ou compresión. Influencia do propio peso. - Concepto de sólido de igual resistencia. - Barra ou anel de pequeno espesor por forza centrífuga. - Tracción e compresión hiperestática - Tensións orixinadas por variacións térmicas ou defectos de montaxe - Tracción e compresión máis aló do límite elástico. Tensión residual - Fundamentos de pandeo. - Equilibrio en fíos e cables. 2.3. Tracción ou compresión biaxial e triaxial: - Tensións en aneis xiratorios - Tensións en depósitos de parede delgada sometidos a presión - Deformacións en esforzos biaxiais e triaxiais
3. Cortadura	3.1. Teoría elemental da cortadura: - Introdución - Cortadura pura - Deformacións producidas por cortadura 3.2. Medios de unión - Unións remachadas e atornilladas - Unións soldadas
4. Flexión	4.1. Flexión. Análise de tensións: - Vigas e diagramas de solicitacións - Introdución á flexión - Flexión pura. Lei de Navier - Flexión Simple - Rendemento xeométrico - Estudo do perfil en dobre T - Enerxía de deformación almacenada en flexión pura - Flexión desviada - Esforzo cortante en flexión simple. Relacións entre esforzo, momento flector e carga - Enerxía interna de deformación producida polo esforzo cortante en flexión simple - Tensións principais. Liñas isostáticas. - Vigas compostas 4.2. Flexión. Análise de deformacións: - Introdución - Ecuación da liña elástica - Ecuación universal da deformada dunha viga de rixidez constante - Teoremas de Mohr - Teoremas da viga conxugada - Deformacións por esforzos cortantes - Vigas de sección variable - Vigas de materiais diferentes - Flexión hiperestática - Vigas continuas
Práctica1: Equilibrio estático	Nesta práctica, revisaranse conceptos relaciones co equilibrio estático (p.e. Centro de Gravidade), así como o seu cálculo experimental.
Práctica 2: Módulo de elasticidade	Proponse o cálculo experimental do módulo de elasticidade. A montaxe consta dun bastidor onde se suxeita unha barra plana. A barras de distintos materiais e/ou seccións aplícaselles unha forza coñecida no seu centro e o módulo de elasticidade calcúlase co desprazamento que se produce e os datos xeométricos da barra.
Práctica 3: Práctica de software F-Tool (I)	Esta práctica tratará de familiarizar ao alumno co cálculo de valores de esforzos normais e cortantes en diferentes supostos mediante o emprego dun software de cálculo estrutural.
Práctica 4: Práctica de software F-Tool (II)	Tratará de introducir ao alumno no cálculo de estruturas planas de complexidade crecente, obtendo esforzos normais, cortantes e flectores, así como a deformada ante diferentes tipos de carga.

Práctica 5: Práctica de software F-Tool (III)	Tratará de introducir ao alumno no cálculo de estruturas planas de complexidade crecente, obtendo esforzos normais, cortantes e flectores, así como a deformada ante diferentes tipos de carga.
Prácticas 6 e 7: Introdución á análise estrutural mediante software	Realización de exemplos de análise estrutural mediante métodos analíticos e computacionais.

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	28	28	56
Prácticas de laboratorio	14	14	28
Seminario	7	0	7
Exame de preguntas de desenvolvemento	13	26	39
Práctica de laboratorio	15	5	20

*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	Nas clases de teoría explícanse os fundamentos de cada tema. Os alumnos dispoñen na bibliografía dos libros de texto recomendados onde se atopa desenvolvido o tema que se está estudando, ademais da información da web que contén o arquivo coa presentación do tema.
Prácticas de laboratorio	Nas clases prácticas aplicaranse os conceptos desenvolvidos en cada tema á resolución de problemas. Deseñáronse unha serie de prácticas acorde co desenvolvemento da materia de teoría co fin de fixar conceptos explicados nesa clase e así o alumno vaia desenvolvendo a súa habilidade para expor solucións técnicas, e ir desenvolvendo a súa creatividade.
Seminario	Nos seminarios analízanse e propoñen unha serie de problemas que teñen que realizar individualmente ou en grupo. O alumno deberá resolver exercicios e problemas baixo a supervisión e corrección do profesor.

Atención personalizada

Methodologies	Description
Lección maxistral	No ámbito da acción titorial, distínguense accións de tutoría académica así como de tutoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de tutorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, co desenvolvemento do proxecto, etc. As tutorías poden ser individualizadas, pero fomentaranse tutorías grupales para a resolución de problemas relacionados coas actividades a realizar en grupo, ou simplemente para informar ao docente da evolución do traballo colaborativo. Nas tutorías personalizadas, 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. Conxugando ambos os tipos de acción titorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade. Os profesores da materia atenderán persoalmente ás dúbidas e consultas dos estudantes, tanto de xeito presencial, segundo o horario que se publicará na páxina web do centro, e a través de medios telemáticos (correo electrónico, videoconferencia, foros FAITIC, etc.). .) baixo a modalidade de cita previa.

Avaliación

	Description	Qualification	Evaluated Competencess		
Exame de preguntas de desenvolvemento	Proba Final (PF) que representa o 40% da EC. 2 Controis Teórico-Prácticos (PT) que representan: 2x15%=30% da EC.	70	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16
Práctica de laboratorio	Memorias de Prácticas (PL) que representan o 20% da EC. Memorias de Entregables (PE) que representan o 10% da EC.	30	CG3 CG4	CE14	CT1 CT2 CT9 CT16 CT17

Other comments on the Evaluation

Convocatoria ordinaria: avaliación continua

O método de avaliación continua (EC) valorará os resultados alcanzados polos alumnos nas diferentes actividades realizadas ao longo do curso, agrupándose en tres partes: Controis Teórico-Prácticos (PT), Memorias de Prácticas (PL), Memorias de Entregables (PE) e Proba Final (PF).

A nota da avaliación continua (NEC) será o resultado de aplicar a media aritmética ponderada da nota de cada unha das partes (PF, PT, PL e PE), tal e como se reflicte a continuación:
NEC=0,4 PF+0,3 PT+0,2 PL+0,1 PE
Para aprobar a avaliación continua, deberanse cumprir dúas condicións: ter unha NEC maior ou igual a 5 e unha PF maior ou igual a 4. En caso de incumprirse a última condición, ignorarase a cualificación PL e PE, pasando a obter unha cualificación de suspenso na avaliación continua da materia, cunha puntuación igual ao mínimo de 4.0 e a media ponderada de PF e PT.

Convocatoria ordinaria: exame ordinario

Aqueles alumnos que non consigan superar a materia polo método de avaliación continua, deberán presentarse ao exame ordinario, onde se avaliarán todas as competencias da materia. Os resultados deste exame suporán o 100% da nota final do alumno, sendo requisito imprescindible para superar a materia obter unha cualificación maior ou igual ao 5. Por último, cabe destacar a opción que todo alumno ten para subir o seu NEC. Noutras palabras, os alumnos que superen a materia por avaliación continua terán a posibilidade de presentarse ao exame ordinario para mellorar a súa nota.

Convocatoria extraordinaria

Os alumnos que non superen a materia na convocatoria ordinaria, realizarán un exame extraordinario que terá o mesmo formato e os mesmos requisitos que o exame ordinario.

Compromiso ético

Na súa dobre condición de militar e alumno da Universidade de Vigo, este está suxeito ás obrigacións derivadas de ambas as institucións. No que a alumno universitario concierne, o Estatuto do Estudante Universitario, aprobado polo Real Decreto 1791/2010 de 30 de decembro, establece no seu artigo 12, punto 2d, que o estudante universitario ten o deber de absterse da utilización ou cooperación en procedementos fraudulentos nas probas de avaliación, nos traballos que se realicen ou en documentos oficiais da universidade. Así mesmo, a LCM, no seu artigo 4 concernente ás regras de comportamento do militar, establece na súa décimo quinta regra que este cumprirá con exactitude os seus deberes e obrigacións impulsado polo sentimento da honra,[].
Por iso, espérase que o alumno teña un comportamento ético adecuado. Si detectásese un comportamento pouco ético durante o curso (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros), penalizarase ao alumno cunha nota de 0,0 na proba escrita ou entregable onde se detectase devandita fraude.

Bibliografía. Fontes de información

Basic Bibliography

Ortiz Berrocal, Luis, **Resistencia de Materiales**,

Complementary Bibliography

González Taboada, J. Antonioa, **Tensiones y deformaciones en materiales elásticos**,
Gere y Timoshenko, **Resistencia de Materiales**,
Vázquez Fernández M, **Resistencia de Materiales**,
Ortiz Berrocal, Luis, **Elasticidad**,
Feodosiev, V.I., **Resistencia de Materiales**,
Rodríguez Avial, F., **Problemas resueltos de resistencia de materiales**,
Rodríguez Avial, M y Zubizarreta, V., **Problemas de elasticidad y resistencia de materiales**,
Miroliúbov, I, **Problemas de Resistencia de Materiales**,

Recomendacións

Other comments

A materia Resistencia de Materiais constitúe o estudo do comportamento dos materiais reais en relación coas súas características de resistencia, rixidez e estabilidade. Esta disciplina require da base conceptual necesaria para a súa correcta comprensión. É por iso que para cursar con éxito esta materia o alumno debe ter:

- Capacidade de comprensión escrita e oral.

- Capacidade de abstracción, cálculo básico e síntese da información.

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo *COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o

profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

A continuación, reflíctense os apartados da presente guía docente que sufrirán modificación no caso ter que abordar a docencia en modalidade virtual:

a) Apartado 6 (CONTIDOS)

Cambios nos contidos prácticos:

- Práctica 1. Equilibrio estático e Práctica 2. Módulo de elasticidade.

En caso necesario substituiríanse con sesións de clase maxistral que se realizarían por medios telemáticos (vídeo conferencia) e nas que sería o profesor o que resolvería as actividades prácticas.

- Prácticas 3 a 7: As Prácticas mediante o Software F-Tool e outros métodos analíticos e computacionales.

Mantéñense, pero en caso necesario realizaríanse de modo non presencial por parte dos alumnos.

b) Apartado 8 (METODOLOXÍA DOCENTE)

Engádense dúas novas metodoloxías docentes:

8.4. Sesión maxistral e/ou sesión práctica virtual síncrona

Impártese a través dunha plataforma de videoconferencia web. Cada sala contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

8.5 Foros de discusión

Actividades desenvolvidas nunha contorna virtual para resolución de dúbidas e/ou debater sobre cuestións que xurdan durante o estudo da materia.

c) Apartado 10 (AVALIACIÓN DA APRENDIZAXE)

As probas de avaliación realizaranse empregando plataformas de teledocencia.

En caso de impartición da docencia en modalidade non presencial, a actividade docente impartirase combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo, para garantir a accesibilidade do alumnado aos contidos docentes.

IDENTIFYING DATA				
Fundamentals of electrical engineering				
Subject	Fundamentals of electrical engineering			
Code	P52G381V01205			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	Núñez Ortuño, José María			
Lecturers	Falcón Oubiña, Pablo González Prieto, José Antonio Núñez Ortuño, José María			
E-mail	jnunez@cud.uvigo.es			
Web	http://faitic.uvigo.es			
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.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CE10	Knowledge and use of the principles of circuit theory and electrical machines.
CT1	Analysis and synthesis
CT2	Problems resolution.
CT6	Application of computer science in the field of study.
CT10	Self learning and work.
CT14	Creativity.
CT16	Critical thinking.
CT17	Working as a team.

Learning outcomes	Competences		
To understand the basics of the operation of circuits and electrical machines	CG3	CE10	
Familiarisation with current techniques for the analysis of electrical circuits		CE10	CT6
Know the techniques of measure of electrical circuits			CT6 CT10
To acquire skills on the process of analysis of electrical circuits			CT1 CT2 CT6 CT10 CT14 CT16 CT17
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)].	CG3		
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)].		CE10	

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)].	CT2 CT16
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)].	CT6
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)].	CT10 CT17

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: Introduction to the handling of instrumentation and assembly of basic direct current circuits. The aim of this practice is to familiarize the student with the instrumentation equipment of the Electrotechnical Laboratory by means of the assembly of basic direct current circuits on a prototyping (or protoboard). These circuits will include assemblies for series and parallel voltage measurement, as well as voltage and current dividers. In this first practice of the subject, we will emphasize the precautions to be taken when handling electrical circuits, letting the student be aware of the dangers related to electric current, showing the basic electrical safety measures, the operation of the protective and safety equipment, and teaching hime/her how to manage dangers. 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: Single-phase transformer tests The aim of this practice is to make the student aware of the main characteristics of a single-phase transformer. To this end, he will experimentally determine the parameters that govern its operation, using the so-called vacuum and short-circuit tests. The student must be able to carry out the appropriate assembly to perform these tests, measuring voltages, currents and powers. From the result of the measurements the student has to be able to interpret the obtained data and extract from them the necessary information to know and quantify the different power losses in a real transformer. With these data he must build the equivalent model of a real transformer. In this practice, the precautions to be taken when manipulating circuits and using electrical machines will be emphasized. In this sense, part of the practice will be dedicated to make the student aware of the dangers related to the electrical current, showing him the basic measures of electrical safety, the operation of the protection and safety devices, and teaching him how to manage the danger. Practice 7: Three-phase asynchronous motor The objective of this practice is that the student makes contact with an industrial asynchronous three-phase motor, identifying its windings, proposing its star and triangle connection, verifying its operation in no-load and making a change in the direction of rotation. Likewise, the problems originated by the loss of a phase in permanent regime and at the start will be analyzed.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	38	66
Laboratory practical	14	7	21
Seminars	7	3	10
Seminars	15	12	27
Essay questions exam	13	13	26

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

Methodologies

	Description
Lecturing	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.
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 teachers of the subject will personally attend to the doubts and queries of the students, both in person, according to the timetable that will be published on the centre's website, and through telematic means (e-mail, videoconference, FAITIC 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	Evaluated Competencess
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	CG3 CE10 CT1 CT2 CT14 CT16

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	CG3	CE10	CT1 CT6 CT10 CT16 CT17

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 (copying, 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.

Sources of information

Basic Bibliography

James W. Nilsson, **Electric Circuits**, 10ª, Pearson, 2014

Fraile Mora, J., **Máquinas Eléctricas**, 8ª, Garceta Grupo, 2016

Complementary Bibliography

Carlson, A. Bruce, **Teoría de circuitos: ingeniería, conceptos y análisis de circuitos eléctricos lineales**, 1ª, Thomson-Paraninfo, 2002

Conejo, A, **Circuitos eléctricos para la ingeniería**, 1ª, McGraw-Hill, 2004

Gabladon, A, **Problemas de circuitos eléctricos**, 1ª, Editorial Diego Marín, 2000

Garrido, C. y Cidrás, J., **Problemas de Circuitos Eléctricos**, 1ª, Editorial Reverte, 1992

Espinosa, J. y Belenguer, **Problemas resueltos de máquinas eléctricas rotativas**, 1ª, Universidad Jaume I, 2012

Chapman, S.J, **Máquinas Eléctricas**, 5ª, McGraw Hill, 2012

Corrales Martín, J., **Cálculo Industrial de Máquinas Eléctricas, Tomo II**, 1ª, Marcombo Boixerau Editores, 1982

Duncan Glover, J. y Sarma, M., **Sistemas de Potencia. Análisis y Diseño**, 3ª, Cengage Learning Editores S.A., 2003

Kosow, I.L., **Máquinas Eléctricas y Transformadores**, 1ª, Pearson Educación, 1993

Casals Torrens, Pau, **Máquinas eléctricas. Aplicaciones de ingeniería eléctrica a instalaciones navales y marinas**, 1ª, Ediciones UPC, 2010

Recommendations

Subjects that continue the syllabus

Electronic technology/P52G381V01301
Fundamentals of automation/P52G381V01401
Naval engines and machines/P52G381V01409

Subjects that it is recommended to have taken before

Physics: Physics II/P52G381V01106

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 in previous courses.

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

Contingency plan

Description

In case of the possible appearance of extraordinary situations that imply the suspension of the face-to-face teaching activity and the change to an offline/online scenario, the following changes will be made:

CONTENTS

Programming: theoretical credits

The teaching of the theoretical content of the subject should not be affected by the transfer to non-presential online mode. If the number of hours to be taught is considerably reduced, the contents of each of the subjects in a way that ensures that learning outcomes and competences are achieved.

Programming: practical credits

Where appropriate, in the section on practical contents, the replacement of some laboratory practice will be proposed that can't be moved to the virtual stage.
Faced with an extraordinary situation, the replacement of the laboratory sessions with the following ones is considered:

Practice 1: Introduction to PSIM and basic circuit simulation example
The aim of this practice is to familiarize the student with the PSIM simulation software. This software is characterized by its simplicity, allows to mount a circuit and check its operation in an easy and fast way. At This practice will introduce the student to the use of this software with examples and proposed exercises.

Practice 2: Simulation of direct current circuits This practice aims to make more advanced circuits than the previous practice and to check the operation of these with the PSIM software. In this practice the student will be able to check concepts introduced in the master classes like Ohm's law, Thevenin's theorem, Boucherot's theorem, etc.

Practice 3: Simulation and measurement of AC circuits In this practice, non-resistive passive elements are introduced in the simulations of electrical circuits, such as coils and capacitors.

Practice 4: Simulation of PSIM circuits in AC The student will continue with the analysis of AC circuits with the electrical circuit simulator and will introduce power measurement elements, power factor, etc.

Practice 5: Practice of three-phase systems The student will learn to analyze three-phase AC circuits using the of PSIM circuit simulation, extending the concepts seen in previous practices and emphasizing the differences between three-phase and single-phase systems.

Practice 6: Simulation of single-phase transformer tests
The aim of this practice is to make the student aware of the main characteristics of a single-phase transformer. For This will determine by simulation with the PSIM tool, the parameters that govern its operation, using the performance of so-called open and short-circuit tests. The student must be able to carry out the assembly suitable for the realization of these tests, measuring voltages, currents and powers.
From the results of the simulated measurements the student must be able to interpret the data obtained and also know and quantify the different power losses in an actual transformer. With this data the student must compose the equivalent model of a real transformer.

Practice 7: Simulation of the behaviour of the three-phase asynchronous machine
The aim of this practice is that the student is able to verify the behaviour of a three-phase asynchronous machine, making its simulated connection to the grid, obtaining its current, power and nominal torque, and determining its Torque-speed characteristic. Finally, you will check the operation of the machine in its various modes.

TEACHING METHODOLOGY

A new teaching methodology will be incorporated into the existing ones.

Synchronous online meeting (theory or practical session):

These sessions will be given through a web videoconference platform within a virtual classroom. Each virtual classroom will

contain various display panels and components, whose design can be customized by the lecturer to adapt it to the needs of the class. In the virtual classroom, any presenter can share the screen or files of your computer, use a whiteboard, chat, stream audio and video or participate in interactive online activities (surveys, questions, etc.).

LEARNING ASSESSMENT

Faced with a change of scenario due to the emergence of extraordinary situations, learning assessment is will remain unchanged with respect to the contents described above in this teaching guide, weightings, minimum requirements, type and number of tests.
The only difference will be in the evaluation format, which in the online modality will take place by combining the FAITIC-Moodle online teaching platform with the Remote Campus of the University of Vigo (and/or similar platforms)

IDENTIFYING DATA				
Mechanism and machine theory				
Subject	Mechanism and machine theory			
Code	P52G381V01206			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	González Gil, Arturo			
Lecturers	Cacabelos Reyes, Antón González Gil, Arturo			
E-mail	arturogg@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The main objective of Mechanism and Machine Theory is to provide the cinematic and dynamic fundamentals of machines and mechanisms and their application in the field of the Mechanical Engineering.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
CE13	Knowledge of the principles of the theory of machines and mechanisms.
CT2	Problems resolution.
CT6	Application of computer science in the field of study.
CT9	Apply knowledge.
CT10	Self learning and work.
CT16	Critical thinking.

Learning outcomes	Competences		
Know the basic foundations of the Theory of Machines and Mechanisms and their application in Engineering Mechanics to solve related problems in the field of Industrial Engineering.	CG3 CG4	CE13	CT2 CT9 CT10 CT16
Know, understand and apply the concepts related with the Theory of Machines and Mechanisms.		CE13	CT2 CT9 CT10 CT16
Know and apply the cinematic and dynamic analyses of mechanical systems.		CE13	CT2 CT9 CT10 CT16
Know and use effectively the software related with the analysis of mechanisms.		CE13	CT2 CT6 CT9 CT10 CT16
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: Basic (1)].	CG3	CE13	
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)].	CG4		CT2 CT9 CT16
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 [Basic (1)].	CG4		CT2 CT9

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)].	CT6 CT9

Contents	
Topic	
Unit 1: Introduction to the topology of the mechanisms	Basic concepts: link, cinematic pair, cinematic chain, mechanism, machine Types of mechanisms Degrees of freedom Grashof theorem Kinematic inversion Mechanical advantage Mechanisms of straight line and fast return Mechanism schematization
Unit 2: Position analysis	Graphic method Graphic-analytical method Analytical method: closed loop equations Four-bar mechanism
Unit 3: Velocity analysis	Elementary movements: rotation and translation Analysis of relative velocity Calculation of instantaneous centres of rotation Graphic method Analytical method
Unit 4: Acceleration analysis	Basic moves: rotation, translation General movement with relative speed. Coriolis acceleration Relation between the acceleration of two points of the same element Graphic methods Analytical methods
Unit 5: Statics	Foundations Force system reduction to a point
Unit 6: Force Analysis and dynamics of the flat movement	Systems dynamically equivalent Inertial forces in the flat movement, principle of D' Alembert.
Unit 7: Rotation dynamics	Static balancing Dynamic balancing Balancing analysis
Unit 8: Dynamic control: the flywheel	Load cycles Flywheel calculation
Unit 9: Cams	The cam follower mechanism Displacement diagram Cinematic analysis Graphic design of cam profiles
Unit 10: Gears	Transmission mechanisms Types of gears and applications Cylindrical gears. Geometric parameters. Normalization. Gear basic law Forces and power transmission of the cylindrical gears Gear train
Laboratory Practices (LP)	PL1 - Machinery analysis PL2 and PL3 - Assembly and kinematic analysis of basic mechanisms PL4 - Kinematic analysis and cam design PL5 - Assembly and analysis of dynamic systems with pulleys and belts PL6 - Assembly and analysis of gear trains PL7 - Defense of the project on the design of a mechanism

Planning	Class hours	Hours outside the classroom	Total hours
Lecturing	28	42	70
Laboratory practical	14	0	14
Seminars	7	7	14
Mentored work	0	8	8
Problem solving	28	16	44
*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	During 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	A series of applied exercises are proposed for the students to solve, edither individually or in groups, under the supervision of the lecturer.
Mentored work	Final work on the analysis and design of a mechanism, which will also take into account social, health and industrial safety aspects. The work will be carried out in groups of three or four people. Oral and written justification of the proposed design are required. This work will be proposed at the beginning of the course and the deadline will be the last session of laboratory.
Problem solving	Intensive course (15 hours) for those students who have failed the subject at first call, prior to theexam in second call. Group tutoring with the lecturer. Doing examans. Assessment tasks and reinforcement hours.

Personalized assistance

Methodologies	Description
Problem solving	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 teledoaching platforms, etc.).

Assessment

	Description	Qualification	Evaluated Competencess		
Lecturing	Written tests: theoretical questions and problems. The written tests aim to evaluate the learning of all the theoretical contents of the subject. There will be two partial tests and one final exam. Each partial test will contribute 20% of the final grade of the student. The final exam, which will cover all the subject matter, will have a weight of 40% in the final grade. The written tests will consist of a series of questions and exercises that give priority to the conceptual and logical reasoning, in order to verify the intellectual maturity of the students to obtain conclusions from the notions or theories exposed in class. All tests will be evaluated for a total of 10 points	70	CG3 CG4	CE13	CT2 CT6 CT9 CT10 CT16
Laboratory practical	The students must present a report of practices for each laboratory practice performed (in case the practice is done in group, only one practice will be delivered per group). Each report will be evaluated on 10 points. The final grade of practices will be the average value of the grades obtained in each practice delivered.	15	CG3 CG4	CE13	CT2 CT6 CT9 CT10 CT16
Seminars	Throughout the course (in particular during the seminar sessions), different exercises will be proposed to students, who may do them in groups or individually. Each of these exercises will be evaluated over 10 points. The grade of this item will be the average value of the grades obtained in each deliverable.	5	CG3 CG4	CE13	CT2 CT6 CT9 CT10 CT16
Mentored work	Group work that must be accompanied with a memory and an oral presentation. The work will be valued on a maximum of 10 points.	10	CG3 CG4	CE13	CT2 CT6 CT9 CT10 CT16

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 rating 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 evaluation

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), Theoretical-Practical Controls (CT), Memories of Practices(MP), Evaluable Exercises (EE), and Final Work (TF). 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 tests of evaluation of theoretical-practical knowledge (TC) throughout the course. The student must present a report for each laboratory practice provided that it is indicated in the realization of the same, 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 is unable to attend a session in which carry out exercises that can be evaluated due to force majeure, the latter must notify the teachers by e-mail so that there is a record and this circumstance is taken into account at the time of the evaluation. In addition, students must carry out and present a group work on the design of a mechanism (see practice 7) that will be evaluated in item TF (10% of the final mark of continuous evaluation). 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:

$NEC= 0.4 \cdot PF+0.15 \cdot CT1+0.15 \cdot CT2+0.15 \cdot MP+0.05 \cdot EE+0.1 \cdot TF$

To pass the subject by continuous evaluation, 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 exam (PF); iii) having a value of $NEC \geq 5$. 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 evaluation of the subject.

Ordinary call: ordinary exam

Those students who fail to 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 every student has the option of improving their grade obtained by continuous evaluation (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 Royal Decree 1791/2010 of December 30, 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 (copying, 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.

Sources of information

Basic Bibliography

D.H. Myszka, **Máquinas y Mecanismos**, Pearson, 2012

R.L. Norton, **Diseño de Maquinaria: síntesis, análisis de máquinas y mecanismos**, McGraw-Hill, 2009

J.C. García Prada, C. Castejón Sisamón y H. Rubio Alonso, **Problemas resueltos de teoría de máquinas y mecanismos**, Editorial Paraninfo, 2007

A. Nápoles Alberro, **Análisis de Mecanismos**, Delta Publicaciones, 2010

Complementary Bibliography

A. Hernández, J. Aguirrebeitia, V. Petuya, C. Pinto, **Dinámica de Máquinas**, Ed. Síntesis, 2019

A. Hernández, **Dinámica de Máquinas**, Ed. Síntesis, 2004

A. Nápoles, A.J. Sánchez, E.E. Zayas, **Teoría de Mecanismos: ejercicios resueltos**, UPC, 2017

J. Domínguez Abascal, **Teoría de máquinas y mecanismos**, Universidad de Sevilla, 2016

A. Simón, A. Bataller, J. Guerra, A. Ortiz, J.A. Cabrera, **Fundamentos de teoría de máquinas**, Bellisco, 2005

R. Calero Pérez, J.A Carta González, **Fundamentos de mecanismos y máquinas para ingenieros**, McGraw-Hill, 1999

A.G. Erdman, G.N. Sandor, **Diseño de Mecanismos: Análisis y Síntesis**, Pearson Educación, 1998

J.E. Shigley, J.J. Uicker, **Teoría de Máquinas y Mecanismos**, McGraw-Hill, 1998

S. Cardona, D. Clos, **Teoría de Máquinas**, UPC, 2001

M. Khamashta, L. Álvarez, R. Capdevila, **Problemas resueltos de cinemática de mecanismos planos**, UPC, 1992

M. Khamashta, L. Álvarez, R. Capdevila, **Problemas resueltos de dinámica de mecanismos planos.**, UPC, 1992

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

Recommendations

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

MODIFICATIONS IN CASE OF EXTRAORDINARY SITUATIONS THAT INVOLVE THE SUSPENSION OF THE PRESENTIAL ACADEMIC ACTIVITY

CONTENTS
The first six laboratory sessions are held in laboratories and equipment, machines and tools are used. As far as possible, these practices will be replaced by demonstration tasks, solving exercises and/or practical cases that allow the student to achieve the objectives set for said practices.

TEACHING METHODOLOGY
A new teaching methodology is added: Synchronous online meeting (theory or practical session): It is taught through a web video conferencing platform. Each virtual classroom contains a variety of display panels and components, the design of which can be customized to best suit the needs of the class. In the virtual classroom, lecturers (and those authorized participants) can share their computer screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).

EVALUATION
The evaluation tests would be carried out by combining the FAITIC-Moodle remote teaching platform and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Environmental technology				
Subject	Environmental technology			
Code	P52G381V01207			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	González Gil, Lorena			
Lecturers	Alfonsín Pérez, Víctor Ángel González Gil, Lorena Maceiras Castro, María del Rocío			
E-mail	lorena.gonzalez@cud.uvigo.es			
Web	http://faitic.uvigo.es			
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, 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.			

Competencies	
Code	
CG7	Ability to analyze and assess the social and environmental impact of the technical solutions.
CE16	Basic knowledge and application of environmental technologies and sustainability.
CT1	Analysis and synthesis
CT2	Problems resolution.
CT3	Oral and written proficiency
CT9	Apply knowledge.
CT10	Self learning and work.
CT12	Research skills.
CT17	Working as a team.
CT19	Sustainability and environmental commitment. Equitable, responsible and efficient use of resources.

Learning outcomes	Competences
To know the available environmental technologies for control of gaseous pollutants	CE16 CT2 CT3 CT10
To know the basic processes for the conditioning of water and wastewater treatment	CE16 CT2 CT3 CT10
To know the performance of wastewater treatment plants	CE16 CT2 CT3 CT10
To know the integrated process of industrial waste treatment	CE16 CT2 CT3 CT10 CT19

To know and be able to apply the different tools for preventing industrial pollution		CE16	CT1 CT2 CT3 CT9 CT10 CT12 CT17 CT19
Ability to analyze and determine the social and environmental impact of the technical solutions to environmental problems	CG7		CT1 CT3 CT9 CT10 CT17 CT19
ENAEE LEARNING OUTCOMES. KNOWLEDGE AND UNDERSTANDING LO1.3.- awareness of the wider multidisciplinary context of engineering (level of development this sub-resulted of learning: Intermediate (2))		CE16	
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))	CG7		CT1 CT2 CT9 CT19
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))	CG7		CT2 CT9 CT19
ENAEE LEARNING OUTCOMES. INVESTIGATIONS LO4.2.- ability to consult and apply codes of practice and safety regulations in their field of study (Intermediate (2))	CG7		
ENAEE LEARNING OUTCOMES. 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))			CT9 CT12
ENAEE LEARNING OUTCOMES. ENGINEERING PRACTICE LO5.4.- ability to apply norms of engineering practice in their field of study (Basic (1))	CG7		CT9
ENAEE LEARNING OUTCOMES. ENGINEERING PRACTICE LO5.5- awareness of non-technical - societal, health and safety, environmental, economic and industrial implications of engineering practice (Intermediate (2))	CG7	CE16	CT19
ENAEE LEARNING OUTCOMES. 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))	CG7		CT19

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	45	73
Laboratory practical	14	7	21
Problem solving	7	7	14
Seminars	15	7	22
Objective questions exam	4	0	4
Essay	0	5	5
Systematic observation	0	0	0
Essay questions exam	3	2	5
Essay questions exam	3	0	3
Essay questions exam	3	0	3

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

Methodologies

	Description
Lecturing	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	The student must solve exercises and problems that will be posed and corrected by the teacher. Also, the lecturer will suggest exercises to perform 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. 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 professors of the subject will solve the questions and queries of the students in person or online (via email, videoconference, FAITIC 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	Evaluated Competencess
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.	15	CG7 CE16 CT1 CT3 CT9 CT12 CT17 CT19
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	CG7 CE16 CT1 CT2 CT3 CT9 CT10 CT12 CT17
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.	7	CE16 CT1 CT3 CT9 CT10 CT12 CT17 CT19
Systematic observation	During class hours, individual tasks (IT, 5%) and other tasks (TO, 3%) that may be in groups will be proposed in order to monitor the contents taught. These activities will be compulsory and scored, each of them, on 10 points.	8	CE16 CT1 CT3 CT9 CT10 CT12 CT17 CT19
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	CG7 CE16 CT1 CT2 CT3 CT9 CT10 CT12 CT17
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 10%).	100	CG7 CE16 CT1 CT2 CT3 CT9 CT10 CT12 CT17
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.	100	CG7 CE16 CT1 CT2 CT3 CT9 CT10 CT12 CT17

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:

- If the weighted average of tests P1, P2, TI and FE is less than 5.
- 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 (copy, 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 Defense University Center 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

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

Complementary Bibliography

Domingo Gómez Orea, **Evaluación de Impacto Ambiental**, 2ª ed., Mundi-Prensa, 2003

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

Subjects that it is recommended to have taken before

Physics: Physics 1/P52G381V01102
Physics: Physics II/P52G381V01106
Chemistry: Chemistry/P52G381V01108

Contingency plan

Description

MODIFICATIONS IN CASE OF SUSPENSION OF PRESENTIAL ACADEMIC ACTIVITY

== ADAPTATION OF THE CONTENTS ==

Practices 1-5 are designed to be carried out in laboratories, since they require specific equipment, reagents and materials. In order for the students to achieve the competences associated with these practices, as far as possible, demonstrative content, virtual visits, videos and other audiovisual media will be provided. In addition, some of the practices can be complemented with small domestic experiments. At the same time, the students will be provided with data mimicking what they could experimentally obtain in the laboratory, thus they can process them and draw conclusions. In the event that it is not possible to perform any of these practices in a demonstrative manner, practices similar to 6 will be carried out using a computer software to strengthen concepts of process and equipment design for treating pollution.
The order of the practical contents may be altered to favour their adaptation to the online teaching, which may also lead to variations in the order of the theoretical lessons.

== ADAPTATION OF THE TEACHING METHODOLOGY ==

A new teaching methodology is added:
Synchronous online meeting (theory or practical session): taught through an online conferencing platform. Each virtual classroom contains a variety of display panels and components, whose layout can be customized to best suit the needs of the session. In the virtual classroom, teachers (and those authorized participants) can share their screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).

== ASSESSMENT ADAPTATION ==

The evaluation test/activities will be carried out by combining the FAITIC-Moodle remote teaching platform and the Campus Remoto of the University of Vigo.

IDENTIFYING DATA				
Mecánica de fluídos				
Subject	Mecánica de fluídos			
Code	P52G381V01208			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2	2c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Lareo Calviño, Guillermo			
Lecturers	Lareo Calviño, Guillermo Suárez García, Andrés			
E-mail	guillermo@cud.uvigo.es			
Web	http://faitic.uvigo.es			
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	
CG4	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.
CG5	Coñecementos para a realización de medicións, cálculos, valoracións, taxacións, peritaxes, estudos, informes, planes de labores e outros traballos análogos.
CE8	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.
CT2	Resolución de problemas.
CT9	Aplicar coñecementos.
CT10	Aprendizaxe e traballo autónomos.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Entender os principios básicos do movemento de fluídos	CG4 CG5	CE8	CT2 CT9 CT10
Capacidade para calcular tubaxes e canles	CG4 CG5	CE8	CT2 CT9 CT10
Capacidade para manexar medidores de magnitudes fluídas	CG4 CG5	CE8	CT2 CT9 CT10
Capacidade para coñecer e dominar as ferramentas coas que se abordan os problemas de fluxos de fluídos.	CG4 CG5	CE8	CT2 CT9 CT10

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)		CE8	
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)	CG4		CT2 CT9
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)	CG4		CT2 CT9
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)	CG4 CG5	CE8	CT2 CT9
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)	CG4 CG5		
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)		CE8	CT9
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)	CG4 CG5		CT2 CT9
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)			CT9
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)			CT10
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)			CT10
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)			CT10

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 3.1. Segundo condicións cinemáticas 3.2. Segundo condicións xeométricas 3.3. Segundo condicións mecánicas de contorno 3.4. Segundo condicións do movemento interno 3.5. Segundo forma de reaccionar ante obstáculos III.4. Sistemas e volume de control III.5. Integrais estendidas a volumes fluídos 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 4.1. Significado físico dos números adimensionais VI.5. Semellanza 5.1. Semellanza parcial 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 2.1. Correntes de Hagen-Poiseuille 2.2. En condutos de sección circular 2.3. Outras seccións VII.3. Efecto de lonxitude finita do tubo VII.4. Perda de carga 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. 4.1. Diagrama de Nikuradse 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 2.1. Perda á entrada dun tubo 2.2. Perda nun tubo á saída 2.3. Perda por contracción 2.4. Perda por ensanche 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	42	70
Prácticas de laboratorio	14	14	28
Resolución de problemas	7	7	14
Exame de preguntas de desenvolvemento	5	0	5
Traballo	15	12	27
Exame de preguntas de desenvolvemento	6	0	6
*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.
Resolución de problemas	Formularanse problemas e/ou exercicios relacionados coa materia. O alumno deberá desenvolver solucións adecuadas ou correctas mediante a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación da información dispoñible e a interpretación dos resultados. Utilizarase como complemento da lección maxistral. Metodoloxías integradas Aprendizaxe colaborativo. Preténdese motivar ao estudante na actividade de investigación, e fomentar as relacións persoais compartindo problemas e solucións. Reservarase unha fracción das clases de aula á resolución por equipos de problemas expostos. Esta dedicación poderá variar ao longo do cuadrimestre e en función das necesidades puntuais da materia. Aprendizaxe baseada en problemas. Método de ensino-aprendizaxe cuxo punto de partida é un problema que, deseñado polo profesor, o estudante ha de resolver para desenvolver determinadas competencias. Utilizarase esta metodoloxía docente para resolución de problemas sinxelos.

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.
Resolución de problemas	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. Os profesores da materia atenderán as dúbidas e consultas dos alumnos de forma síncrona en despachos físicos ou virtuais baixo a modalidade de concertación previa ou asíncrona por medios telemáticos (correo electrónico, foros de FAITIC, etc.).
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	Evaluated Competencess
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.	10	CG4 CE8 CT2 CG5 CT9 CT10
Resolución de problemas	Avaliación en Seminarios (ES): A avaliación en seminarios realizarase a través de traballo en grupos de alumnos. Proporanse exercicios para a súa resolución en grupos, durante o tempo do seminario. Tanto a resolución conxunta do exercicio, como a contribución individual serán valoradas. Realizaranse, como mínimo, dous (2) seminarios avaliables durante o curso.	10	CG4 CE8 CT2 CG5 CT9 CT10

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	CG4 CG5	CE8	CT2 CT9 CT10
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.	10	CG4 CG5	CE8	CT2 CT9 CT10
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	CG4 CG5	CE8	CT2 CT9 CT10

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

Basic Bibliography

WHITE, F., **MECÁNICA DE FLIUDOS**, MCGRAW HILL, 2008

CRESPO, A., **MECÁNICA DE FLIUDOS**, THOMSON, 2006

CENGEL, Y, **MECÁNICA DE FLIUDOS**, MCGRAW HILL, 2007

Complementary Bibliography

BARRERO RIPOLL, A, **FUNDAMENTOS Y APLICACIONES DE LA MECÁNICA DE FLUIDOS**, MCGRAW HILL, 2005

GILES, R.V., **MECÁNICA DE FLUIDOS E HIDRÁULICA**, MCGRAW HILL, 1994

LÓPEZ-HERRERA SÁNCHEZ, J.M., **MECÁNICA DE FLUIDOS: PROBLEMAS RESUELTOS**, MCGRAW HILL, 2005

FOX, **INTRODUCCIÓN A LA MECÁNICA DE FLUIDOS**, MCGRAW HILL, 1989
SHAMES, I., **LA MECÁNICA DE FLUIDOS**, MCGRAW HILL, 1995
STREETER, V., **MECÁNICA DE FLUIDOS**, MCGRAW HILL, 1989
BRUN, E., **MECÁNICA DE FLUIDOS I Y II**, LABOR, 1980
OUZIAUX, R., **MECANIQUE DES FLUIDES APPLIQUEÉ**, DUNOD, 1978
VENNARD, J.K., **ELEMENTOS DE MECÁNICA DE FLUIDOS**, CONTINENTAL, 1979
MATAIX, C., **MECÁNICA DE FLUIDOS Y MÁQUINAS HIDRÁULICAS**, CASTILLO, 1986
ROCA VILA, R., **INTRODUCCIÓN A LA MECÁNICA DE FLUIDOS**, LIMUSA, 1980
MASSEY, B.S., **MECÁNICA DE FLIUDOS**, C.E.C.S.A., 1979
ROBERSON, J.A., **MECÁNICA DE FLIUDOS**, INTERAMÉRICA, 1983

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.

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

=== ADAPTACIÓN DAS METODOLOXÍAS ===

ANEXO: MODIFICACIÓNS EN CASO DE SITUACIÓNS EXTRAORDINARIAS QUE IMPLIQUEN A SUSPENSIÓN DA ACTIVIDADE ACADÉMICA PRESENCIAL
No caso de que por circunstancias extraordinarias suspéndase a actividade presencial, proponse as seguintes modificacións aos apartados descritos anteriormente:
-Apartado 6. Contidos
Neste apartado proponse a substitución das prácticas descritas no apartado 6, que en lugar de realizarse presencialmente basearanse en información e documentación exposta a través da plataforma Moodle, manténdose a avaliación de ditas prácticas coa realización de cuestionarios (MP) a través de dita plataforma: Estas prácticas son as seguintes:
PL 1. Principio de Arquímedes
Estudo do principio de *Arquímedes baseándose en esquemas, vídeos e información web.
PL 2. Medición da presión hidrostática
Estudo da presión hidrostática baseándose en esquemas, vídeos e información web.
PL 3. Ecuación de Bernoulli
Estudo da ecuación de Bernoulli baseándose en esquemas, vídeos e información web.
PL 4. Demostración da medición de fluxos
Estudo de métodos de medición de fluxos baseándose en esquemas, vídeos e información web.
PL 5. Demostración de perdas en tubaxes e conectores
Estudo das perdas de carga en tubaxes e conectores baseándose en esquemas, vídeos e información web.

-Apartado 8. Metodoloxías docentes
Neste apartado detállase unha nova metodoloxía docente:
Sesión maxistral e/ou sesión práctica virtual síncrona. Impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).
-Apartado 10. Avaliación

Nun escenario de docencia virtual, as probas de avaliación realizaranse combinando a plataforma de *teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
English I				
Subject	English I			
Code	P52G381V01209			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	English			
Department				
Coordinator	Tomé Rosales, María de los Ángeles			
Lecturers	Beasley , Jeffrey Foley , Mary Christina Rich Stephens, Christopher Martin Tomé Rosales, María de los Ángeles			
E-mail	externo.angelestome@cud.uvigo.es			
Web	http://faitic.uvigo.es			
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.			

Competencies	
Code	
CG10	Ability to work in a multidisciplinary and multilingual environment.
CE34	To promote, through speaking and writing in Spanish and English, communication skills to ease the transmission and understanding of orders, ideas and concepts.
CT4	Oral and written proficiency in a foreign language.
CT5	Information Management.
CT7	Ability to organize and plan.
CT8	Decision making.
CT9	Apply knowledge.
CT15	Objectification, identification and organization.
CT17	Working as a team.
CT18	Working in an international context.

Learning outcomes	Competences		
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.	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18

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.	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18
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.	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18
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.	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18
ENAEE Learning Outcome: KNOWLEDGE AND UNDERSTANDING: LO1.3.- Critical awareness of the wider multidisciplinary context of engineering [Intermediate (2)].	CG10		
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)].			CT5
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)].		CE34	CT4 CT18
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)].		CE34	CT4 CT7 CT8 CT17 CT18
ENAEE Learning Outcome: LIFELONG LEARNING: LO8.1.- Ability to recognise the need for and to engage in independent lifelong learning [Basic (1)].			CT8
ENAEE Learning Outcome: LIFELONG LEARNING: LO8.2.- Ability to follow developments in science and technology [Basic (1)].			CT8

Contents	
Topic	
Unit 1	1.1. Questions and answers 1.2. Do you believe in it?
Unit 2	2.1. Call the doctor? 2.2. Older and wiser?
Unit 3	3.1. The truth about air travel 3.2. Incredibly short stories
Unit 4	4.1. Eco-guilt 4.2. Are you a risk taker?

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	20	20	40
Mentored work	20	20	40
Essay questions exam	30	24	54
Essay	4	4	8
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, FAITIC forums, etc.) on appointment.
Tests	**Description**
Oral exam	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, FAITIC forums, etc.) on appointment.
Essay	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, FAITIC forums, etc.) on appointment.

Assessment					
	Description	Qualification	Evaluated Competencess		
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	CG10	CE34	CT4 CT8 CT9 CT15 CT17 CT18
Essay	Activity (15%)	15	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18

Oral exam	Activity 2 (15%)	15	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18

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.

Sources of information

Basic Bibliography

Latham-Koenig, Christina & Clive Oxenden, **English File. Upper-intermediate. Student's Book**, 3ª, Oxford University Press, 2014

Complementary Bibliography

Collie, J. and S. Slater, **Cambridge Skills for Fluency: Listening**, 1ª, Cambridge University Press, 2008
Collie, J. and S. Slater, **Cambridge Skills for Fluency: Speaking**, 1ª, Cambridge University Press, 2008
Collie, J. and S. Slater, **Cambridge Skills for Fluency: Reading**, 1ª, Cambridge University Press, 2008
Collie, J. and S. Slater, **Cambridge Skills for Fluency: Writing**, 1ª, Cambridge University Press, 2008
Comfort, J., **Effective Presentations**, 1ª, Oxford University Press, 2005
Craven, M., **Cambridge English Skills. Real Listening and Speaking. Level 3.**, 1ª, Cambridge University Press, 2008
Eastwood, J., **Oxford Practice Grammar**, 1ª, Oxford University Press, 1999
Gower, R., **Cambridge English Skills. Real Writing. Level 3.**, 1ª, Cambridge University Press, 2008
Hancock, M., **English Pronunciation in Use**, 1ª, Cambridge University Press, 2003
Hashemi, L. and B. Thomas, **Grammar for First Certificate**, 1ª, Cambridge University Press, 2008

Ibbotson, M., **Cambridge English for Engineering**, 1ª, Cambridge University Press, 2008
Ibbotson, M., **Professional English in Use. Engineering**, 1ª, Cambridge University Press, 2009
Mccarthy, M. and F. O'Dell, **English Vocabulary in Use**, 1ª, Cambridge University Press, 2002
Murphy, R., **English Grammar in Use**, 16ª, Cambridge University Press, 2003
Redman, S., **Idioms and Phrasal Verbs. Advanced**, 1ª, Oxford University Press, 2011
Swan, M., **Practical English Usage**, 1ª, Oxford Universiy Press, 2005
Thomas, B. and B. Matthews, **Vocabulary for First Certificate**, 1ª, Cambridge University Press, 2007
Vince, M., **First Certificate Language Practice**, 1ª, Macmillan, 2009
Cambridge Learner's Dictionary, 1ª, Cambridge University Press, 2001
Cambridge Dictionary of American English, 1ª, Cambridge University Press, 2001
Cambridge Dictionary of American Idioms, 1ª, Cambridge University Press, 2003
Cambridge Phrasal Verbs Dictionary, 1ª, Cambridge University Press, 2006
Collins Cobuild Active English Dictionary, 1ª, Collins Cobuild, 2003
Longman Active Study Dictionary, 1ª, Pearson, 2004
Macmillan Essential Dictionary for Learners of American English, 1ª, Macmillan, 2003
Cambridge Word Selector, 1ª, Cambridge University Press, 2005
Diccionario Cambridge Klett Pocket, 1ª, Cambridge University Press, 2002
Diccionario Collins Compact Plus, 1ª, Grijalbo Mondadori, 2003
Diccionario Oxford Business, 1ª, Oxford University Press, 2005
Diccionario Oxford Pocket para Estudiantes de Inglés, 1ª, Oxford University Press, 1997
Gran Diccionario Oxford, 1ª, Oxford University Press, 2003
The Guardian,
The Times,
The New York Times,
The Washington Post,
The BBC,
The CNN,
English Listening,
Lingo Rank,
The British Council,
The Naked Scientists,
The United Nations,
NATO,
The UK Ministry of Defence,
The UK Foreign and Commonwealth Office,
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

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo has established an extraordinary plan that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

Teaching methodology:
Classes would become synchronous online sessions, taught by combining FAITIC-Moodle and Campus Remoto of the University of Vigo.

Assessment:
Assessable activities and exams would be carried out by combining FAITIC-Moodle and Campus Remoto of the University of Vigo.

IMPORTANT NOTES:
1. When doing assessable activities or exams, teachers should be able to see students on the screen all the time (except during breaks, when teachers should be able to see the computer screen, the desk and the chair). If teachers are not able to see a student, that student's mark will be 0 in those activities they have done while hiding from teachers.

2. If when doing assessable activities or exams students are systematically looking at a point which is not on the screen just before answering the items of the assessable task or of a task from the exam, the mark of that task will be 0.

3. If when doing assessable activities or exams FAITIC-Moodle registers a student is using two different IP addresses, the mark of those activities will be 0.

4. It is forbidden to use a translation extension on the browser students are using to do activities on FAITIC-Moodle. If students use them, they will be responsible for the consequences derived from its use (for instance, automatic translation into a different language).

5. Unless students are using their mobiles to get connected to Campus Remoto, their mobile must not be in the room where they are doing the exam.

6. If in any of the production activities, examiners realise that a student has plagiarised and they can prove it, that student's mark will be 0.

IDENTIFYING DATA				
Electronic technology				
Subject	Electronic technology			
Code	P52G381V01301			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	Spanish			
Department				
Coordinator	Falcón Oubiña, Pablo			
Lecturers	Falcón Oubiña, Pablo Gómez Pérez, Paula			
E-mail	pfalcon@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The objective of this course is to provide the students with the theoretical and practical fundamental knowledge in electronics' five main areas: analog electronics, digital electronics, industrial sensors, power electronics and communications electronics. In case of any discrepancy between this translation of the guide and the Spanish version, the valid one is the Spanish version.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CE11	Knowledge of the fundamentals of electronics.
CT2	Problems resolution.
CT9	Apply knowledge.
CT10	Self learning and work.
CT17	Working as a team.

Learning outcomes	Competences		
To know of the operation of electronic devices.	CG3	CE11	CT2 CT9 CT10 CT17
Know conditioning and data acquisition electronic systems and devices.		CE11	CT10
To identify different types of industrial sensors.		CE11	CT10
To know the basics of a digital electronic system.		CE11	CT2 CT9 CT10 CT17
To know basic electronic circuits for data communications.	CG3	CE11	CT9 CT10
ENAEE LEARNING OUTCOME: KNOWLEDGE AND UNDERSTANDING LO 1.3 Be aware of the multidisciplinary context of engineering. (level of development of this sub-learning outcome: Basic (1))		CE11	
ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS LO 2.2 Ability to identify, formulate and solve engineering problems within an specialty; choose and apply properly analytical methodologies; recognize the importance of social, health and safety, environmental, economic and industrial restrictions. (Medium (2))			CT2 CT9
ENAEE LEARNING OUTCOME: COMMUNICATION AND TEAMWORK LO 7.2 Ability to operate properly within national and international contexts, both individually and as a team, and cooperate with engineers and/or people from other disciplines. (Medium (2))			CT10 CT17
ENAEE LEARNING OUTCOME: CONTINUOUS EDUCATION LO 8.1 Ability to realize the need for continuous training and undertake this activity throughout their professional life on their own. (Medium (2))			CT10

Contents	
Topic	
Digital Electronics	- Basic concepts - Logical values: positive and negative logic - Logical families: TTL, ECL, CMOS - Binary functions and basic logic blocks - Truth table - Karnaugh maps - Basic integrated circuits - Design of basic combinational digital systems
Operational Amplifiers	- Basic concepts - Differential amplifier and operational amplifier - The op. amp.: terminals, feedback, virtual shortcut - Op-Amp circuits with closed-loop and negative feedback: inverting and non-inverting amplifiers, summing amplifier, differential amplifier, integrator, differentiator,... - Design of analog systems based on operational amplifiers
The diode	- Basic concepts - Semiconductors - The diode - The zener diode - Other diodes: LED, photodiode, etc. - Applications
The Bipolar Junction Transistor (BJT)	- Structure - BJT operation - Polarization, load line analysis and operating point (Q) - Applications
Field-Effect Transistor (JFET)	- Structure - Families of FET transistors - Polarization - Applications
Small-Signal Amplifiers	- Amplifier gain: voltage amplifier, current amplifier - Input impedance - Output impedance - Small-signal model for BJT - Small-signal model for JFET
Applications	- Data acquiring systems - Sensors and actuators - Analog to digital converter - Design of digital and analogical electronic systems - Industrial communications
Practice 1: Digital Electronics	This practice introduces the student to digital combinational circuits by assembling basic circuits within a protoboard.
Practice 2: Operational Amplifiers	The goal of this practice is introducing the closed-loop operation of these types of amplifiers, by assembling different circuits within a protoboard.
Practice 3: Simulation of digital and analog circuits	The goal of this practice is to introduce the simulation software PSIM and "Digital Electronic Simulator" to the student, in order to understand the importance of a proper simulation.
Practice 4: Basic electronic circuits with diodes	This practice shows the student different circuits for diodes (rectifiers, trimmers, ...), by assembling them in a protoboard and testing them with different input signals.
Practice 5: Basic electronic circuits with transistors	This practice shows basic circuits with transistors (mainly BJT) in order to show the polarization concepts shown in theory.
Practice 6: Simulation of electronic circuits with diodes and transistors	With this practice the student will learn to solve different circuits conformed by diodes and/or transistors with the simulation software PSIM.
Practice 7: Multistage amplifier design	This practice tries to merge all the concepts learned during the course for analog devices by designing a simple multistage amplifiers conformed by a small-signal amplifiers followed by one (or more) stages of high power amplifiers (wit op-amps).

Planning			
	Class hours	Hours outside the classroom	Total hours

Lecturing	28	35	63
Laboratory practical	14	4	18
Seminars	22	0	22
Problem and/or exercise solving	9	15	24
Problem and/or exercise solving	1.5	2	3.5
Problem and/or exercise solving	1.5	2	3.5
Laboratory practice	3	0	3
Essay	2	11	13

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

Methodologies

	Description
Lecturing	They will consist in an oral explanation by the lecturer of the most important parts of the course, all related with the materials that the student had to work previously. This is intended to favor the active participation of the students, that will have occasion to rise doubts and questions during the sessions. Active participation is desired during all the sessions.
Laboratory practical	During these sessions, in the classroom, interleaved with the lectures, the professor will proceed to solve examples and/or exercises that properly illustrate the problems to solve. As long as the number of participants in the classroom allows, active participation will be promoted.
Seminars	Previous preparation of the theoretical sessions: Prior to the start of the theoretical sessions, the students will have available a series of materials that have to prepare, as the sessions will relay on them. Previous preparation of the laboratory sessions: It is mandatory that the students make all the assigned previous tasks prior to access the laboratory. These task are intended to greatly improve the laboratory knowledge acquisition. The achieved report will be taken into account when the laboratory session is to be evaluated. This section includes the intensive course designed for preparing the extraordinary exam.

Personalized assistance

Methodologies	Description
Seminars	In the scope of tutorial action, academic tutoring actions and personalized tutoring are distinguished. Within the first option, students will have tutoring hours where they can consult questions related to the subject contents, organization and/or planning. In personalized tutoring hours, each student, individually, can discuss with the teacher any problem regarding his/her understanding of the subject. Both tutorial actions aim to compensate the different learning rhythms through attention to diversity. The teachers of the subject will personally attend to the doubts and queries of the students, in person, according to the schedule that will be published on the website of the center, such as through telematic means (email, videoconference, FAITIC forums, etc.) under the modality of previous appointment.

Assessment

	Description	Qualification	Evaluated Competencess		
Problem and/or exercise solving	Final exam to evaluate the global knowledge acquired of the subject, due at the end of the semester.	40	CG3	CE11	CT2 CT9 CT10
Problem and/or exercise solving	First assessable test of the knowledge acquired up to that moment (due date: around the 5th week of the semester).	15	CG3	CE11	CT2 CT9 CT10
Problem and/or exercise solving	Second assessable test, corresponding to themes 4, 5 and 6 (approximate date: 9th week of the semester).	15	CG3	CE11	CT2 CT9 CT10
Laboratory practice	Laboratory exam where the ability to understand, ensemble and simulate basic electronic circuits are tested (due date: at the end of the semester).	15	CG3	CE11	CT2 CT9 CT10 CT17
Essay	Group work corresponding to the first part of the practical evaluation (approximate date: 10th week of the semester).	15	CG3	CE11	CT2 CT9 CT10 CT17

Other comments on the Evaluation

The student evaluation and qualification criteria proposed for this subject are set out. Given the peculiarities of the Centro

Universitario de la Defensa, where this subject will be taught, and taking into account that the students are in a boarding school, only evaluation criteria for assistants are proposed.

Ordinary call:

Continuous evaluation

In the ordinary call, a process of continuous evaluation is carried out in which the weight of the different parts in which the subject is structured over the final mark is as follows:

- Knowledge of theory (T): 70%
- Practical knowledge (L): 30%

Knowledge of theory:
The theory knowledge part is evaluated by combining two scoring tests and a final exam as follows:

- Partial exam 1 (P1):
    - A test of approximately 1 hour and a half in length and preferably located at the end of themes 1 and 2 of the subject.
    - Weight: 15% of the continuous assessment score (NEC).
    - It is qualified with 10 points.
    - Made individually.
    - It can take the form of a multiple choice questionnaire, short answer questionnaire, problem solving or some combination of the above.
    - There is no minimum qualification.

- Partial Exam 2 (P2):
    - A test of approximately 1 hour and a half, preferably located at the end of themes 3 and 4 of the course.
    - Weight: 15% of the continuous assessment score (NEC).
    - It is qualified with 10 points.
    - Made individually.
    - It can take the form of a multiple choice questionnaire, short answer questionnaire, problem solving or some combination of the above.
    - There is no minimum qualification.

- Final exam (EF):
    - Exam to be taken on the evaluation dates.
    - Weight: 40% of the continuous assessment score (NEC).
    - It is qualified with 10 points.
    - Made individually.
    - They can be in the form of a multiple choice questionnaire, short answer questionnaire, problem solving or some combination of the above.
    - A minimum qualification of 4.0 is required.

Practical knowledge:

The practical part of the course is assessed by means of group work and a practical laboratory test, as follows:

- Group work (L1):
    - Design and simulation of an electronic system for the solution of an engineering problem.
    - The work proposal will be approved by the teachers to check that it meets the minimum milestones of the task.
    - If the students do not propose a work within the deadline set by the teachers at the beginning of the course, a a generic work will be assigned to them with the necessary requirements.

    - Weight: 15% of the continuous evaluation score (NEC).
    - A minimum score of 4.0 points is required.

- Practical laboratory exam (L2):
    - This is a test to evaluate the ability acquired by the student to assemble electronic circuits and to check their operation with the instruments used in the practices.
    - The realization of the test is individual.
    - Weight: 15% of the continuous evaluation score (NEC).
    - It is qualified with 10 points.
    - A minimum score of 4.0 points is required.

Final mark and minimum requirements to pass the course through continuous assessment:

To ensure that the student has acquired the minimum skills in each of the aspects of the subject, students will be required to achieve a minimum score of 4.0 out of 10 in the final exam of theory (EF), and a minimum score of 4.0 out of 10 in the practical part (L1 and L2).

In this way, the final mark in continuous assessment (NEC) is calculated using the following formulas, a minimum mark of 5.0 in the NEC being necessary to pass the course:

NEC = 0.15*P1 + 0.15*P2 + 0.4*EF + 0.15*L1 + 0.15*L2
In the event that the minimum mark required in any of the parts is not reached, the final mark for continuous assessment will be calculated as:

NEC = min(4.0, NEC)
The student who does not pass the course in continuous evaluation must take the ordinary exam.
Ordinary exam

- Knowledge of theory (T): 70%
- Practical knowledge (L): 30%

Theory:

Consists of:

- A single exam, of approximately 3 hours, to be performed within the course calendar.
- It is qualified with 10 points (T).
- Individual.
- It can include tests, short questions and/or problems or a combination of them.

Laboratory:

Consists of:

- A single practical exam, of approximately 45 min, at the laboratory, related to the practical contents of the subject.
- It is qualified with 10 points (L).
- Individual.

Final mark and minimum requirements to pass the subject:

The final mark (NEO) will be computed following the next equation:

NEO = 0.7 * T + 0.3 * L

A minimum of 4.0 out of 10 points are required for the T exam, and a minimum of 4.0 out of 10 points are required for the L exam. Once obtained these minimums, a punctuation equal or higher than 5.0 points over 10 in the total computation of NEO is mandatory to pass the subject.

Extraordinary exam:

The students that did not pass the subject on first convocatory must attend the second convocatory (or extraordinary exam),

that will have the same structure, exam duration, percentages and minimum points required than in the ordinary exam.

Code of Honor:During exames, the use of non-allowed electronic devices, notes or books is forbidden.Exams lacking some of the sheets will not be graded.
All the results obtained must be properly justified, in any of the exams or activities. None of the numerical results will be considered if no explanation is given about the methodology used to obtain them.

It is expected that all the students abide to these considerations. If a non-ethical behaviour is detected, the student will automatically be graded with a 0.0 at the current convocatory.

Sources of information

Basic Bibliography

Malvino, Albert; Bates, David J., **Principios de Electrónica**, 7ª,

E. Mandado, **Sistemas Electrónicos Digitales**, 9ª,

Complementary Bibliography

R. Pallás Areny, **Sensores y acondicionadores de señal**, 4ª,

J. Millman, **Microelectrónica. Circuitos y sistemas analógicos y digitales**, 4ª,

N. R. Malik, **Circuitos Electrónicos. Análisis, simulación y diseño**, 1ª,

T. L. Floyd, **Fundamentos de Sistemas Digitales**, 9ª,

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/P52G381V01102
Physics: Physics II/P52G381V01106
Mathematics: Calculus 1/P52G381V01103
Fundamentals of electrical engineering/P52G381V01205
Mathematics: Calculus II and differential equations/P52G381V01201

Contingency plan

Description

In view of the possible appearance of extraordinary situations involving the suspension of face-to-face teaching activity and the change to a non-presential/online scenario, the following changes will be made:

CONTENTS

Theoretical credits
The teaching of the theoretical contents of the subject should not be affected by the transfer to non-presential/online mode. If the number of hours to be taught is considerably reduced, the contents of each of the subjects will be adapted in such a way as to guarantee the acquisition of the learning results and skills of the subject.

Practical credits
In view of the impossibility of working with the instrumentation equipment present in the laboratories, the corresponding practices will be replaced by equivalents that can be transferred to a virtual scenario. Specifically, the practices will be carried out as follow:

Practice 1: Introduction to electronic circuit simulation
The aim of this practice is to familiarize the student with the PSIM electronic circuit simulation software, as well as with the digital system simulator to carry out assemblies with analog devices and combinational systems respectively.

Practice 2: Applications with digital electronic devices
The aim of this practice is that the student is able to design, assemble and test a basic digital electronic circuit, based on combinational systems, from an engineering problem. In this practice, a digital circuit simulator will be used to assemble the circuit.

Practice 3: Design with operational amplifiers
This practice aims to further familiarize the student with the PSIM simulation software. In this practice it will be used to introduce the operational amplifiers and to let the student observe the usefulness of these devices to solve engineering problems. For this purpose, different assemblies will be made with these operational amplifiers where the student can check

the operation of the operational amplifiers under different conditions. These assemblies will also serve the student to reason how different assemblies should be joined together to obtain a given transfer function, which can be applied in many areas of engineering.

Practice 4: Assembly and measurement of basic electronic circuits with diodes
This practice aims at using the PSIM simulation software to mount and measure basic circuits with diodes, such as rectifier circuits (half-wave and full wave), as well as different configurations of signal trimming circuits.

Practice 5: Assembly and measurement of basic electronic circuits with transistors
The fundamental objective of this practice is that the student understands the concepts of the working point of a transistor, and in this way check the zones of operation it works (active, cut-off and saturation). For this purpose, different simple circuits in direct current with bipolar transistors will be carried out in PSIM.

Practice 6: Simulation of electronic circuits with diodes and transistors
The aim of this practice is to familiarize the student with the PSIM electronic circuit simulation software, for the realization of non-linear circuits with diodes and analysis of the working point of bipolar junction and field effect transistors. The small signal amplifiers will also be introduced in the simulator, so that the student understands how they work.

Practice 7: Design of complex analogue systems with amplifiers
The aim of this practice is that the student is able to design, assemble and test a multi-stage amplification circuit, in PSIM, combining different types of amplifiers (small signal and operational), observing the differences between them. For this purpose, the amplifier will be designed and the assembly will be done in an incremental way, incorporating progressively the elements (preampliication, amplification, impedance matching, etc.). In the same way, the student understands the usefulness of this type of amplifier assembly and its interconnection with other engineering concepts such as, for example, signal treatment of different devices and the adapting of the voltage or current levels to operate with them efficiently.

TEACHING METHODOLOGY

A new teaching methodology would be added:

Synchronous online meeting (theory or practical session):
These sessions will be given through a web videoconferencing platform within a virtual classroom. Each virtual classroom will contain various display panels and components, whose design can be customized by the teacher to suit the needs of the class. In the virtual classroom, teachers (and authorized participants) will be able to share their computer screen or files, use a whiteboard, chat, broadcast audio and video, or participate in interactive online activities (surveys, questions, etc.).

LEARNING ASSESSMENT

In a non-presential/online scenario, the evaluation of learning in the online modality will take place combining the FAITIC-Moodle platform with the Campus Remoto tool of the University of Vigo (and/or similar platforms). Below, we show the modifications in the weighting of the tests motivated by the change to the online teaching modality. These changes only affect the continuous assessment of the ordinary call.

Ordinary call

Continuous evaluation

The assessment of theoretical learning will remain unchanged from what was described earlier in this teaching guide in terms of content, weightings, minimum requirements and number of exams.

The assessment of practical learning will be modified by replacing the test that can be assessed in person with a paper. Therefore, the practical part will be evaluated by means of two works whose content and weighting is detailed in the following section.

Practical knowledge:

The laboratory practice part is evaluated by carrying out two group works, as follows:

Group work 1 (L1):
- Design and simulation of a digital circuit that solves a real problem that the students propose according to their particular needs.
- The work proposal will be approved by the teachers to check that it meets the minimum milestones of the task.

- In the event that the students do not propose a work within the deadline set by the teachers at the beginning of the course, a generic work will be assigned to them with the necessary requirements.
- The work will be done in groups of maximum 2 students.
- Weight: 15% of the continuous assessment score (NEC).
- It is qualified with 10 points.
- A minimum score of 4.0 points is required.

Group work 2 (L2):
- Design and simulation of an analogical electronic system for the solution of an engineering problem.
- The work proposal will be approved by the teachers to check that it meets the minimum milestones of the task.
- In the event that students do not propose a work within the deadline set by the teachers at the beginning of the course, a generic work will be assigned to them with the necessary requirements.
- Weight: 15% of the continuous assessment score (NEC).
- It is qualified with 10 points.
- A minimum score of 4.0 points is required.

Final mark and minimum requirements to pass the course through continuous assessment:
To ensure that the student has acquired the minimum skills in each of the aspects of the subject, students will be required to achieve a minimum score of 4.0 out of 10 in the final exam of theory (EF), and a minimum score of 4.0 out of 10 in the practical part (L1 and L2).

In this way, the final mark in continuous assessment (NEC) is calculated using the following formulas, a minimum mark of 5.0 in the NEC being necessary to pass the course:

NEC = 0.15*P1 + 0.15*P2 + 0.4*EF + 0.15*L1 + 0.15*L2

In the event that the minimum mark required in any of the parts is not reached, the final mark for continuous assessment will be calculated as:

NEC = min(4.0, NEC)

IDENTIFYING DATA				
Materials engineering				
Subject	Materials engineering			
Code	P52G381V01302			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	Spanish			
Department				
Coordinator	Devesa Rey, Rosa			
Lecturers	Devesa Rey, Rosa González Gil, Lorena			
E-mail	rosa.devesa.rey@cud.uvigo.es			
Web	http://faitic.uvigo.es/			
General description	The subject Materials Engineering aims that the Graduated in Mechanical Engineering purchase the knowledges and the skills related with the foundations of the science, technology and chemical of materials, that allow the student to know the main material families (metallics, polymeric and ceramic) and including materials for tools and construction and all this related with their properties, behaviour in service and which basic treatments must be employed to modify them. Given the narrow relation between microstructure and properties, it will be of great importance that the student knows the main mechanisms to modify the constitution and structure of the materials and, with this, to achieve the optimisation of their properties. The learning results form part of the specifically assigned technologies to a graduated in Mechanical Engineering. When finalising this subject the student has to be able of: 1. To know the main forming and transformation processes used in the industry. 2. To know the characteristics of the materials more commonly employed in Engineering. 3. To argue the selection of a material for simple applications in the field of the industrial engineering. 4. To know the different thermal, thermochemical and thermomecanical treatments that can be applied both to materials for tools or construction. 5. To use the union processes more suitable, in function of the material.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
CG5	Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
CG6	Capacity for handling specifications, regulations and mandatory standards.
CG11	Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Industrial Technical Engineer.
CE25	Knowledge and skills for engineering materials.
CT5	Information Management.
CT7	Ability to organize and plan.
CT9	Apply knowledge.
CT10	Self learning and work.
CT15	Objectification, identification and organization.
CT17	Working as a team.

Learning outcomes			
Learning outcomes	Competences		
To know the main forming processes and transformation of materials used in the industry.	CG3 CG4	CE25	CT5
To show capacity to select the prepararon process more adapted for the obtention of basic pieces from a determinate material.	CG3 CG4 CG5	CE25	CT7 CT9
To know the main union processes of the materials used in the industry.	CG3	CE25	CT9
To comprise the complex interrelationships between the properties of the materials and forming and union processes to be able to optimise the properties and the productivity in a wide margin of industrial states.	CG4 CG5 CG6	CE25	CT9
To know the characteristics of the materials more usually employed in Engineering.	CG3 CG6	CE25	CT5

To know the evolution of the distinct types of materials and of the processes for his possible forming.	CG3 CG6	CE25	CT5
To know and to apply the selection criteria for the most adapted material and a concrete application.		CE25	CT9
To analyse and to propose operative solutions to problems in the field of materials engineering.	CG4 CG11		CT9 CT15
To interpret, analyse, synthesize and extract conclusions and results of measures and essays.	CG4	CE25	CT7 CT15
To draft texts with the suitable structure to the aims of communication. To present text to a public with the strategies and the suitable means.	CG11		CT5 CT7 CT17
To show capacities of communication and work in team.		CE25	CT17
To identify the own needs of information and uses the means, spaces and available services to design and execute suitable researches to the thematic field.	CG4	CE25	CT5
To carry out to term the works entrusted from the basic orientations given by the professor, deciding the length of the parts, including personal contributions and expanding sources of information.	CG4 CG6	CE25	CT7 CT10
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)].	CG3	CE25	
ENAEE learning outcome: ENGINEERING ANALYSIS: LO2.1.- Ability to analyse complex engineering products, processes and systems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to correctly interpret the outcomes of such analyses [intermediate (2)].	CG4	CE25	CT9
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)].	CG4		CT9
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 [basic (1)].	CG4 CG5		CT7 CT9
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)].	CG6 CG11		CT5
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 [advanced (3)].		CE25	CT9
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 [advanced (3)].		CE25	CT9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.4.- Ability to apply norms of engineering practice in their field of study [intermediate (2)].	CG6 CG11		CT9
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- Ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large [basic (1)].	CG4		CT5
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)].			CT5 CT7 CT10 CT17

Contents

Topic

UNIT 1: MECHANICAL PROPERTIES OF MATERIALS Location and length: Weeks 1-2 [5 hours] Objective and development: This unit sims to study the main selection criteria of materials, including technological and mechanical properties. It also studied the location, extraction and concentration of metals in nature.	1.1 CRITERIA OF MATERIAL SELECTION Introduction. Parameters that influence in the selection process. Materials in the design process. Technological properties: Cost, supply and transformation. Relation with user. Interaction with the environment. 1.2 MECHANICAL PROPERTIES Introduction. Relation stress-deformation. Elastic and plastic behaviour. Ductility. Hardness. Fracture. 1.3 OBTENTION OF METALLIC MATERIALS Introduction. Abundance of metals. Metals in nature. Metallurgy: obtention of metals from one of their minerals. Concentration of ores.
UNIT 2: MATERIALS FOR TOOLS Location and length: Weeks 2-3 [4 hours] Objective and development: It is estudiad the metallurgy operations, which involve the extraction and production of steel, as well as the obtention of other relevant structural materials.	2.1 STRUCTURAL MATERIALS: METALS AND ALLOYS Introduction. Iron extraction and steel production. Recycling of steel and its environmental impact (UNE-EN 13437). Steels classification. Non-ferrous alloys. 2.2 MATERIALS FOR DEFENCE: STEELS FOR ARMOURS; ALLOYS OF ALUMINIUM, TITANIUM AND MAGNESIUM
UNIT 3: STRUCTURAL AND BUILDING MATERIALS Location and length: Weeks 3-4 [4 hours] Objective and development: This unit deepens in building materials, mainly in the technology of concrete and wood, as well as the uses of the polymers and ceramic, regarding the raw materials and degradation, among others.	3.1 THE PORTLAND CEMENT. TECHNOLOGY OF CEMENTS Raw materials (water, arids, additives) and manufacture. Reactions of hydratation and hardening. Expansion and contraction. Mechanical resistance. Inventory of emmisions. Measures in fresh and hardened concrete. Degradation of cements. 3.2 WOODS Structures, properties and main woods. Technology of woods. Degradation and recycling of woods. 3.3 POLYMERS Structures, properties and main polymers. Uses as building materials. Degradation and recycling of polymers. 3.4 CERAMICS Structure, properties and main ceramic materials. Uses as building materials. Degradation and recycling of ceramic materials.
UNIT 4: DEGRADATION OF MATERIALS. THERMAL, THERMOCHEMICAL AND THERMOMECHANICAL TREATMENTS Location and length: Weeks 4-6 [6 hours] Objective and development: This unit analyses the principles of materials corrosion, the importance of the different microstructures in steels and the thermal treatments, as well as thermochemical treatments, with and without change of composition of the material.	4.1 DEGRADATION OF MATERIALS. PROCESSES OF CORROSION Principles of corrosion. Types of corrosion. Thermodynamics and kinetics of corrosion. Protection against corrosion. 4.2 THERMAL TREATMENTS Introduction. Thermal cycle. Normalisation and annealing. Martensitic transformations: Time-Temperature-Transformation diagrams (TTT). Quenching. Isothermal treatments: austempering, martempering, isothermal annealing. Problems generated during the thermal treatments. 4.3 THERMOCHEMICAL AND SUPERFICIAL TREATMENTS Introduction. Superficial modification, without change of composition: Quenching by flame, induction or laser, hardening by transformation, superficial fusion. Superficial modification, with change of composition: carburization, nitrurization, carbonitrurization. Types of coatings: coatings by immersion, coatings by electrodeposition, annealing, ceramic coatings, physical and chemical deposition, thermal projection. Preparation of the surfaces by mechanical treatments: cleaning with dissolvent, cleaning with mechanical tools.
UNIT 5: MATERIALS SUBJECTED TO SMELTING, PLASTIC AND VISCOELASTIC DEFORMATION AND POWDER COMPACTION Location and length: Weeks 7 -9 [6 hours] Objective and development: This unit analyses the answer of different materials subjected to distinct processes of conformed, like the smelting of metals, the plastic deformation of metals, the molding, injection and extrusion of polymers and the poder metallurgy.	5.1 SMELTING Foundations of the smelting of metals 5.2 ANSWER OF THE MATERIALS SUBJECTED TO THE MAIN PROCESSES OF PLASTIC DEFORMATION 5.3 ANSWER OF THE MATERIALS SUBJECTED TO THE MAIN VISCOELASTIC PROCESSE Molding of polymers 5.4 POWDER METALLURGY

UNIT 6: UNION AND WELDING TECHNOLOGIES Location and length: Weeks 9-11 [3 hours] Objective and development: This unit analyses the main union technologies: the union by means of adhesives and the union by means of welding.	6.1 ADHESIVE MATERIALS 6.2 MATERIALS FOR WELDING
LABORATORY (14 hours)	P1. Obtention of aluminium by aluminothermy and/or electrolysis (2 hours) It is studied the concentration processes of metals from the ores by means of extraction processes. It will be employed AENOR norms (accessible database through the University of Vigo). For example, it will be proposed to research some of the following norms and the consequent resolution of questions: . Mechanical characteristics of the aluminium and its alloys (UNE-EN 683-2:2008) . Annealing of aluminium and its alloys (UNE 38019:2017) . Scrap of the aluminium and its alloys (UNE-EN 12258-3:2004). . Welding of the aluminium and its alloys (UNE-EN ISO 9692-3:2016). P2. Evaluation of building materials (concretes) (4 hours) The student manufactures concrete with different compositions and study its properties in fresh and hardened material. It is also analized the Instruction of Structural Concrete (EHE-08). Students work in groups the resolution of a more complex problem, so that its realisation need of the cooperative work of two students (or three students, exceptionally). It is included in this time the presentation and evaluation of the project. P3. Influence of corrosion in the modification of mechanical properties (2 hours) Student performs essays of corrosion in metals and study the reactions involved. P4. Superficial treatments of materials: cataphoresis and electrolytic cleaning (2 hours) Student makes treatments of surfaces recovery with painting applied by means of cataphoresis and elimination of oxides adhered with electrolytic cleaning. P5. Thermal treatments of materials: normalised, annealing and quenching (2 hours) Students test three thermal treatments on metal probes and their effects on mechanical properties. P6. Union technologies: evaluation of adhesives (2 hours) Student determine the most effective unions between materials by means of simple or hybrid unions, in different environmental conditions. They will use the AENOR norms (accessible database through the University of Vigo). For example, it will be proposed researches of some of the following norms and the consequent resolution of questions: . Self-adhesive tapes (UNE-EN 12481:2002) . Adhesives for paper, cardboard and packagings (UNE-CR 14376:2002) . Adhesives. Terms and definitions (UNE-EN 923:2016) The laboratory program may vary to adjust to the master classes or seminar sessions.
SEMINARS (7 hours)	Seminars in small groups, which will reinforce the contents of the master classes.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	38	66
Problem solving	7	14	21

Seminars	15	15	30
Laboratory practical	12	0	12
Essay questions exam	4	4	8
Problem and/or exercise solving	9	0	9
Presentation	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	In the masterclasses it will be explained the basics of each subject. Students will have in advance a summary of the Unit, in addition to the information that can be found on the course website, which contains the files with the pdf of the Unit. It is recommended to devote between half hour and an hour depending on the contents.
Problem solving	The methodology employed will be the resolution of problems and/or exercises. A series of practicas cases will be proposed to the students, so they have to solve them in pairs or small groups.
Seminars	Intensive course of 15 hours for those students that have suspended the subject in first opportunity, previous to the examination in second opportunity.
Laboratory practical	It consists in a series of laboratory practices in accordance with the Units explained in masterclasses, aiming at fixing concepts explained in masterclasses and helping the students to develope their skills to pose technical solutions.

Personalized assistance	
Methodologies	**Description**
Problem solving	The professors of the subject will attend personally the doubts and queries of the students, so much of face-to-face form, according to the schedule published in the CUD web page, as through telematic means (email, videoconference, FAITIC forums, etc.) under the modality of previous appointment.
Seminars	Tutorships in small groups with the professor.

Assessment					
	Description	Qualification	Evaluated Competencess		
Problem solving	It will be evaluated: the autonomous resolution of exercises or questions, proposed by the professors, assessing, among other concepts: the proper resolution of exercises, the approach, order and delivery on time.	10	CG4 CG6 CG11	CE25	CT5 CT7 CT9 CT10 CT15
Laboratory practical	It will be evaluated: the activities carried out in the laboratory, the resolution of questions made during the laboratory sessions, attitude and order in the laboratory and the resolution of questionnaires about the practices carried out, which can be done in person or through the virtual platform of the subject. They will evaluate the activities carried out in the laboratory, the resolution of questions of the script of practices, the attitude and order in the laboratory and the resolution of questionnaires about the practices made, that will be able to do *presencialmente or through the virtual platform of the subject.	10	CG4 CG6 CG11	CE25	CT5 CT7 CT9 CT10 CT15
Essay questions exam	GLOBAL WRITTEN TEST: It will consist of a part of theory and a part of questions and/or problems. It is a necessary condition to pass the course by continuous evaluation obtain a minimum of 4 in each part.	40	CG3 CG4 CG5 CG6 CG11	CE25	CT5 CT7 CT9 CT15
Problem and/or exercise solving	INTERMEDIATE EXAMS: Two intermediate exams will be carried out (30%), in which all the topics explained so far will be evaluated.	30	CG3 CG4 CG5 CG6	CE25	CT5 CT7 CT9 CT15
Presentation	EVALUATION OF LEARNING BASED IN PROJECTS: It will be evaluated the final project, taking into account criteria related to the content and format of the final memory delivered, as well as the use of the language, the quality of the presentation and the answers to questions of the professors. In the oral presentation, any member of the group has to answer to questions of the project. All have to show, therefore, deep knowledge of the product delivered, independently of the part in which they had centred their efforts.	10	CG4 CG6 CG11	CE25	CT7 CT9 CT10 CT15

Other comments on the Evaluation

Ordinary and Extraordinary Examinations In order to evaluate all the competences in the ordinary and extraordinary exams, these will include, in addition to questions of theory and part of problems, questions of the laboratory sessions. The evaluation will be considered positive when a score of 5 points out of 10 is reached.**Intensive course**Those students who have not passed the course at the first opportunity will attend an intensive course of 15 hours, in which tasks will be carried out to reinforce the main theoretical and practical contents taught in the course. At the end of such course the extraordinary examination will be carried out.**ETHICAL COMMITMENT**It is expected that students have an adequate ethical behavior. If unethical behavior is detected (copying, plagiarism, use of unauthorized electronic devices or others), the student will be penalized with the impossibility of passing the subject by the continuous assessment modality (in which he will obtain a grade of 0.0). If this type of behavior is detected in ordinary or extraordinary exam, the student will obtain in the call a score in 0.0 points out of 10.

Sources of information

Basic Bibliography

W.D. Callister, Jr, **Introducción a la Ciencia e Ingeniería de los Materiales (I, II)**, 1, Reverté, 2012

S. Kalpakjian y S.R. Schmid, **Manufactura, Ingeniería y Tecnología 5ª Ed**, 5, Pearson Education, 2008

D.R. Askeland, **Ciencia e Ingeniería de los Materiales**, 1, Paraninfo-Thomson Learning, 2001

J.A. Puértolas Ráfales, R. Ríos Jordana, M. Castro Corella, J.M. Casals Bustos, **Tecnología de Materiales**, 1, Síntesis, 2009

M. Ashby, H. Shercliff, D. Cebon, **Materials: Engineering, science, processing and design**, 2, Butterworth-Heinemann, Elsevier, 2010

S. Barroso Herrero, J.R. Gil Bercero, A.M. Camacho López, **Introducción al conocimiento de los materiales y sus aplicaciones**, 1, Universidad Nacional de Educación a Distancia, 2008

Complementary Bibliography

Recommendations

Other comments

Students of the course Materials Engineering are recommended to review the contents of composition, structure and material properties of the Materials, Science and Technology course.

Contingency plan

Description

=== EXCEPTIONAL MEASURES SCHEDULED ===
In front of the uncertain and unpredictable evolution of the sanitary alert caused by the *COVID-19, the University of Vigo establishes an extraordinary planning that will activate in the moment in that the administrations and the own institution determine it attending to criteria of security, health and responsibility, and guaranteeing the teaching in a no face-to-face stage or partially face-to-face. These already scheduled measures guarantee, in the moment that was prescriptive, the development of the teaching of a more agile and effective way when being known in advance (or with a wide *antelación) by the students and the *profesorado through the tool normalised and institutionalised of the educational guides.

 Section 6 (CONTENTS):

The masterclasses and seminar activities may be taught in virtual classroom, keeping the distribution and contents of the face-to-face teaching. In the case of the laboratory practices, it will be proposed, when possible, the realisation of simulation practices, as well as bibliographic researches and the use of technical and/or scientific databases, ensuring in each case that student work the contents scheduled of each laboratory practice.

 Section 8 (EDUCATIONAL METHODOLOGIES): it is added the modality of synchronous virtual education and asynchronous:

Masterclasses session and/or synchronous virtual practical session: it will be employed a videoconference web plattform. Each virtual classroom contains diverse visualisation components, whose design can customise so that it adapts better to the needs of the class. In the virtual classroom, the professors (and those authorised participants) can share the screen or archives, employ a blackboard, chat, transmit audio and video or participate in online interactive activities (surveys, questions, etc.).

Masterclasses sessions and/or asynchronous virtual practical session: The recordings of the synchronous sessions will put to disposal of the students in the virtual subject, so that they can use them to review the concepts of each session.

 Section 10 (EVALUATION):

In case that they can not make evaluation in the face-to-face way, it will be proposed the combined use of the FAITIC-Moodle platform and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Elasticity and additional topics in resistance of materials				
Subject	Elasticity and additional topics in resistance of materials			
Code	P52G381V01303			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	Spanish			
Department				
Coordinator	Cacabelos Reyes, Antón			
Lecturers	Cacabelos Reyes, Antón Febrero Garrido, Lara			
E-mail	acacabelos@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The subject Elasticity and Advanced Strength of Materials is a subject of the specific mechanic block that is taught in the first quadmester of the third academic year in the CUD. The subject is continuation and extension of the subject Strength of Materials of second-year. To establish the general equations that govern the mechanical behaviour of the deformable solids, it is necessary to complement the equations of the statics, kinematics and dynamics, with equations that relate the stress and deformations in the surroundings of the point. In the case of small deformations, it is checked that in most of materials the process of deformation is reversible, in terms of elastic behaviour. Then, it is established as the goal of the "Theory of the Elasticity" the study of the deformable solids with elastic behaviour. The mathematical formulation of all these theories drives to equations of big complexity and the finding of exact solutions remain limited to some particular cases. For the case of one-dimensional or two-dimensional solids, it is possible to establish simplifying hypothesis regarding to the stress distribution. This is the approach of the "Strength of Materials" that allows to attach the study of those deformable solids that admit simplifying hypothesis in relation to its stress and deformational states. The teaching of this subject pursues that the students aquire the basic knowledge related with the capacity to know and understand the behaviour of the elastic solid under any type of load. Besides they reinforce the basic concepts of the stress analysis so that it can be applied to the design and calculation of structural elements and elements of machines. The elasticity and strength of materials establishes the criteria that allow to determine the most convenient material, the shape and the most adapted dimensions that the elements of a structure or a machine need to resist the action of the external loads without an excessive economic cost. Likewise, the students are initiated in the handling of computational programs to calculate efforts, of trips and tensions of basic structural systems.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
CE22	Knowledge and skills to apply the fundamentals of elasticity and strength of materials to the actual behavior of solids.
CT2	Problems resolution.
CT5	Information Management.
CT9	Apply knowledge.
CT10	Self learning and work.
CT17	Working as a team.

Learning outcomes	Competences		
Kowledge of the elasticity fundamentals	CG3	CE22	
Further deepening on mechanics of materials and stress analysis	CG3 CG4	CE22	CT2 CT10
Knowledge of deformations in beams and shafts	CG3 CG4	CE22	CT2 CT9
Ability to apply the knowledge of elasticity and mechanics of materials, and to analyze the mechanical performance of machines, structures, and general structural elements	CG4	CE22	CT2 CT5 CT9

Ability to take decisions about suitable material, shape and dimensions for a structural element subjected to a specific load	CG4	CE22	CT2 CT5 CT9 CT17
Knowledge of different solving methods for structural problems and ability to choose the most suitable method for each specific problem	CG4	CE22	CT2 CT5 CT9
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)].	CG3	CE22	
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 [Level of achievement: Intermediate (2)].	CG4		CT2 CT9
ENAEE learning outcome: RESEARCH AND INNOVATION: LO4.3 Ability to perform experimental investigation, understand the results and draw conclusions in the study field [Level of achievement: Intermediate (2)].		CE22	CT9
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 [Level of achievement: Intermediate (2)].		CE22	CT9

Contents	
Topic	
Review of Strength of Materials	Axial loading. Shear. Pure bending and nonuniform bending.
Fundamentals of elasticity	Introduction to Elasticity. Goals of Elasticity and Strength of Materials. Definition of stress in elastic solids. Stress tensor. Principal stresses and principal directions. Graphic representation of three-dimensional stress. Mohr´s Circles. Deformation analysis in continuum media. State of strain at a point. Strain tensor. Graphic representation of deformational state. Mohr´s Circles. Stress-Strain relations. Stress-Strain experimental relations. Generalized Hooke´s laws.
Torsion	Torsion of a prismatic bar of circular cross section. Coulomb□s theory. Design of transmission shafts. Strain energy stored by torsion. Statically indeterminate torsion members. Torsion of noncircular prismatic bars.
Combined loadings	Combined Loadings. Combined bending and torsion in bars of circular cross section Bending of beams of nonsymmetrical section. Shear center. Combined axial and bending load in non-slender bodies. Thin-wall pressure vessels.
Lateral bending. Buckling.	Buckling. Introduction. Centric compression load in slender column. Euler critical load. The effect of end conditions on critical load. Eccentric load in slender column. Validity range in Euler buckling theory. Design formulas for columns. Bucking coefficients method for column design.
Strain energy. Energy methods.	Strain energy concept. External loads and strain relations. Influence coefficients concept. Strain energy expressions. Clapeyron theorem. Principle of virtual works. Castigliano´s theorems.

Criteria for initiation of inelastic material behavior. Failure condition.	Plastic deformation of materials. Failure condition. Maximum normal stress theory or Rankine theory Maximum normal strain theory or Sain-Venant theory. Maximum shear stress theory or Coulomb theory. Maximum strain energy theory or Beltrami-Haigh theory Maximum distorsion energy theory or von Mises theory Comments about failure theories. Safety factor.
Experimental methods in elasticity	Electrical strain gages method. Fundamentals. Electrical strain gages. Data analysis. Photoelasticity. Fundamentals. Basic optical concepts in photoelasticity. Photoelasticity equipment. Interpretation of the stress contours.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	56	84
Problem solving	7	0	7
Seminars	15	0	15
Laboratory practical	14	14	28
Essay questions exam	11	2	13
Essay	1	2	3

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

Methodologies

	Description
Lecturing	The general contents of the subject will be presented in a structured way, emphasizing the fundamentals and main characteristics and those of more difficult understanding for the student. During the course, the content that will be taught during the following, week will be shown in the online platform, so that the student will be able to prepare the contents in advance.
Problem solving	Activity in which problems and/or exercises related to the subject will be solved. The student has to develop the suitable or correct solutions by means of the exercises, the application of formulas or algorithms, the aplication of procedures of transformation of the available information and the interpretation of the results. It complements the Master Session.
Seminars	Intensive course of 15 hours for those students who have failed the subject in first call, prior to the exam in second call. Group tutoring with the lecturer.
Laboratory practical	Practices of cooperative laboratory in which the theoretical concepts studied in the master sessions will be applied.

Personalized assistance

Methodologies	Description
Lecturing	In the field of the tutorial action, actions of academic tutorial as well as personalised tutorial can be considered. In the first case, the students will have office hours to ask about any question related with the contents. The tutorials can be one by one, but group tutorials for the resolution of problems will be encouraged. In the personalised tutorials, each student will be able to comment with the lecturers about any problem or idea to take a suitable follow-up of the subject. The lecturers of the subject will answer personally the questions and queries of the students, both in person, according to the schedule that will be published on the website of the center, and through telematic means (email, videoconference, FAITIC forums, etc. .) under the modality of previous appointment.

Assessment

	Description	Qualification	Evaluated Competencess		
Laboratory practical	The evaluation of the practices will be valued by checking the memories of practices (MP) that the student will have to deliver	20	CG4	CE22	CT2 CT5 CT9 CT10
Essay questions exam	Written tests: theoretical questions and problems. The written tests give as an objective to the evaluation of the learning of all the theoretical contents selected for the subject. - Final exam (PF): 40% - Intermediate exam (PI): 30%	70	CG3 CG4		CT2 CT9

Essay	During the course of the subject, evaluable activities will be proposed (evaluable problems or work) with the aim of having students solve them autonomously and / or expose them in their own class. - Evaluable activities (AE): 10%	10	CG3 CG4	CE22	CT2 CT9 CT10

Other comments on the Evaluation

The criteria of evaluation of each section will be published at the beginning of the quadmester. They will be provided to the students, through the virtual platform.

The final evaluation of student will be the sum of the grades obtained in each one of the parts previously mentioned, being his/her grade of continuous evaluation (NEC):

NEC = 0,4*PF + 0,3*PI + 0,2*MP + 0,1*AE

If the NEC is inferior to 5, the student will have to attend to the ordinary exam of all the contents of the subject, that will suppose 100% of the grade.

However, some minimum requirements will be demanded:

If some of the previous examinations is not delivered or a grade inferior to 4 points is obtained in the final examination, the qualification of the continuous evaluation will be the minimum of the grade of continuous evaluation calculated with the previous formula and 4 points.

Detection of cheating in any kind of evaluation activity (midterm or final exams, laboratory work, etc.) will be penalized with a zero in the evaluated item and, in those evaluations with a mandatory minimum grade to pass the course, the student will not be evaluated by continuous evaluation. This sanction will affect both students copying during the evaluation tests, and those that facilitate copying.

The attempt of academic fraud during the realization of any of these tests (PI or PF) will suppose that the student or students involved will not pass the subject by continuous evaluation (where you will get a grade of 0,0). Likewise, the student or group of students who are found to have plagiarized or copied a work will obtain a grade of zero. 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 any case, the student who has passed the continuous evaluation, is offered the opportunity to sit for the ordinary exam to upload a grade.

Sources of information

Basic Bibliography

Hibbeler R.C., **Mecánica de Materiales**, 8ª Edición,
Gere J. M. y Timoshenko S. P., **Resistencia de Materiales**,
Craig R R., **Mechanics of Materials**, 3th Editio,

Complementary Bibliography

Hibbeler R.C., **Mechanics of Materials, SI Edition**, 9th Edition in SI units,
Gere J. M. y Goodno B. J., **Mechanics of Materials**, 8th Edition in SI units,
Luis Ortiz-Berrocal, **Elasticidad**, 3a Edición,
Luis Ortiz-Berrocal, **Resistencia de Materiales**, 3a Edición,
Philpot T. A., **Mechanics of materials: an integrated learning systems**, 2nd Edition,
Rodríguez Avial, M., **Problemas de elasticidad y resistencia de materiales**,
Lumbreras Azanza, José Javier, **Elasticidad y resistencia de materiales. Prácticas de laboratorio**,

Recommendations

Subjects that continue the syllabus

Machine design/P52G381V01405
Theory of structures and industrial constructions/P52G381V01404

Subjects that it is recommended to have taken before

Resistance of materials/P52G381V01204

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===

* Teaching methodologies modified

A new teaching methodology is added:

Synchronous online meeting (theory or practical session): It is taught through a web video conferencing platform. Each virtual classroom contains various display panels and components, the design of which can be customized to best suit the needs of the class. In the virtual classroom, lecturers (and those authorized participants) can share their computer screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).

* Non-attendance mechanisms for student attention (tutoring)

The tutorials will be held in a virtual office on the remote campus of University of Vigo.

* Modifications (if applicable) of the contents

Section 6 CONTENTS: The sessions of laboratories PL1, PL2, PL3 and PL6 are developed using equipment from the laboratories. These practices, as far as possible, would be replaced by demonstration tasks, solving exercises and / or practical cases that allow the student to achieve the objectives set for such practices. The PL4 and PL5 practices require computer programs. If the license of the programs and the capacities of the students' computer equipment allow it, these practices will be maintained or adapted to achieve the objectives set for those practices. The PL7 laboratory session, on the other hand, allows adaptation to the online modality in a simpler way since it is aimed at reinforcing topic 6 by solving problems by applying energy theorems.

=== ADAPTATION OF THE EVALUATION ===

Section 10: EVALUATION: The evaluation tests would be carried out by combining the FAITIC-Moodle online teaching platform and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Enxeñaría gráfica				
Subject	Enxeñaría gráfica			
Code	P52G381V01304			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3	1c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Arce Fariña, María Elena			
Lecturers	Arce Fariña, María Elena Puente Luna, Iván			
E-mail	elena.arce@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Esta materia enmárcase dentro do módulo de Tecnoloxía Mecánica. Enlaza e complementa a materia Expresión Gráfica de primeiro curso e pretende englobar toda a linguaxe do debuxo técnico, reforzando a base teórica, os fundamentos xeométricos que permiten a concepción e visualización das formas e dimensións, e ampliando a práctica, a través dos xa ineludibles contornas informáticas. Todo iso sen esquecer o estudo da Normalización, que facilita o intercambio de información técnica a través da linguaxe gráfica das normas vixentes. O obxectivo é a creación e manexo de información gráfica desde a perspectiva do enxeñeiro mecánico, particularizando nas características concretas do grao impartido no Centro Universitario da Defensa de Marín. Abarcarase a xeometría descritiva de superficies, a informática gráfica, a definición de conxuntos e mecanismos de maneira inequívoca, a representación normalizada de buques, etc., buscando unha formación xeneralista e sobre todo adecuada e útil para o futuro desempeño dos estudantes.			

Competencias	
Code	
CG1	Capacidade para a redacción, sinatura e desenvolvemento de proxectos no ámbito da enxeñaría industrial, na especialidade de Mecánica, que teñan por obxecto, dacordo cos coñecementos adquiridos segundo o establecido no apartado 5 de esta orde, a construción, reforma, reparación, conservación, demolición, fabricación, instalación, montaxe ou explotación de: estruturas, equipos mecánicos, instalacións enerxéticas, instalacións eléctricas e electrónicas, instalacións e plantas industriais, e procesos de fabricación e automatización.
CE19	Coñecementos e capacidades para aplicar as técnicas de enxeñaría gráfica.
CT2	Resolución de problemas.
CT6	Aplicación da informática no ámbito de estudo.
CT9	Aplicar coñecementos.
CT10	Aprendizaxe e traballo autónomos.
CT14	Creatividade.
CT16	Razoamento crítico.
CT17	Traballo en equipo.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Coñecer e dispor de criterios fundamentados para a elección e aplicación de compoñentes normalizados.	CG1	CE19	CT2 CT9 CT10 CT16
Saber aplicar a xeometría na resolución de problemas de construcións e instalacións industriais.		CE19	CT2 CT9 CT14
Adquirir habilidades para crear e xestionar información gráfica relativa a problemas de enxeñaría mecánica.		CE19	CT10 CT14 CT16 CT17
Capacidade para realizar análise do funcionamento dos mecanismos a partir das especificacións dos planos.	CG1	CE19	CT2 CT9 CT14
Coñecer as tecnoloxías CAD para o modelado xeométrico e a xeración de planos a partir de leste.		CE19	CT6 CT9 CT10

RESULTADO 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)		CE19	
RESULTADO 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)	CG1		CT2 CT9
RESULTADO 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)			CT2 CT9 CT14 CT16
RESULTADO DE APRENDIZAXE ENAEE: 3. PROXECTOS EN 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: Avanzado (3)		CE19	CT2 CT9
RESULTADO DE APRENDIZAXE ENAEE: 3. PROXECTOS EN ENXEÑARÍA Subresultado: 3.2 Capacidade de proxecto utilizando algún coñecemento de vangarda da súa especialidade de enxeñaría. Nivel de desenvolvemento: Adecuado (2)	CG1	CE19	CT9
RESULTADO DE APRENDIZAXE ENAEE: 5. APLICACIÓN PRÁCTICA DA ENXEÑARÍA Subresultado: 5.1 Comprensión das técnicas aplicables e métodos de análises, proxecto e investigación e as súas limitacións no ámbito da súa especialidade. Nivel de desenvolvemento: Adecuado (2)		CE19	CT9
RESULTADO 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)			CT2 CT9 CT16
RESULTADO 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)	CG1		CT10 CT17

Contidos	
Topic	
CONTIDOS TEORICOS	.
Tema 1. Introdución aos gráficos de enxeñaría.	1.1. Tipos de gráficos en enxeñaría. Campos de aplicación. Gráficos para o deseño, a visualización e a comunicación. A linguaxe gráfica. 1.2. Sistemas gráficos. Tipos e estrutura dos ficheiros gráficos. Manexo da información. Xerarquías. Capas. 1.3. Modelos. Modelo xeométrico. Asociatividade da información. 1.4. Construcións gráficas empregadas en enxeñaría. 1.5. Diagramas e nomogramas.
Tema 2. Deseño mecánico e utilización de elementos de transmisión.	2.1. Condicións de utilización e montaxe de árbores e eixos, casquillos e rodamentos, poleas, rodas dentadas, cadeas de transmisión, cables, tensores, levas, cardans, flectores, amortiguadores, aisladores de vibracións. 2.2. Definición e representación de engrenaxes. Rodas dentadas. Representación convencional. 2.3. Definición e representación de rodamentos. Tipos de rodamentos. Representación convencional. Montaxe e freo. Tolerancias. Rótulas e cabezas de articulación con rótulas. 2.4. Estanqueidade. Estanqueidade estática e dinámica. Xuntas e Reténs. Compatibilidade cos líquidos.

Tema 3. Deseño estrutural.	3.1. Estudo de unións. Natureza das unións. Criterios para o deseño de unións: graos de liberdade. Métodos de realización de unións. 3.2. Utilización nos deseños de elementos de unión.Clasificación dos elementos de fixación. Estudo dos elementos de unión. Esforzos. Criterios de montaxe. Condicións específicas de utilización en deseño dos anteriores elementos de unión. 3.3. Deseño de unións permanentes. Soldadura, tipos e simboloxía empregada nos planos. Regras de deseño de pezas soldadas. Estudo de unións de chapas e perfís laminados. Consideracións de proxecto. Solucións máis frecuentes empregadas na realización de nós de estruturas metálicas. Remachado, tipos convencionais de remaches e sistemas especiais. Estudo de unións de chapas e perfís de uso aeronáutico.
Tema 4. Xestión da variabilidade; repercusión funcional das tolerancias. Análise e síntese de tolerancias.	4.1. A variabilidade asociada aos problemas de enxeñaría. 4.2. Variabilidade macro e micro xeométricas. 4.3. Tolerancias dimensionales e axustes. Especificación. 4.4. Tolerancias xeométricas. Especificación. 4.5. Referencias e sistemas de referencia. 4.6. Tolerancias de rugosidade superficial. Especificación. 4.7. Tolerancias estatísticas. Funcións de custo das tolerancias. 4.8. Análise de tolerancias e síntese de tolerancias. 4.9. Combinación de tolerancias; repercusión no funcionamento da acumulación de tolerancias.
Tema 5. Especificación xeométrica de produtos.	5.1. Especificación xeométrica segundo ISO. 5.2. Cadeas de Normas ISO. 5.4. Matrices de Normas GPS.
Tema 6. Fundamentos dos gráficos por computador.	6.1. Transformacións xeométricas básicas. 6.2. Graficación de liñas: algoritmos básicos. 6.3. Modelado de superficies: implícitas, paramétricas, redes poligonales. 6.4. Modelado de sólidos: métodos e esquemas de representación.
Tema 7. Sistemas CAD/CAE/CAM. Sistemas para adquisición de datos das xeometrías reais. Prototipado rápido.	7.1. Sistemas CAx (Computer Aided Technologies). 7.2. Ferramentas CAD/CAM. 7.3. Ferramentas CAE no contexto da enxeñaría de deseño. 7.4. Realidade virtual: características e dispositivos. Aplicacións no campo da enxeñaría. 7.5. Dixitalización de formas. Proxectos de enxeñaría inversa. 7.6. Sistemas de prototipado rápido.
Tema 8. Introdución ao deseño industrial.	8.1. Deseño. Tipos. O deseño industrial (produto, comunicación e imaxe corporativa). 8.2. Metodoloxías para o deseño. 8.3. Etapas do proceso de deseño. 8.4. A creatividade no proceso de deseño. 8.5. Valoración de alternativas de deseño. 8.6. DfX (Design for X).
Tema 9. Introdución ao debuxo naval.	9.1. Conceptos xerais en Construción Naval. 9.2. Clasificación de buques. 9.3. Introdución ás técnicas de representación de buques. 9.4. Dimensións e características principais dos buques. 9.5. Coeficientes adimensionais que caracterizan as formas do buque. 9.6. Elementos estruturais e construtivos.
Tema 10. Representación de buques.	10.1. Proxecto de construción do buque. Documentación e planos a desenvolver. 10.2. Plano de formas e liñas do buque. 10.3. Curva de áreas e sección mestra. 10.4. Marcas de calado. 10.5. Representación e anotación da estrutura e seccións do buque. 10.6. Planos xerais e de detalle da estrutura do buque. Coaderna mestra, desenvolvemento do forro exterior, seccións típicas, cubertas e bloques. 10.7. Disposición Xeral do buque. Contornos, espazos, tanques, etc... 10.8. Planos de instalacións e maquinaria.
CONTIDOS PRÁCTICOS	.
Prácticas 1, 2 e 3. Modelado de sólidos e ensambles.	Nas primeiras sesións de laboratorio o alumno aprenderá a xerar elementos tridimensionais utilizando as ferramentas habituais de modelado.
Práctica 4. Confección de documentación técnica (planos, proxectos, etc.).	O obxectivo fundamental desta práctica é que o alumno aprenda a utilizar as ferramentas de confección da documentación técnica obtida a partir dos modelos e ensamblaxes realizadas anteriormente.

Práctica 5. Enxeñaría inversa	O obxectivo fundamental desta práctica é que o alumno realice a reconstrución tridimensional dun obxecto a partir de fotografías. O software pode ser elixido polo alumno, suxeríndose a posibilidade de empregar: Meshroom, Eyescloud, ReCap Prol e Agisoft Photoscan (ou Metashape). A reconstrución realizarase a partir de varias fotografías, xa que se se utiliza unha única fotografía non se conseguirá unha reconstrución fiel, senón unha aproximación.
Prácticas 6 e 7. Deseño e modelado dun Equipo de Protección Individual (EPI) ou unha prótese ortopédica.	O obxectivo fundamental destas prácticas deseñar e desenvolver un destes elementos (a definir polo alumnado): EPI en postos de operarios (caretas protectoras, lentes de protección, cascos, orelleiras, etc.) para a prevención e protección fronte aos accidentes laborais e danos para a saúde. Prótese ortopédicas. O alumno deberá realizar o modelo 3D do conxunto ensamblado e planos do mesmo.

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	28	42	70
Prácticas con apoio das TIC	14	21	35
Seminario	7	7	14
Resolución de problemas e/ou exercicios	17	1	18
Exame de preguntas de desenvolvemento	9	1	10
Práctica de laboratorio	2	1	3

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

Metodoloxía docente

	Description
Lección maxistral	Cada unidade temática teórica será presentada polo profesor, expondo exemplos para unha mellor comprensión dos contidos. Mediante a formulación de cuestións sobre os contidos teóricos e exemplos fomentarase a participación activa do alumnado. Utilizaranse presentacións ofimáticas e a lousa para transmitir información como definicións, gráficos, fotografías, etc. Na medida do posible, proporcionarase copia das transparencias aos alumnos con anterioridade á exposición, centrando o esforzo do profesor e do alumnado na exposición e comprensión dos coñecementos. As reproducións en papel das transparencias nunca deben ser consideradas como substitutos de apuntamentos tomados en clase ou dos textos suxeridos na bibliografía, senón como material complementario.
Prácticas con apoio das TIC	Actividades de aplicación dos coñecementos a situacións concretas e de adquisición de habilidades básicas e procedimentales relacionadas coa Enxeñería gráfica. Estas desenvolveranse en aulas de informática con equipamento especializado.
Seminario	Realización de actividades de reforzo á aprendizaxe mediante a resolución tutelada de maneira grupal de supostos prácticos vinculados aos contidos teóricos e prácticos da materia. Aqueles exercicios de clases de laboratorio que o alumno non puidese finalizar, tratará de facelo nas súas horas de estudo e se ten algunha dificultade ou dúbida poderase resolver nestas clases de seminarios grupales.

Atención personalizada

Methodologies	Description
Seminario	No ámbito da acción titorial, distínguense accións de tutoría académica así como de tutoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de tutorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, co desenvolvemento dos temas, casos prácticos, comentarios de texto, etc. As tutorías poden ser individualizadas, pero fomentaranse tutorías grupales para a resolución de problemas relacionados coas actividades a realizar en grupo, ou simplemente para informar ao docente da evolución do traballo colaborativo. Nas tutorías personalizadas, 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. Conxugando ambos os tipos de acción titorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade. Os profesores da materia atenderán persoalmente ás dúbidas e consultas dos estudantes, tanto de xeito presencial, segundo o horario que se publicará na páxina web do centro, como a través dos medios telemáticos (correo electrónico, videoconferencia, foros FAITIC, etc.) baixo a modalidade de cita previa.

Avaliación

	Description	Qualification	Evaluated Competencess		
Prácticas con apoio das TIC	PROBA PRÁCTICAS (peso na avaliación: 20%) Realizarase unha proba práctica de avaliación baseada nos problemas realizados en clase. ENTREGABLES PRÁCTICAS (peso na avaliación: 20%) Ao longo do cuadrimestre, en determinadas sesións de prácticas, exporanse problemas que deberán ser resoltos polos alumnos e entregaranse para a súa avaliación cando o determine o profesor. A avaliación de cada entregable estará de acordo cos criterios que con anterioridade comunicáronse aos alumnos	40	CG1	CE19	CT2 CT6 CT9 CT14 CT16 CT17
Resolución de problemas e/ou exercicios	PROBA INTERMEDIA. Realizarase unha proba de curta duración. A realización das proba será obrigatoria e esixible para superar a materia. A temática da proba abarcará os contidos avanzados ata a data.	20	CG1	CE19	CT9 CT10 CT16
Exame de preguntas de desenvolvemento	Realizarase unha Proba Final que abarcará a totalidade dos contidos da materia, tanto teóricos como prácticos, e que poderá incluír probas tipo test, preguntas de razoamento, resolución de problemas e desenvolvemento de casos prácticos. Esíxese alcanzar unha cualificación mínima de 4 puntos sobre 10 posibles para poder superar a materia.	40	CG1	CE19	CT9 CT10 CT16

Other comments on the Evaluation

OBSERVACIÓNS SOBRE A AVALIACIÓN: A avaliación final de alumno atenderá á suma da puntuación outorgada a cada unha das partes antes comentadas, sendo a súa nota de avaliación continua final (NAC): NAC= 0.20 * PROBA INTERMEDIA + 0.20 * ENTREGABLES PRÁCTICAS + 0.20 * PROBA PRÁCTICAS + 0.40 * PROBA FINAL. Para superar a materia, a nota final de avaliación continua (NAC) calculada pola fórmula anterior deberá ser polo menos 5 puntos sobre 10. Ademáis, esixiranse uns requisitos mínimos e condicións nalgúns dos apartados, que garantan o equilibrio entre todos os tipos de competencias. A pesar de obter unha NAC de polo menos 5 puntos sobre 10, o alumno deberá presentarse ao exame ordinario de todos os contidos da materia, que suporá o 100% da nota, nos seguintes supostos: a) Non realizar algunha das probas intermedias ou a non asistencia a máis dunha sesión de prácticas; b) Obter unha nota inferior a 4 puntos sobre 10 na proba final de avaliación continua (PF). En calquera destes dous supostos, a cualificación da avaliación continua será o mínimo da nota de avaliación continua calculada coa fórmula anterior e 4 puntos. En calquera caso, o alumno que superase a avaliación continua, terá a posibilidade de presentarse ao exame ordinario para subir nota. Tanto no exame ordinario como no extraordinario (convocatoria de xullo), avaliaranse tódalas competencias da materia. Por iso, os exames ordinario e extraordinario incluirán unha proba práctica de programación no laboratorio.

COMPROMISO ÉTICO: Espérase que os alumnos teñan un comportamento ético adecuado. Se se detecta un comportamento pouco ético (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros) penalizarase ao alumno coa imposibilidade de superar a materia pola modalidade de avaliación continua (na que obterá unha cualificación de 0.0). Se este tipo de comportamento detéctase en exame ordinario ou extraordinario, o alumno obterá no devandito exame unha cualificación de 0.0.

Bibliografía. Fontes de información

Basic Bibliography

Félez, J.; Martínez, M.L., **Fundamentos de Ingeniería Gráfica**, Síntesis, 1999

Félez, J.; Martínez, M.L., **Ingeniería Gráfica y Diseño**, Síntesis, 2008

Complementary Bibliography

Company, P. P.; Gomis, J. M.; Ferrer, I., Contero, M., **Dibujo normalizado**, Servicio de Publicaciones de la Universidad Polité, 1997

Company, P.; Vergara, M.; Mondragón, S., **Dibujo Industrial**, Publicacions de la Universitat Jaume I, 2007

Pérez, J. L.; Palacios, S., **Expresión Gráfica en la Ingeniería**, Prentice Hall, 1998

Recomendacións

Subjects that continue the syllabus

Deseño de máquinas/P52G381V01405
Enxeñaría de fabricación e calidade dimensional/P52G381V01407
Oficina técnica/P52G381V01501

Subjects that it is recommended to have taken before

Expresión gráfica: Expresión gráfica/P52G381V01101

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada pola COVID- 19, a Universidade establece una planificación extraordinaria que se activará no momento en que as administracións e a propia institución o determinen atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou non totalmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun xeito mais áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes DOCNET.

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A continuación, detállanse aqueles aspectos que se modificarán na guía no caso de que se determine algunha actuación derivada de criterios de seguridade.

Apartados da guía docente onde se reflectirán cambios:

 Metodoloxía docente

Engádese unha nova metodoloxía docente:

- Sesión maxistral e/ou sesión práctica virtual síncrona:
Impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

 Avaliación da aprendizaxe

- As probas de avaliación realizaranse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Fluid machines				
Subject	Fluid machines			
Code	P52G381V01305			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Regueiro Pereira, Araceli			
Lecturers	Regueiro Pereira, Araceli			
E-mail	regueiro@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The subject "Fluid Machines" is a subject of the specific mechanical block that is taught in the second semester of the third course of the degree in mechanical engineering taught at the CUD. The subject uses the fundamental tools used in the study of fluid movement (differential, integral and dimensional analysis) acquired in the subject "Fluid Mechanics" and applies them to energy transformer devices in which energy is transferred between the fluid that runs through the machine and its moving parts. The subject is focused on the study of machines with incompressible fluid. The need to reconcile the specific military training of the future Navy Officer with that of the degree in mechanical engineering leads to the subject being taught and evaluated aboard the "Juan Sebastián de Elcano" Training Ship.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CE24	Applied knowledge of the basics of fluidmechanics systems and machines.
CT2	Problems resolution.
CT9	Apply knowledge.
CT10	Self learning and work.
CT17	Working as a team.

Learning outcomes	Competences		
Understand basic concepts of fluid machinery.	CG3	CE24	CT2 CT9 CT10
Acquire skills in the sizing process of pumping facilities and fluid machines	CG3	CE24	CT2 CT9 CT10 CT17
ENAEE Learning outcome: KNOWLEDGE AND UNDERSTANDING: RA1.2.- 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 development of each sub result (Basic (1), Appropriate (2) and Advanced (3)] In this sub-result appropriate (2).	CG3	CE24	
ENAEE Learning outcome: ENGINEERING ANALYSIS: RA2.2.- Ability to analyse complex engineering products, processes and systems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to correctly interpret the outcomes of such analyses [Appropriate (2)].			CT2 CT9
ENAEE Learning outcome: ENGINEERING DESIGN: RA3.2.- Ability to design using some awareness of the forefront of their engineering specialisation [Basic (1)].		CE24	CT9
ENAEE Learning outcome: INVESTIGATIONS: RA4.3.- laboratory/workshop skills and ability to design and conduct experimental investigations, interpret data and draw conclusions in their field of study [Basic (1)].		CE24	CT9
ENAEE Learning outcome: ENGINEERING PRACTICE: RA5.1.- Understanding of applicable techniques and methods of analysis, design and investigation and of their limitations in their field of study [Basic (1)].		CE24	CT9
ENAEE Learning outcome: ENGINEERING PRACTICE: RA5.2.- Practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Basic (1)].			CT9

ENAEE Learning outcome: ENGINEERING PRACTICE: RA5.3.- Understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study [Basic (1)].	CT9
ENAEE Learning outcome: LIFELONG LEARNING: RA8.2.- . Ability to follow developments in science and technology [Basic (1)].	CT10

Contents	
Topic	
Unit 1: Fluid machinery classification.	1.1.-Fluid machinery classification. 1.2.-Constitutive parts. 1.3.-Fluid machinery applications.
Unit 2: Energy balance in fluid machinery.	2.1.-Characterisation of fluid machinery. Inlet and outlet sections definition. 2.2.-Total energy conservation law. 2.3.-Internal energy conservation law. 2.4.-Mechanical energy conservation law. Hydraulic head. 2.5.-Mechanical energy balance and performance in driven machinery. 2.6.-Mechanical energy balance and performance in driving machinery.
Unit 3: Positive displacement machinery.	3.1.-Positive displacement machinery. Principles and classification. Characteristics. Applications. 3.2.-Alternative volumetric pumps. 3.3.-Rotary and peristaltic volumetric pumps. 3.4.-Hydraulic motors and linear actuators. Performance curves.
Unit 4: Principles of hydraulic circuits.	4.1.-General diagram of hydraulic circuits. Functional decomposition and simbology. 4.2.-Control elements and accessories in hydraulic circuits. 4.3.-Design and control of elementary hydraulic circuits.
Unit 5: Principles of pneumatic circuits.	5.1.-General diagram of pneumatic circuits. Functional decomposition and simbology. 5.2.-Control elements and accessories in pneumatic circuits. 5.3.-Design and control of elementary pneumatic circuits.
Unit 6: Hydraulic turbomachinery fundamentals.	6.1.-Introduction. Reference systems. Normalized views. 6.2.-Angula momentum conservation law. Euler theorem. 6.3.-One-dimensional theory. 6.4.-Bernouilli equation in rotor reference frame. 6.5.-Simplified theory of radial turbomachines. Centrifugal pumps. Francis turbines. 6.6.-Simplified theory of axial turbomachines. Kaplan turbines. 6.7.-Dimensional analysis and physical similarity in hydraulic turbomachinery.
Unit 7: Fluid machinery and instalations practice.	7.1.-Pumps and pump stations calculations. Pump performance and installation curves. 7.2.-Pelton turbine operation. Regulation. 7.3.-Francis turbine operations. Regulation. 7.4.-Marine propellers. 7.5.-Wind turbines. 7.6.-Revesible hydraulic plants.
Practice 1: Identification of the elements of fluid machinery in CAD assemblies.	Aims and development: In this first practical session the student opens CAD files prepared by the lecturer to visualise the constitutive elements of fluid machinery and hydraulic installations. The main aim of this practical activity is to strengthen the nomenclature and facilitate the three-dimensional visualisation of the flow in the interior of fluid machines.
Practice 2: CFD simulation of positive displacement pumps.	Aims and development: In this first CFD practice activity, dynamic mesh models are explained in order to define the movement of pistons, valves and rotary parts in volumetric pumps.
Practice 3: Hydraulic circuit simulation with demo software.	Aims and development: To strengthen the theoretical knowledge related with lesson 4, in this practice a hydraulic circuit will be designed, with the aim to understand the activities of each one of the elements involved: elements of generation, actuation and of control.
Practice 4: Pneumatic circuit simulation with demo software.	Aims and development: To strengthen the theoretical knowledge of the subject 5 it is expected that the student designs a pneumatic circuit of intermediate complexity to satisfy some requirements imposed by the lecturer, analyse the operation of the different elements and look for the greater simplicity of the circuit.

Practice 5: Analysis of a real hydraulic or pneumatic circuit using Fluidsim software	Aims and development: In order to strengthen the theoretical knowledge acquired in topics 4 and 5, and to reinforce the concepts and skills of software management developed in practices 3 and 4, this practice is proposed, in which Fluidsim software is used, the updates of which incorporate knowledge of Vanguard. In it, the student has to analyze a simple case of a real hydraulic or pneumatic circuit (hydraulic jack, hydraulic component of an excavator, opening of a door ...). The student will choose the component that he wants to analyze so that different components are studied and each student has to face different problems.
Practice 6: Problem solving involving turbopumps and installations.	Aims and development: The student will solve a problem of turbopumps in which parameters of design of the impeller and the installation come into play. Taking as a starting point a table with the record of experimental measurements, the operating curves of a centrifugal turbopump are derived and the operating point is evaluated for different configurations.
Practice 7: Calculation of a real hydraulic installation using the Epanet software	Aims and development: In this practice, problems with real pumping facilities are modeled and solved with the Epanet software. This practice is intended to inculcate that the available software tools facilitate the calculation work, but do not free the user from having the necessary engineering knowledge for the correct introduction of the data and interpretation of the results.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	39	65
Laboratory practical	14	21	35
Problem solving	22	1	23
Objective questions exam	4	4	8
Problem and/or exercise solving	10	9	19

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

Methodologies

	Description
Lecturing	In these sessions the basic theoretical contents of the program will be explained in detail, exposing clarifying examples that deepens in the understanding of the subject. A digital board will be used in exposition and edition mode. At the beginning of the course, copy of the slides will be provided to the students that request it in the office of the sailing ship. Anyway, paper copies of the slides never should be considered like substitutes of textbooks or notes, but like complementary material.
Laboratory practical	Practices of laboratory with computer. Computer sessions are of paramount importance. Circuit simulations facilitate enormously the understanding of hydraulic and pneumatic systems. In a similar way, CFD simulations allow to visualise the three-dimensional flow in turbomachines and volume chamber evolution in volumetric machines. Resolution of problems and/or exercises in autonomous form. Some practical sessions conclude by posing a problem like closing activity of the practice.
Problem solving	Resolution of problems and/or exercises. The teacher solves a representative problem linked to the theory.

Personalized assistance

Methodologies	Description
Problem solving	In personalized tutorials, each student, individually, will be able to discuss with the teacher any problem that is preventing them from adequately monitoring the subject, in order to find some kind of solution between them. This is intended to compensate for different learning rhythms through attention to diversity. The teacher of the subject will personally attend to the doubts and queries of the students, both in person (being available in the midshipmen library every school day from 18:15 - 19:00), and through telematic means (email, videoconference, FAITIC forums, etc.) by appointment.

Assessment

Description	Qualification	Evaluated Competencess

Lecturing	The theory contents taught in the master sessions are evaluated by 2 intermediate exams along the semester. These intermediate exams are short written tests (1 hour) carried out in the daily class schedule and whose purpose is to evaluate the assimilation of the contents by the students, motivate the autonomous study and identify those students requiring attention individual tutorial attention. During the course two intermediate tests are carried out consisting of conceptual questions and short problems.	30	CG3	CE24	CT2 CT9 CT10
Laboratory practical	The evaluation of the practices carries out realising the average of the punctuations obtained in each one of the sessions. In each script of practices collect the tasks to realise and the criteria of evaluation. The activity of evaluation is varied according to the practice. In some of the practices evaluates with report, in others with questionnaire of short answer and others with resolution of problems posed.	30		CE24	CT2 CT9 CT17
(*)	Final written exam is a long-term test (4 hours) that aims to evaluate the learning of all the contents of the subject.	40	CG3	CE24	CT2 CT9 CT10

Other comments on the Evaluation

Student final mark is obtained by a weighted sum over the scores achieved in each of the above mentioned parts. A continuous evaluation mark (NEC) is defined according to : NEC = 0,15 * IntExam1+ 0,15* IntExam2 + 0,3 * PracticeMark+ 0,4 * FinalExam Passing the course by continuous evaluation requires a NEC mark equal to or greater than 5 points. However, minimum requirements will be required in some sections in order to ensure a satisfactory balance between all types of skills. These requirements are: 1. Carry out of both intermediate exams and conduct at least 6 of the 7 practical sessions. 2. Obtain a grade of 4 or more points out of 10 in the Final Exam Students with NEC less than 5 or who do not fulfill one of the two previous requirements must attend to the regular exam in order to pass the subject. For those students who do not meet the two requirements the final mark of continuous evaluation is obtained as: NEC FINAL = min (4, NEC). In addition, the option to attend the regular exam is offered to all those students who wish to improve their continuous evaluation mark. Students that do not achieve to pass the subject by continuos evaluation shoult attend to a eight-hours intensive course previous to the date of the regular exam. Both the regular and the extraordinary exam (July exam) will evaluate all the subject skills. Therefore, these exams will include a question regarding the tasks performed during the practices. ETHICAL COMMITMENT: Students are expected to have appropriate ethical behavior. If unethical behavior (cheating, plagiarism, use of unauthorized electronic devices or others) is detected, the student will be penalized with the impossibility of passing the subject by the continuous evaluation modality (in which he/she will obtain a grade of 0). If this type of behavior is detected in regular or extraordinary exams, a 0 mark qualification is transferred to his/her academic record.

Sources of information

Basic Bibliography

C. Paz Penín, E. Suárez Porto, A. Eirís Barca, **Máquinas hidráulicas de desplazamiento positivo**, 2012

J. Agüera Soriano, **Mecánica de fluidos incompresibles y turbomáquinas hidráulicas**, 5ª, 2002

J. Roldán Viloria, **Tecnología y circuitos de aplicación neumática, hidráulica y electricidad**, 2012

Complementary Bibliography

A. Esposito, **Fluid power with applications**, 7ª, 2009

J. Hernández Rodríguez, P. Gómez del Pino, C. Zanzi, **Máquinas hídráulicas. Problemas y soluciones**, 2016

A. Serrano Nicolás, **Oleohidráulica**, 2002

Recommendations

Other comments

Fluid Mechanics fundamentals are invoked very often during the course. In case of difficulties it is recommended that students refresh acquired knowledge and they can also go to tutorials.

Contingency plan

Description

MODIFICATIONS IN CASE OF EXTRAORDINARY SITUATIONS THAT INVOLVE THE SUSPENSION OF THE PRESENTIAL ACADEMIC ACTIVITY.

Next, those aspects that will be modified in the guide are detailed in the event that any action derived from security criteria is determined.

Sections of the teaching guide where changes will be reflected:

5. Teaching methodology
Two new teaching methodologies are added:
5.1 Classes and practices in the online modality:
It is taught through a web video conferencing platform. Each room contains various display panels and components, the design of which can be customized to best suit the needs of the classroom. In the virtual classroom, teachers (and those authorized participants) can share their computer screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).
5.2. Discussion forums: activities developed in a virtual environment to resolve doubts and / or debate on issues that arise in the study of the subject.

7. Assessment of learning
7.1. The evaluation tests will be carried out by combining the FAITIC-Moodle remote teaching platform and the Remote Campus of the University of Vigo

IDENTIFYING DATA				
Basics of business management				
Subject	Basics of business management			
Code	P52G381V01306			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Rodríguez Rodríguez, Francisco Javier			
Lecturers	Rodríguez Rodríguez, Francisco Javier			
E-mail	fjavierrodriguez@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The primary objective of the subject Basics of Operations Management is to provide students with a basic and sufficient level of knowledge related to the specific methods and techniques of Operations within organizations. In this field, the word Organization is applicable to private enterprises, whether industrial, commercial or services, public enterprises and administrations, public institutions and bodies, as well as quarters, headquarters, organs, fleets and sections of The Spanish Navy. All these organizations have in common that they must be managed by people with adequate training to perform an effective and efficient direction of operations, both from a strategic and operational perspective. The future graduates will practice their profession in the different organisms and units grouped within the Navy, which can be considered the parent organization of all the organizations that integrate it. Therefore, it is important that all students know the management tools needed to run an organization of any kind. The study of this subject will allow students to consolidate and expand some of the knowledge previously acquired in the first year subject Introduction to Business Management. The necessary skills will be developed to manage the organizations through the study and practice of applied knowledge of Operations management. Basics of Operations Management has an important relationship with the subject Logistics and Management of Resources in the Navy, which is taught within the specific military training of the two fundamental specialties of General Corps and Marine Infantry. The contents of the subject Basics of Operations Management of the Degree in Mechanical Engineering have been divided into six parts: General Introduction, Introduction to Project Management, Forecasting Demand, Basic Decisions in Production Management, Introduction to work study and Introduction to the Quality, Safety and Environmental managing. These six parts will be developed in eleven topics as specified in the subject planning.			

Competencies	
Code	
CG8	Ability to apply the principles and methods of quality.
CG9	Ability to organize and plan within the sphere of a company, and other institutions and organizations.
CE15	Basic knowledge of production systems and manufacturing.
CE17	Applied knowledge of business organization.
CT1	Analysis and synthesis
CT2	Problems resolution.
CT7	Ability to organize and plan.
CT8	Decision making.
CT9	Apply knowledge.
CT11	Ability to understand the meaning and application of the gender perspective in the various fields of knowledge and professional practice with the aim of achieving a more just and egalitarian society.
CT18	Working in an international context.

Learning outcomes	Competences		
To know the basis on which the activities related to production and operations management are supported.	CG8 CG9	CE15 CE17	CT1 CT2 CT7 CT8 CT9 CT18

To know the scope of the different production-related activities.	CG8 CG9	CE15 CE17	CT1 CT2 CT7 CT8 CT9 CT18
To obtain an overall view for the execution of the activities related to production and operations management.	CG8 CG9	CE15 CE17	CT1 CT2 CT7 CT11
To conduct a workplace assessment from an approach that helps the development of people with a perspective of efficiency and equality.			CT11
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:Basic (1)].	CG9	CE15 CE17	
ENAEE learning outcome: ENGINEERING ANALYSIS: LO2.1.- Ability to analyse complex engineering products, processes and systems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to correctly interpret the outcomes of such analyses [Suitable (2)].		CE15 CE17	CT2 CT8 CT9
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 [Suitable (2)].			CT1 CT2 CT8 CT9 CT11
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 [Suitable (2)].	CG8		CT2 CT7 CT9 CT11
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.4- Ability to apply norms of engineering practice in their field of study [Suitable (2)].	CG9		CT9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.5- Awareness of non-technical -societal, health and safety, environmental, economic and industrial - implications of engineering practice [Suitable (2)].			CT11
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.6.- Awareness of economic, organisational and managerial issues (such as project management, risk and change management) in the industrial and business context [Suitable (2)].	CG9	CE17	
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 [Basic (1)].	CG9		CT11
ENAEE learning outcome: MAKING JUDGEMENTS: LO6.2.- Ability to manage complex technical or professional activities or projects in their field of study, taking responsibility for decision making [Suitable (2)].	CG9	CE17	

Contents

Topic	
Chapter 1. Production systems and components. Aims: To identify the concepts of operations, production and productivity in the organizational context.	Chapter index: 1.1. Notions of production. Production system. Current production systems. 1.2. Operations management. Organizing to produce goods and services. 1.3. New trends in production and operations. 1.4. Productivity, quality and social responsibility.
Chapter 2. Productivity and its measurement. Aims: To define and describe productivity measurement. To gain knowlegde on the factors affecting productivity and to apply management techniques that improve productivity.	Chapter index: 2.1. Concept of productivity. Productivity measurement. 2.2. Productivity variables. Management role. Strategies for productivity growth. 2.3. Productivity in companies and organizations. Productivity and the service sector.
Chapter 3. Concept and functions of operations management. Aims: To define production management and to identify its basic functions.	Chapter index: 3.1. Production management. Production planning, scheduling and controlling. 3.2. Relationships between production, logistics and operations. 3.3. Supply chain. Managing inventory. Independent vs. Dependent demands. 3.4. The role of an Operations manager.

Chapter 4. Project Planning, Scheduling and Controlling. Aims: To understand each product or service as a new project. To explain the main project management techniques.	Chapter index: 4.1. Strategic importance of project management. 4.2. Project planning. 4.3. Project scheduling. 4.4. Project controlling. 4.5. Introduction to PERT and CPM. 4.6. PERT/CPM networks. 4.7. Calculating Slack time and identifying the critical path(s). 4.8. Variability in activity times.
Chapter 5. Forecasting demand. Aims: To define the forecasting process and its approaches. To describe the quantitative forecasting methods.	Chapter index: 5.1. Forecasting. Types of forecasts. The importance of forecasting. Forecasting approaches. 5.2. Quantitative methods. Time-series models. Associative models.
Chapter 6. Strategic decisions. Aims: To identify the process and layout strategies within the organizations. To present the concept of capacity planning.	Chapter index: 6.1. Process and layout strategies. Process analysis and design. 6.2. Capacity. Capacity planning. Tools for analysis and decision-making. 6.3. Location strategy. Factors that affect location decisions. Methods of evaluating location alternatives.
Chapter 7. Tactical decisions. Inventory management. Aims: To describe the functions of inventory and basic inventory models.	Chapter index: 7.1. Functions of inventory. Inventory management. 7.2. Inventory models. Models for independent demand. Other models.
Chapter 8. Tactical decisions. Production Planning, Scheduling and Controlling. Aims: To identify the planning, scheduling and controlling processes. To explain Material Requirements Planning.	Chapter index: 8.1. The planning process. Aggregate planning. Production scheduling and control. 8.2. Material Requirements Planning (MRP). Inventory management for dependent demand. 8.3. MRP structure and management. 8.4. Enterprise Resource Planning (ERP).
Chapter 9. Tactical decisions. JIT Philosophy. Definition and principles. Aims: To describe Just In Time (JIT) phylosophy and Lean Manufacturing. Objectives and principles.	Chapter index: 9.1. Introduction to JIT. 9.2. The 4Ps of JIT. 9.3. Lean Manufacturing. 9.4. Total productive maintenance, TPM.
Chapter 10. Introduction to work study. Aims: To define job design. To understand the importance of an effective and efficient Human Resources management. To explain the fundamentals of the Method study. To describe Time studies. To explain Predetermined Time Standards. To describe work sampling.	Chapter index: 10.1. Job design. 10.2. Ergonomics and work physiology. 10.3. Method analysis and work measurement. 10.4. Time studies. 10.5. Predetermined Time Standards. Methods-Time Measurement (MTM). 10.6. Work sampling.
Chapter 11. Introduction to quality, environment and safety. Aims: To define quality and the international quality standards.To identify the environmental management systems and standards. To define safety and industrial hygiene and to understand their importance in the prevention of occupational risks.	Chapter index: 11.1. Quality. International quality standards. ISO 9000 standards. Standards PECAL/AQAP with requirements of the Spanish Ministry of Defense (NATO requirements). 11.2. Environmental management systems. ISO 14000 standards. EMAS regulation. 11.3. Safety and industrial hygiene. Prevention of occupational risks.
Practical session 1. Productivity calculations.	Situations of industrial or services companies are raised in which students should determine or measure the productivity from the data supplied. These exercises are presented and resolved.
Practical session 2. Project planning.	It comprises the determination of project schedules with PERT/ CPM charts.
Practical session 3. Forecasting demand.	It consists in forecasting the demand for products or services of a company, using time-series models and associative models that have been studied. Several exercises for forecasting are presented and resolved.

Practical session 4. Process analysis. Layout design. Capacity decisions.	Examples are given of flow charts and operation process charts (process charts, flow diagrams, etc.) for process analysis. Problems on break-even analysis are presented and resolved.
Practical session 5. Inventory models for independent demand.	Inventory problems are presented and resolved using the ABC method, as well as exercises based on the Economic Order Quantity (EOQ) model and its variations (independent demand).
Practical session 6. Aggregate planning.	Aggregate planning problems, with the two pure strategies: chase and level, are presented and resolved.
Practical session 7. Inventory models for dependent demand.	Diverse problems are presented and resolved using the MRP technique, preparing materials lists and calculating gross and net requirements (dependent demand).

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	39	65
Problem solving	14	21	35
Seminars	22	15	37
Essay questions exam	13	0	13

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

Methodologies

	Description
Lecturing	Each lecture session will be presented by the professor, setting examples for a better understanding of the contents. By raising issues in theoretical contents and examples, the active student participation will be boosted and assessed. Office presentations and the dashboard will be used to convey information such as definitions, graphics, pictures, etc. As far as possible, copies of the presentations will be provided to the students prior to the lecture, focusing the effort of the teacher and students in the exhibition and understanding of the knowledge. Printed reproductions of the presentations should never be considered as substitutes for notes taken in class or the texts suggested in the bibliography, but as complementary material.
Problem solving	Problems and /or exercises are formulated that the student must solve by interpreting the available information, applying formulas or algorithms and interpreting the results. These exercises can be collected at the end of the class or sent over the intranet in a short time.
Seminars	They consist in the realization of activities of reinforcement to the learning by means of: Troubleshooting. Complementing to the realised in the practical classes. Case studies. Analysis of real events, fundamentally in companies and Defense organizations with the purpose of knowing them, interpreting them, reflecting, diagnosing and elaborating possible solutions. Those exercises in laboratory classes that students were unable to finish, need to be addressed in their study hours and if there is any difficulty or doubt, they can be resolved in these seminars. Intensive course (15 hours) for those students who have failed the subject at first call, prior to the exam in second call. Group tutoring with the lecturer.

Personalized assistance

Methodologies	Description
Seminars	PERSONALIZED ATTENTION In addition to tutorials or group seminars, individual tutorials can be carried out, in which each student, individually, can consult the professor doubts or difficulties that prevent him from following the theoretical or practical contents of the subject. Additional exercises will be proposed to reinforce the learning of the contents of the subject, aimed at students who show difficulties to follow in an appropriate way the development of classes.

Assessment

Description	Qualification	Evaluated Competencess

Lecturing	Intermediate test of continuous assessment: It has as objective the evaluation of the acquired competences, being able to include multiple-choice test questions with different alternatives of answer, direct short answer questions and troubleshooting. It will be realized during the quadmester and will be of short duration. The execution of the test will be compulsory and required to pass the subject. (Percentage on the final grade: 25%) Final exam of continuous assessment: a final test will be carried out covering all the contents of the subject, both theoretical and practical, and it may include test questions, reasoning questions, troubleshooting and case study's development. It is required to achieve a minimum grade of 4 points out of 10 possible to be able to pass the subject, as well as exceed a minimum grade of 3 points out of 10 in each part (theory and problems) of the aforementioned exam.(Percentage over final grade: 50%)	70	CG8 CG9	CE15 CE17	CT1 CT2 CT7 CT8 CT9 CT11
Problem solving	Assessment of the practical sessions: during the quadmester, in certain practical sessions, problems or exercises will be raised to be solved by the students and submitted for evaluation when determined by the professor. The evaluation of each deliverable will be in accordance with the criteria that have previously been communicated to the students.	25	CG8 CG9	CE15 CE17	CT1 CT2 CT7 CT8 CT9 CT11 CT18
Seminars	Participation: Participation and attitude will be evaluated during theoretical classes, practical sessions and group tutorials, as well as contributions in the virtual platform.	5	CG8 CG9	CE15 CE17	CT1 CT2 CT7 CT8 CT9 CT11

Other comments on the Evaluation

Final assessment of students will attend to the sum of the score given to each of the above mentioned parts, being their overall continuous assessment grade (CAG):

*CAG= 0,25*INTERMEDIATE TEST + 0,20*PRACTICAL SESSIONS + 0,50* FINAL EXAM + 0,05* PARTICIPATION*

In order to pass the subject, the overall continuous assessment grade (CAG) calculated by the previous formula must be at least 5 points out of 10. Otherwise, students must take the ordinary exam.

However, minimum requirements and conditions will be required in some of the sections, which ensure a balance between all types of competences.

The student must take the ordinary exam of all the contents of the subject, which will represent 100% of the grade, in the following cases:

- If a student fails to take the intermediate test or does not attend more than one practical session.
- If a student earns a grade below 4 points out of 10 in the final exam of continuous assessment, as well as not achieve a minimum grade of 3 points out of 10 in any of the parts (theory and problems) of the aforementioned exam.

In either of these two assumptions, the continuous assessment grade will be the minimum of the continuous assessment grade calculated with the previous formula and 4 points. In any case, students who have passed the continuous assessment, will have the possibility to take the ordinary exam to increase grades.

Both the ordinary and the extraordinary exams (July call) will evaluate all the competences of the subject. To pass the subject in either of these two calls, it will be necessary to exceed a minimum grade of 3 points out of 10 in each part (theory and problems) of these exams.

ETHICAL COMMITMENT: Students are expected to have appropiate ethical behavior. If unethical behavior is detected (copying, plagiarism, use of unauthorized electronic devices or others), the student will be penalized with the impossibility of passing the subject by the continuos assessment modality (in which he/she will obtain a grade of 0,0). If this type of behavior is detected in ordinary or extraordinary exams, the student will obtain in that call a grade of 0,0.

Sources of information

Basic Bibliography

Heizer, J., Render, B., **Dirección de la producción y de operaciones. Decisiones estratégicas**, 8ª ed., Pearson Educación S.A., 2007

Heizer, J., Render, B., **Dirección de la producción y de operaciones. Decisiones tácticas**, 8ª ed., Pearson Educación S.A., 2008

Chase, R.B., Jacobs, F.R., Aquilano, N.J., **Administración de operaciones. Producción y cadena de suministros**, 13ª ed., McGraw-Hill, 2014

Complementary Bibliography

Velasco, J., Campins, J.A., **Gestión de la producción en la empresa. Planificación, programación y control**, Ediciones Pirámide, 2013

Velasco, J., **Organización de la producción. Distribuciones en planta y mejora de los métodos y los tiempos**, Ediciones Pirámide, 2010

López Varela, P., Iglesias Baniela, S., **Planificación, programación y control de proyectos mediante técnicas de camino crítico**, Tórculo Edicions, 2007

Vallhonrat, J.M., Corominas, A., **Localización, distribución en planta y manutención**, Marcombo, 1991

Roux, M., **Manual de logística para la gestión de almacenes**, Ediciones Gestión 2000, 1997

Oficina Internacional del Trabajo (OIT) Ginebra, **Introducción al estudio del trabajo**, 1986

Hodson, W.K., **Manual del Ingeniero Industrial Maynard**, McGraw-Hill, 1996

Goldratt, E.M., Cox,J., **La Meta: un proceso de mejora continua**, Ediciones Díaz de Santos, 2005

American Production Inventory Control Society, **Información sobre producción y control de inventarios**,

Heizer, J., Render, B., **Blog del libro: Dirección de la producción y de operaciones**,

Toyota, **Toyota Production System**,

PennState University, **Supply Chain Professional Certificate - Military options**,

Asociación Española de Normalización y Certificación, **Normas de Calidad y Medioambiente**,

Ministerio de Defensa, **Normativa PECAL/AQAP**,

Instituto Nacional de Seguridad e Higiene en el Trabajo, **Normativa PRL**,

Recommendations

Other comments

The subject has no associated prerequisite. However, in order to successfully complete this course, the student must have:
- Sufficiently developed written and oral comprehension skills.
- Capacity of basic calculation and synthesis of information.
- Teamwork and communication skills.
- At least basic knowledge acquired in the subject Introduction to Business Management taught in first year.

The most frequent learning difficulties are related to the lack of such knowledge, but can be saved with a little effort and the means available in this center.

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained

* Teaching methodologies modified

* Non-attendance mechanisms for student attention (tutoring)

* Modifications (if applicable) of the contents

* Additional bibliography to facilitate self-learning

* Other modifications

=== ADAPTATION OF THE TESTS ===
* Tests already carried out
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Pending tests that are maintained
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Tests that are modified
[Previous test] => [New test]

* New tests

* Additional Information

IDENTIFYING DATA				
Fundamentos de automática				
Subject	Fundamentos de automática			
Code	P52G381V01401			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4	1c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	González Prieto, José Antonio			
Lecturers	Fernández García, Norberto González Prieto, José Antonio			
E-mail	jose.gonzalez@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Esta materia enmárcase dentro do módulo Común á Rama Industrial, e nela perséguese dotar ao alumnado dunha formación básica, tanto teórica como práctica, sobre os conceptos fundamentais relativos á automatización de procesos industriais, así como á análise e deseño de sistemas de control. Desta forma nesta materia desenvólvense, por unha banda, os conceptos fundamentais asociados ao modelado de sistemas lóxicos de eventos discretos mediante Redes de Petri así como a súa implantación en autómatas programables (PLC), e por outra banda, os conceptos fundamentais asociados á teoría de sistemas dinámicos, abordando o seu modelado, representación e estudo analítico, así como temas relativos á análise e deseño de controladores integrados no clásico lazo realimentado de control.			

Competencias	
Code	
CG3	Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
CE12	Coñecementos sobre os fundamentos de automatismos e métodos de control.
CT2	Resolución de problemas.
CT3	Comunicación oral e escrita de coñecementos.
CT6	Aplicación da informática no ámbito de estudo.
CT9	Aplicar coñecementos.
CT16	Razoamento crítico.
CT17	Traballo en equipo.
CT20	Capacidade para comunicarse con persoas non expertas na materia.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Adquirir unha visión global e realista do alcance actual dos sistemas de automatización industrial	CG3	CE12	CT3 CT16
Coñecer cales son os elementos constitutivos dun sistema de automatización industrial, como funcionan, e como se dimensionan	CG3	CE12	CT2 CT3 CT9 CT16
Coñecemento aplicado sobre os autómatas programables, a súa programación e a súa aplicación á automatización de sistemas industriais	CG3	CE12	CT2 CT3 CT6 CT9 CT16 CT17 CT20
Coñecementos xerais sobre o control continuo de sistemas dinámicos, das principais ferramentas de simulación de sistemas continuos e dos principais dispositivos de control de procesos con maior interese a nivel industrial	CG3	CE12	CT2 CT3 CT6 CT9 CT16 CT17 CT20
Conceptos xerais das técnicas de axuste de reguladores industriais	CG3	CE12	CT2 CT3 CT9 CT16

Resultado de aprendizaxe ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.3.- Ser conscientes do contexto multidisciplinar da enxeñaría. [nivel de desenvolvemento (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CE12
Resultado de aprendizaxe ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.1.- 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 (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CT2 CT9

Contidos	
Topic	
Tema 1. Introdución á automatización industrial e elementos de automatización.	1.1. Introdución á automatización de tarefas e procesos industriais. 1.1.1. A automatización de procesos industriais. 1.1.2 O autómata programable industrial ou PLC. 1.1.3 Elementos do autómata programable. Entradas, saídas, e memoria. 1.1.4 Ciclo de funcionamento do autómata. Tempo de ciclo. 1.2 Características xerais dos autómatas programables. 1.2.1. Operadores lóxicos e aritméticos. 1.2.2 Operadores de asignación (con memoria e sen memoria). 1.2.3 Combinacións de variables binarias. 1.2.3 Temporizadores e contadores. 1.3 Linguaxes e técnicas de programación de autómatas programables. 1.3.1. Formas de representación dun programa (FBD, AWL, ST, Grafcet, LADDER). 1.3.2 Programación lineal e estruturada. 1.3.3 Introdución á lóxica de contactos (LADDER). 1.3.4 Introdución á programación modular estruturada en LADDER.
Tema 2. Ferramentas de modelado de sistemas secuenciais.	2.1 Introdución ao modelado de sistemas dinámicos de eventos discretos. 2.1.1. Modelado mediante grafos de estados e táboas. O problema dimensional. 2.1.2 Modelado mediante Redes de Petri. Descrición con procesos distribuídos 2.1.3 Principais elementos e propiedades das Redes de Petri. Regras de evolución. 2.1.4 Representación e lóxica asociada ás Redes de Petri. Distribución e selección. 2.2 Modelado de procesos distribuídos mediante Redes de Petri. 2.2.1. Representación de procesos e ciclos. Repeticións dun proceso simple. 2.2.2 Aplicación de temporizadores. Activacións controladas por tempo. 2.2.3 Aplicación de contadores. Contaxe de eventos e ciclos de procesos. 2.2.3 Arcos inhibidores e as súas aplicacións. 2.2.5. Secuencias simultáneas. Sincronización de procesos concorrentes. 2.2.6. Exclusión mutua entre procesos. Xestión de recursos compartidos. 2.2.7. Sistemas colaborativos. Coordinación de múltiples tarefas independentes. 2.3 Programación modular estruturada de Redes de Petri en LADDER. 2.3.1. Estrutura modular de programación. 2.3.2. Desenvolvemento do módulo de definición e inicialización de variables. 2.3.3. Desenvolvemento do módulo de avaliación de transicións. 2.3.4. Integración de temporizadores e contadores no módulo de transicións. 2.3.5. Desenvolvemento do módulo de activación de lugares. 2.3.6. Desenvolvemento do módulo de activación de saídas.

Tema 3. Representación, modelado e simulación de sistemas dinámicos continuos.	3.1 Introdución aos modelos de sistemas dinámicos. 3.1.1. Modelos lineais e modelos non lineais. 3.1.2 Modelos continuos e modelos discretos. 3.1.3 Modelado en variables de estado. 3.1.4 O concepto de estabilidade. 3.2 Sistemas dinámicos lineais. 3.2.1. Caracterización e propiedades fundamentais. 3.2.2 Variables de estado. 3.2.3 Funcións de transferencia. A transformada de Laplace e as súas propiedades. 3.2.4 Diagramas de bloques de funcións de transferencia. Operacións básicas. 3.2.5 A función de transferencia con realimentación. 3.3 Modelado de sistemas físicos. 3.3.1. Sistemas mecánicos. 3.3.2. Sistemas eléctricos. 3.3.3. Sistemas químicos, hidráulicos e pneumáticos. 3.3.4. Sistemas biolóxicos e sociolóxicos.
Tema 4. Análise de sistemas dinámicos continuos.	4.1 Introdución á análise de sistemas dinámicos continuos. 4.1.1. Réxime transitorio e estacionario. 4.1.2. Tipos de sinais (impulso, chanzo, rampla) e as súas transformadas de Laplace. 4.1.3. Polos e ceros da función de transferencia. Propiedades do plano de Laplace. 4.1.4. Propiedades frecuenciales de sistemas dinámicos lineais continuos. 4.2 Caracterización da resposta no dominio temporal. 4.2.1. Especificacions no dominio temporal. 4.2.2. Sistemas de primeira orde. Función de transferencia, resposta temporal e estabilidade. 4.2.3. Sistemas de segunda orde. Función de transferencia, resposta temporal e estabilidade. 4.2.4. Descrición e análise do erro en réxime permanente. 4.3 Caracterización da resposta no dominio frecuencial. 4.3.1. Especificacions no dominio da frecuencia. Diagramas de Bode. 4.3.2. Propiedades frecuenciais dos sistemas de primeira orde. 4.3.3. Propiedades frecuenciais dos sistemas de segunda orde.
Tema 5. Introdución aos sistemas de control. Deseño de controladores PID	5.1 Introdución aos sistemas de control. 5.1.1. O lazo de control 5.1.2. Actuadores e sensores. 5.1.3. Controladores dixitais. 5.1.4. Accións básicas de control: Proporcional (P), integral (I) e derivativo (D). 5.2 Regulador PID para sistemas de primeira orde. 5.2.1. Especificaciones temporais e frecuenciais. 5.2.2. Deseño mediante asignación de polos. 5.2.3. Análise de estabilidade. 5.2.4. Análise dos efectos da presenza dun cero. 5.3 Regulador PID para sistemas de segunda orde. 5.3.1. Especificaciones temporais e frecuenciais . 5.3.2. Deseño mediante asignación de polos. 5.3.3. Análise de estabilidade. 5.3.4. Análise dos efectos da presenza dun cero.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	28	42	70
Prácticas de laboratorio	14	14	28
Seminario	7	0	7
Foros de discusión	0	8	8
Traballo tutelado	14	7	21

Exame de preguntas de desenvolvemento	2	0	2
Exame de preguntas de desenvolvemento	2	0	2
Exame de preguntas de desenvolvemento	3	0	3
Exame de preguntas de desenvolvemento	1	0	1
Exame de preguntas de desenvolvemento	3	0	3
Exame de preguntas de desenvolvemento	3	0	3
Exame de preguntas de desenvolvemento	1	0	1
Exame de preguntas de desenvolvemento	1	0	1

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

Metodoloxía docente

	Description
Lección maxistral	Exposición por parte do profesor dos contidos sobre a materia obxecto de estudo, bases teóricas e directrices dun traballo, exercicio ou proxecto a desenvolver polo estudante. Para iso utilizaranse medios como lousas virtuais e software de programación visual con soporte para realizar animacións dos resultados prácticos expostos en clase.
Prácticas de laboratorio	Actividade na que se formulan problemas relacionados coa materia. O alumno debe desenvolver as solucións adecuadas ou correctas mediante a exercitación de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación da información dispoñible e a interpretación dos resultados. Durante os seminarios os alumnos realizarán a preparación das solucións que posteriormente serán simuladas nas clases prácticas de laboratorio.
Seminario	Actividade na que se formulan problemas relacionados coa materia. O alumno debe desenvolver as solucións adecuadas ou correctas mediante a exercitación de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación da información dispoñible e a interpretación dos resultados.
Foros de discusión	Neste apartado valórase a participación e a actitude do alumno durante as sesións de teoría, prácticas e tutorías de seminario. Eventualmente, valoraranse as distintas actividades expostas na plataforma de docencia virtual e a dedicación do alumno a resolver en horas non lectivas os problemas expostos na materia.
Traballo tutelado	Análise e estudo por parte do profesor e dos alumnos dos contidos sobre a materia obxecto de estudo como método formativo cuxo obxectivo é reforzar e asentar os coñecementos adquiridos prestando especial atención a aqueles contidos que se consideren mais problemáticos.

Atención personalizada

Methodologies	Description
Lección maxistral	Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos,tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.
Prácticas de laboratorio	Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos,tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.
Seminario	Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos,tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.
Traballo tutelado	Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos,tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.
Foros de discusión	Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos,tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.

Avaliación

	Description	Qualification	Evaluated Competencess

Foros de discusión	Participación (P) Neste apartado valórase a participación e a actitude do alumno durante as sesións de teoría, prácticas e tutorías de seminario. Eventualmente, valoraranse as distintas actividades expostas na plataforma de docencia virtual.	5	CG3	CE12	CT3 CT9 CT16 CT17 CT20
Exame de preguntas de desenvolvemento	Proba puntuable de teoría (PT1) - Proba escrita para avaliar os coñecementos adquiridos nos temas 1 e 2 - Semana 7 do cuadrimestre. - A proba terá 2 horas de duración. - A proba realízase de maneira individual. - Pode ter a forma de cuestionario tipo test, cuestionario de respostas curtas, resolución de problemas ou algunha combinación das anteriores.	15	CG3	CE12	CT2 CT3 CT9 CT16
Exame de preguntas de desenvolvemento	Proba puntuable de teoría (PT2) - Proba escrita para avaliar os coñecementos adquiridos nos temas 3, 4 e 5. - Semana 11 do cuadrimestre. - A proba terá 2 horas de duración. - A proba realízase de maneira individual. - Pode ter a forma de cuestionario tipo test, cuestionario de respostas curtas, resolución de problemas ou algunha combinación das anteriores	15	CG3	CE12	CT2 CT3 CT9 CT16
Exame de preguntas de desenvolvemento	Exame final de teoría (ET) - Proba escrita para avaliar os coñecementos adquiridos en todos os temas. - Semana 14 do cuadrimestre. - A proba terá 3 horas de duración. - A proba realízase de maneira individual. - Pode ter a forma de cuestionario tipo test, cuestionario de respostas curtas, resolución de problemas ou algunha combinación das anteriores	40	CG3	CE12	CT2 CT3 CT9 CT16
Exame de preguntas de desenvolvemento	Exame final de laboratorio (L) - Proba escrita para avaliar os coñecementos adquiridos en todos os temas. - Semana 14 do cuadrimestre. - A proba terá 1 hora de duración. - A proba realízase de maneira individual. - Realizarase coincidindo coa proba puntuable do exame final de teoría (ET). - Pode ter a forma de cuestionario tipo test, cuestionario de respostas curtas, resolución de problemas ou algunha combinación das anteriores	25	CG3	CE12	CT2 CT3 CT9 CT16

Other comments on the Evaluation

Nota final e requisitos mínimos para superar a materia mediante avaliación continua:

Para asegurar que o alumno adquiriu as destrezas mínimas en cada un dos aspectos da materia esixirase aos alumnos que alcancen unha nota mínima de 4 sobre 10 no exame final de teoría, de modo que a nota final en avaliación continua (NEC) calcúlase coas seguintes fórmulas:

$$MED\_CON = 0{,}15\ PT1 + 0{,}15\ PT2 + 0{,}40\ ET + 0{,}25\ L + 0{,}05\ P$$

$$NEC = MED\_CON \text{ si } ET \geq 4$$

$$NEC = \min(4, MED\_CON) \text{ si } ET < 4$$

É necesario que esta nota (*NEC) sexa igual ou superior a 5 puntos (sobre unha escala de 10) para superar a materia. O alumno que non supere a materia nesta convocatoria debe presentarse ao exame ordinario.

Nota final e requisitos mínimos para superar a materia no exame ordinario:

A nota final (NEO) calcúlase coa seguinte fórmula:

$$NEO = 0{,}75\ T + 0{,}25\ L$$

Onde:

- **T:** representa a parte teórica do exame ordinario da materia. Proba escrita individual para avaliar os coñecementos adquiridos nas sesións de teoría. Pode ter a forma de cuestionario tipo test, cuestionario de respostas curtas, resolución de problemas ou algunha combinación das anteriores.
- **L:** representa a parte práctica do exame ordinario da materia. Proba escrita individual para avaliar os coñecementos adquiridos nas sesións prácticas. Pode ter a forma de cuestionario tipo test, cuestionario de respostas curtas, resolución de problemas relacionados coas prácticas ou algunha combinación das anteriores.

É necesario que esta nota (NEO) sexa igual ou superior a 5 puntos (sobre unha escala de 10) para superar a materia. O alumno que non supere a materia nesta convocatoria ou en avaliación continua debe presentarse á convocatoria extraordinaria.

Nota final e requisitos mínimos para superar a asignatura no exame extraordinario:

A nota final (NEE) calcúlase coa seguinte fórmula:

NEE = 0,75 T + 0,25 L

Onde:

- **T:** representa a parte teórica do exame ordinario da materia. Proba escrita individual para avaliar os coñecementos adquiridos nas sesións de teoría. Pode ter a forma de cuestionario tipo test, cuestionario de respostas curtas, resolución de problemas ou algunha combinación das anteriores.
- **L:** representa a parte práctica do exame ordinario da materia. Proba escrita individual para avaliar os coñecementos adquiridos nas sesións prácticas. Pode ter a forma de cuestionario tipo test, cuestionario de respostas curtas, resolución de problemas relacionados coas prácticas ou algunha combinación das anteriores.

É necesario que esta nota (NEE) sexa igual ou superior a 5 puntos (sobre unha escala de 10) para superar a materia.

Criterios de avaliación en caso de fraude académica:

A fraude académica (a copia, o plaxio ou o seu facilitación a terceiros, así como o uso de dispositivos electrónicos non autorizados en calquera das probas das que consta a avaliación da materia) será penalizado da seguinte maneira:

- **Avaliación continua:** o alumno non poderá aprobar a materia mediante avaliación continua, e será cualificado con NEC=0.
- **Exame ordinario**: o alumno será cualificado con NEO=0 y NPC=0.
- **Exame extraordinario**: o alumno será cualificado con NEE=0.

Bibliografía. Fontes de información

Basic Bibliography

Mandado; Acevedo; Fernández; Armesto, **Autómatas programables y sistemas de automatizaciónn**, 1, Marcombo, 2009

Ogata, **Ingeniería de control moderna**, 5, Prentice - Hall, 2010

Complementary Bibliography

Valdivia, **Sistemas de control continuos y discretos**, 1, Ediciones Paraninfo, 2012

Dorf, **Sistemas de control modernos**, 10, Prentice - Hall, 2005

Cucharero, **Guiado y control de misiles**, 1, Ministerio de Defensa, 1995

Silva, **Las redes de Petri en la Automática y la Informática**, 1, Editorial AC, 1985

Recomendacións

Subjects that it is recommended to have taken before

Física: Física I/P52G381V01102
Física: Física II/P52G381V01106
Matemáticas: Cálculo I/P52G381V01103
Fundamentos de electrotecnia/P52G381V01205
Matemáticas: cálculo II e ecuacións diferenciais/P52G381V01201
Tecnoloxía electrónica/P52G381V01301

Other comments

Ademais, para cursar esta materia con éxito, o alumno debe ter:
- Capacidade de comprensión escrita e oral.
- Capacidade de abstracción, cálculo básico e síntese da información.
- Destrezas para o traballo en grupo e para a comunicación grupal.

Plan de Continxencias

Description

Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

No caso de que a situación durante o curso 2020/2021 volva necesitar dun cambio de paradigma formativo que implique a necesidade de modificar as condicións do ensino para ser orientada ao formato de ensino virtual a distancia, considérase oportuno realizar as seguintes consideracións respecto da materia de Fundamentos de Automática.

-Apartado 6.1 (Programación: créditos teóricos):
 Bloque I: Automatización industrial e modelado de sistemas secuenciais. O ensino adaptarase de forma inmediata e natural ao formato a distancia empregando aulas virtuais debido a que os contidos se impartirán en ambas as modalidades empregando ferramentas audiovisuais e interactivas idénticas.
 Bloque II: Análise e deseño de sistemas de control. O ensino adaptarase de forma inmediata e natural ao formato a distancia empregando aulas virtuais debido a que os contidos se impartirán en ambas as modalidades empregando ferramentas audiovisuais e interactivas idénticas.

- Apartado 6.2 (Programación: créditos prácticos):
 Bloque I: Automatización industrial e modelado de sistemas secuenciais.
Neste caso debe terse en conta que os alumnos non poderán acceder aos equipos onde estea instalado o software de simulación e programación de autómatas programables. Para permitir que os alumnos poidan realizar as súas prácticas de forma virtual adaptarase a formación da seguinte forma:
 Durante as horas de laboratorio realizarase unha clase maxistral onde o profesor mostrará como resolver parcialmente o práctica paso a paso (de forma que os alumnos poidan seguir o desenvolvemento nos seus equipos) empregando o software de edición e simulación de autómatas programables.
 Os alumnos deben ter instalado o mesmo software nos seus equipos (en caso de incompatibilidade de sistemas operativos disporase dunha máquina virtual co software instalado) e realizar o seguimento da práctica virtual executando os procedementos mostrados polo profesor.
 Os alumnos deben completar pola súa conta a parte da práctica non resolta durante a clase maxistral, tendo en conta que debe ser un traballo individual. Para iso farase fincapé en que o descoñecemento dos métodos de traballo desenvolvidos durante as prácticas de laboratorio será determinante para poder aprobar o exame destes contidos na materia.
.
 Bloque II: Análise e deseño de sistemas de control.
Neste caso debe terse en conta que os alumnos non poderán acceder aos equipos onde estea instalado o software de simulación nin aos laboratorios onde realizar a montaxe dos kits. Para permitir que os alumnos poidan realizar as súas prácticas de forma virtual adaptarase a formación da seguinte forma:
. As dúas últimas prácticas con contidos presencial no laboratorio debido á necesidade de empregar kits, substituiranse polas súas prácticas equivalentes simuladas, onde os alumnos terán que desenvolver o mesmo traballo de deseño de enxeñaría de control, pero sendo aplicados sobre sistemas dinámicos virtuais.
. Durante as horas de laboratorio realizarase unha clase maxistral onde o profesor mostrará como resolver parcialmente o práctica paso a paso (de forma que os alumnos poidan seguir o desenvolvemento nos seus equipos) empregando o software de simulación de sistemas dinámicos.
. Os alumnos deben ter instalado o mesmo software nos seus equipos (en caso de incompatibilidade de sistemas operativos disporase dunha máquina virtual co software instalado) e realizar o seguimento da práctica virtual executando os procedementos mostrados polo profesor.
. Os alumnos deben completar pola súa conta a parte da práctica non resolta durante a clase maxistral, tendo en conta que debe ser un traballo individual. Para iso farase fincapé en que o descoñecemento dos métodos de traballo desenvolvidos durante as prácticas de laboratorio será determinante para poder aprobar o exame destes contidos na materia.

- Apartado 8 (Metodoloxía docente): Engadirase unha nova metodoloxía docente:
Sesión maxistral e/ou sesión práctica virtual síncrona: Impártese a través dunha plataforma de videoconferencia web. Cada

aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

- Apartado 10 (Avaliación):
As probas de avaliación realizaríanse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Fundamentos de sistemas e tecnoloxías de fabricación				
Subject	Fundamentos de sistemas e tecnoloxías de fabricación			
Code	P52G381V01402			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4	1c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Álvarez Feijoo, Miguel Ángel			
Lecturers	Álvarez Feijoo, Miguel Ángel			
E-mail	alvarezfeijoo@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	A materia Fundamentos de Sistemas e Tecnoloxías de Fabricación céntrase no estudo e a aplicación de coñecementos científicos e técnicos relacionados cos procesos de fabricación de compoñentes e conxuntos cuxa finalidade funcional é mecánica, así como a avaliación da súa precisión dimensional e a dos produtos a obter, cunha calidade determinada. Todo iso incluíndo desde as fases de preparación até as de utilización dos instrumentos, as ferramentas, utillaxes, equipos, máquinas ferramenta e sistemas necesarios para a súa realización, de acordo ás normas e especificacións establecidas, e aplicando criterios de optimización.			

Competencias	
Code	
CG3	Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
CE15	Coñecementos básicos dos sistemas de produción e fabricación.
CT2	Resolución de problemas.
CT8	Toma de decisións.
CT9	Aplicar coñecementos.
CT10	Aprendizaxe e traballo autónomos.
CT17	Traballo en equipo.
CT20	Capacidade para comunicarse con persoas non expertas na materia.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Coñecer a base tecnolóxica e aspectos básicos dos procesos de fabricación	CG3	CE15	CT2 CT9 CT10 CT20
Comprender os aspectos básicos dos sistemas de fabricación	CG3	CE15	CT2 CT10
Desenvolver habilidades para a fabricación de conxuntos e elementos en contornas CAD/CAM	CG3	CE15	CT2 CT8 CT9 CT17 CT20
Resultados da aprendizaxe ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.2.- 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 (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CG3		
Resultados da aprendizaxe ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.1.- 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 (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Avanzado (3)].		CE15	

Resultados da aprendizaxe ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.2.- 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 (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CT2 CT9
Resultados da aprendizaxe ENAEE: APLICACIÓN PRÁCTICA DA ENXEÑARÍA: RA5.1.- Comprensión das técnicas aplicables e métodos de análises, proxecto e investigación e as súas limitacións no ámbito da súa especialidade [nivel de desenvolvemento (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Básico (1)].	CT2 CT9
Resultados da aprendizaxe ENAEE: APLICACIÓN PRÁCTICA DA ENXEÑARÍA: RA5.2.- Competencia práctica para resolver problemas complexos, realizar proxectos complexos de enxeñaría e levar a cabo investigacións propias da súa especialidade [nivel de desenvolvemento (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CT9 CT10
Resultados da aprendizaxe ENAEE: COMUNICACIÓN E TRABALLO EN EQUIPO: RA7.1.- Capacidade para comunicar eficazmente información, ideas, problemas e solucións no ámbito de enxeñaría e coa sociedade en xeral [nivel de desenvolvemento (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Básico (1)].	CT8 CT10 CT17
Resultados da aprendizaxe ENAEE: COMUNICACIÓN E TRABALLO EN EQUIPO: RA7.2.- 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 (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CT20

Contidos

Topic	
UNIDADE DIDÁCTICA 1. INTRODUCIÓN	Tema 1. Introdución ás tecnoloxías de fabricación.
UNIDADE DIDÁCTICA 2. METROLOXÍA E METROTECNIA.	Tema 2. Principios de Metroloxía Dimensional. Tema 3. Instrumentos e métodos de medida. Tema 4. Medición por coordenadas. Tema 5. Medición por imaxe.
UNIDADE DIDÁCTICA 3. PROCESOS DE CONFORMADO POR ARRANQUE DE MATERIAL	Tema 6. Introdución ao conformado por arranque de material. Tema 7. Fundamentos e teorías do corte. Tema 8. Torneado: operacións, máquinas e utillaxe. Tema 9. Fresado: operacións, máquinas e utillaxe. Tema 10. Mecanizado de buracos con movemento principal rectilíneo: operacións, máquinas e utillaxe. Tema 11. Conformado con abrasivos: operacións, máquinas e utillaxe. Tema 12. Procesos de mecanizado non convencionais.
UNIDADE DIDÁCTICA 4. AUTOMATIZACIÓN E XESTIÓN DOS PROCESOS DE FABRICACIÓN.	Tema 13. Control Numérico de máquinas-ferramenta..
UNIDADE DIDÁCTICA 5. PROCESOS DE CONFORMADO DE MATERIAIS EN ESTADO LÍQUIDO E GRANULAR.	Tema 14. Aspectos xerais do conformado por fundición de metais. Tema 15. Modelos, moldes e caixas de machos. Tema 16. Tecnoloxía da fusión, coada e acabado. Tema 17. Equipos e fornos empregados en *fundición. Tema 18. Conformación de materiais granulares: pulvimetalurxia.
UNIDADE DIDÁCTICA 6. PROCESOS DE CONFORMADO POR DEFORMACIÓN PLÁSTICA DE METAIS.	Tema 19. Aspectos xerais do conformado por deformación plástica. Tema 20. Procesos de laminación e forxa. Tema 21. Procesos de extrusión e estirado. Tema 22. Procesos de conformado da chapa.
UNIDADE DIDÁCTICA 7. PROCESOS DE CONFORMADO POR UNIÓN	Tema 23. Tecnoloxía do proceso de soldadura. Tema 24. Procesos de unión e montaxe sen soldadura.

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	28	56	84
Resolución de problemas	7	0	7
Seminario	15	0	15
Prácticas de laboratorio	14	14	28
Exame de preguntas obxectivas	4	0	4
Exame de preguntas de desenvolvemento	9	3	12

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

Metodoloxía docente	
	Description
Lección maxistral	Exposición por parte do profesor dos contidos sobre a materia obxecto de estudo, bases teóricas e/ou directrices dun traballo, exercicio ou proxecto a desenvolver polo estudante.
Resolución de problemas	Actividade na que se formulan problema e/ou exercicios relacionados coa materia. O alumno debe desenvolver as solucións adecuadas ou correctas mediante a exercitación de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación da información dispoñible e a interpretación dos resultados. Adóitase utilizar como complemento da lección maxistral.
Seminario	Curso intensivo de 15 horas para aqueles alumnos que suspenderon a materia en primeira convocatoria, previo ao exame en segunda convocatoria. Tutorías grupais co profesor.
Prácticas de laboratorio	Actividades de aplicación dos coñecementos a situacións concretas e de adquisición de habilidades básicas e procedimentales relacionadas coa materia obxecto de estudo. Desenvólvense en espazos especiais con equipamento especializado (laboratorios, aulas informáticas, etc.).

Atención personalizada	
Methodologies	**Description**
Lección maxistral	No ámbito da acción tutorial, distínguense accións de tutoría académica, así como de tutoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de tutorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia. Nas tutorías personalizadas, 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. Conxugando ambos os tipos de acción tutorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade. Os profesores da materia atenderán as dúbidas e consultas dos alumnos de forma síncrona en despachos físicos ou virtuais baixo a modalidade de concertación previa ou asíncrona por medios telemáticos (correo electrónico, foros de FAITIC, etc.).

Avaliación					
	Description	Qualification	Evaluated Competencess		
Lección maxistral	Probas escritas: cuestións teóricas e problemas. As probas escritas teñen como obxectivo a avaliación da aprendizaxe de todos os contidos teóricos seleccionados para a materia. - Probas intermedias (PI): 15% + 15% - Cuestionarios e test: 7.5% + 7.5%	45	CG3	CE15	CT2 CT8 CT9 CT17 CT20
Resolución de problemas	A avaliación en seminarios realizarase a través das probas escritas	0	CG3	CE15	CT2 CT8 CT9 CT10 CT20
Prácticas de laboratorio	A avaliación das prácticas realizarase valorando as memorias de prácticas (MP) que o alumno deberá entregar	15	CG3	CE15	CT2 CT8 CT9 CT10 CT17
Exame de preguntas de desenvolvemento	Exame final de avaliación continua (avalíanse todos os contidos da materia)	40	CG3	CE15	CT2 CT8 CT9 CT10 CT17

Other comments on the Evaluation

A avaliación final de alumno atenderá á suma da puntuación outorgada a cada unha das partes:- Proba final de avaliación continua (PF) 40%.

- Probas intermedias (PI) 30% (2x15%).

- Cuestionarios e test 15% (2x7.5%).- Prácticas de laboratorio (PL) 15%.

Sendo, por tanto a súa nota de avaliación continua (NEC):

NEC =0,40·PF + 0,15·PI1 + 0,15·PI2 + 0,15 Cuestionarios + 0,15·MP

No caso de que a NEC sexa menor que 5, o alumno deberá presentarse ao exame ordinario, ao non superar a materia por avaliación continua. Con todo, tamén se esixirán uns requisitos mínimos, nalgún dos apartados, que garantan o equilibrio entre todos os tipos de competencias. Devanditos requisitos son:- A non realización e entrega de todos os puntuables anteriores.

- Obter polo menos un 4 sobre 10 no exame final de avaliación continua.Aqueles alumnos que non cumpran algún dos

requisitos anteriores, deberán presentarse ao exame ordinario para poder superar a materia, e a súa nota de avaliación continua calcularase como: NEC FINAL = min(4,NEC). Tamén poderán acudir ao exame ordinario todos aqueles alumnos que desexen mellorar a súa cualificación obtida por avaliación continua.COMPROMISO ÉTICO: Espérase que os alumnos teñan un comportamento ético adecuado. Si detéctase un comportamento pouco ético (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros) penalizarase ao alumno coa imposibilidade de superar a materia pola modalidade de avaliación continua (na que obterá unha cualificación de 0.0). Si este tipo de comportamento detéctase en exame ordinario ou extraordinario, o alumno obterá en devandita convocatoria unha cualificación en acta de 0,0.

Bibliografía. Fontes de información

Basic Bibliography

Kalpakjian, Serope, **Manufactura, ingeniería y tecnología**, Pearson, 2002

Todd, R.H.; Allen, D.K.; Alting, L., **Fundamental principles of manufacturing processes**, Industrial Press Inc., 2011

Alting, L., **Procesos para ingenieria de manufactura**, Alfaomega, 1990

Faura, F., **Prácticas de tecnología mecánica**, Ed. Universidad de Murcia, 1994

Groover, M. P., **Fundamentos de manufactura moderna: materiales, procesos y sistemas**, Prentice Hall,

Dieguez, J.L.; Pereira, A.; Ares, J.E:, ´**Fundamentos de fabricación mecánica**,

De Garmo; Black; Kohser, **Materiales y procesos de fabricación**, Reverté, 1988

Lasheras, J.M., **Tecnología mecánica y metrotecnia**, Donostiarra, 2000

Complementary Bibliography

Recomendacións

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

=== ADAPTACIÓN DAS METODOLOXÍAS ===
* Metodoloxías docentes que se manteñen
- Sesión maxistral.
- Resolución de problemas e/ou exercicios.
- Prácticas de laboratorio.
- Traballo tutelado.

* Metodoloxías docentes que se engaden:
- Sesión maxistral e/ou sesión práctica virtual síncrona. Impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

* Mecanismo non presencial de atención ao alumnado (tutorías)
Os profesores da materia atenderán as dúbidas e consultas dos alumnos de forma síncrona en despachos físicos ou virtuais baixo a modalidade de concertación previa ou asíncrona por medios telemáticos (correo electrónico, foros de FAITIC, etc.).

* Modificacións (si proceden) dos contidos a impartir
Neste apartado proponse a substitución das prácticas descritas no apartado 6 polas seguintes:
- Práctica 1: Metrotecnia
Medición directa e indirecta. Estudo dos diversos instrumentos de medida dispoñibles no laboratorio, baseándose en esquemas e vídeos.
- Práctica 2: Fabricación con máquinas ferramentas convencionais.
Estudo de diversos tipos de torno, incluíndo máquinas de control numérico. Exemplos de procesos de mecanizado, baseándose en esquemas e vídeos.
- Práctica 7: Soldadura.

Coñecemento de diferentes equipos de soldadura eléctrica. Soldeo de diferentes materiais empregando diferentes técnicas, baseándose en esquemas e vídeos.

=== ADAPTACIÓN DA AVALIACIÓN ===
Nun escenario de docencia virtual, as probas de avaliación realizaranse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Thermal engineering I				
Subject	Thermal engineering I			
Code	P52G381V01403			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	Spanish			
Department				
Coordinator	Febrero Garrido, Lara			
Lecturers	Febrero Garrido, Lara González Gil, Arturo			
E-mail	lfebrero@cud.uvigo.es			
Web	http://faitic.uvigo.es/			
General description	This document shows the competences that the students must acquire with the subject Advanced Thermodynamics. It contains the program contents, an estimation of the students working load and the evaluation criteria. This subject, taken by fourth-year students of the mechanical engineering bachelor degree, explains the fundamentals of combustion, the mixture of air and water vapor and the main processes occurred in thermal systems.			

Competencies	
Code	
CG1	Skills for writing, signing and developing projects in the field of industrial engineering, whose purpose is, specializing in Mechanics, according to the knowledge acquired pursuant to paragraph 5 of this order, construction, alteration, repair, maintenance, demolition, manufacturing, installation, assembly or operation of: structures, mechanical equipments, energy facilities, electrical systems and electronic installations and industrial plants, and manufacturing processes and automation.
CE21	Knowledge applied to thermal engineering.
CT1	Analysis and synthesis
CT2	Problems resolution.
CT6	Application of computer science in the field of study.
CT8	Decision making.
CT10	Self learning and work.
CT14	Creativity.
CT16	Critical thinking.
CT17	Working as a team.

Learning outcomes			
Learning outcomes	Competences		
Understanding the processes in which humid air is involved and managing of the psychrometric chart.	CG1	CE21	CT1 CT2 CT10
Understanding the fundamentals of combustion.	CG1	CE21	CT1 CT2 CT6 CT10 CT16 CT17
Understanding the power production cycles.		CE21	CT1 CT2 CT6 CT10 CT14 CT16

Ability to assess any basic thermal process.	CG1	CE21	CT1 CT2 CT6 CT8 CT10 CT14 CT16 CT17
To acquire basic knowledge about thermal machines.	CG1	CE21	CT1 CT2 CT8 CT10 CT17
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)].		CE21	
ENAEE learning outcome: ENGINEERING ANALYSIS: LO2.1.- Awareness of the multidisciplinary context of the engineering [Intermediate (2)].	CG1		CT2 CT8
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)].			CT1 CT2 CT8 CT14 CT16
ENAEE learning outcome: ENGINEERING PROJECTS: LO3.1.- The ability to apply their knowledge to plan and carry out projects that meet previously specified requirements [Basic (1)].			CT2
ENAEE learning outcome: RESEARCHING AND INNOVATION: LO4.3.- Ability to design and conduct experiments, interpret data and draw conclusions [Basic (1)].		CE21	
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)].		CE21	
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 [Intermediate (2)].			CT6 CT8
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKIN: 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 [Basic (1)].	CG1		CT8 CT10 CT17

Contents	
Topic	
BLOCK 1 (B1): Gas-vapor mixtures.	B1-1. Dry air and atmospheric air. Specific and relative humidity of the air. B1-2 Dew point temperature. Psychrometric charts. B1-3 Air conditioning.
BLOCK 2 (B2): Combustion and fuels properties.	B2-1. Fuels. Description and characteristics. Boilers and burners. B2-2 The combustion process. Theoretical and actual combustion. B2-3 Enthalpy of formation, enthalpy of combustion and heating values. B2-4 First-law analysis of reacting systems. B2-5 Second-law analysis of reacting systems.
BLOCK 3 (B3) Power production cycles.	B3-1 Gas power cycles I: Otto, Diesel, Stirling and Ericsson ideal cycles. Air standard cycles. B3-2 Gas power cycles II: Brayton cycle. Actual cycles. Intercooling reheating and regeneration. Ideal jet-propulsion cycles. B3-3 Vapor and combined power cycles: Rankine cycle. Actual vapor cycles. Reheating and regeneration. Open and closed feedwater heaters. B3-4 Combined gas-vapor power cycles.

BLOCK 4 (B4) Refrigeration cycles.	B4-1 Vapor-compression refrigeration systems: Actual cycles. Refrigerant properties. B4-2 Heat pumps. B4-3 Innovative vapor-compression refrigeration systems: Cascade refrigeration systems. Multistage compression refrigeration systems. Multipurpose refrigeration systems with a single compressor. B4-4 Gas refrigeration cycles. B4-5 Absorption refrigeration systems.
Practices of laboratory	PL 1. Introduction to thermal comfort and indoor air quality. The aim of this practice is to determine the air humidity in different indoor stays of buildings and in the outside. Besides, the concept of thermal comfort and indoor air quality are introduced, features that are related with the health and the welfare of the users of buildings. Equipment of measurement employed: hygrometers, sensors of temperature, measurers of quality of indoor air, etc. PL 2. Visit to the boiler room of the students residence. The students will make a technical visit to the boiler room in Francisco Moreno residence, that consists of two boilers of natural gas and provides domestic hot water (DHW) and heating to the students residence. The aim of the visit is to identify the equipments involved in a heeating system and to make a simplified diagram of the installation. Besides, this practice includes the study of conditions of security and health in a boiler room: identification of risks, measures of emergency, risks prevention, control of the Legionella, etc. PL 3. Development and presentation of works on social, health and security features related to Thermal Engineering. In this practice the students have to present the work developed during the first weeks of course. The works are proposed by the lecturers at the beginning of the course and they will be made by groups of 4 or 5 students. The subjects will treat on social, health and industrial security of related to Thermal Engineering. For example: energy efficiency in buildings, energy efficiency in ships, storage and transport of liquid fuels, maritime transport of fuels, thermal solar energy in buildings, renewable energies, cogeneration and trigeneration, etc. PL 4. Analysis of thermodynamic cycles with computer software. This practice consists of learning to use a computer tools for the simulation of power and refrigeration cycles (CYCLEPAD). The practice is oriented to the resolution of problems of cycles (ideal and real) used in the more usual thermal machines. PL 5. Quantitative analysis of Stirling cycle. By means of an experimental Stirling engine, the studdents will analyse different variables that affect the operation of the engine, the developed cycle, and its performance. Also, they will study the operation of the engine in reverse cycle like thermal cooling machine. PL 6. Experimental study of a heat pump In this practice the students will study the operation of an experimental installation of a heat pump. They will make energy balances in each one of its components to determine the coefficient of operation (COP), working as heating machine and cooling machine. Likewise, they will study its behaviour working as water - water heatpump and air - water heatpump. PL 7. Introduction to the design of solar refrigeration installations. It is a theoretical and demo practice on installations of production of cold by means of thermal solar energy. It pretends that the students know an efficient alternative to the use of conventional equipmente, whose refrigerants are highly hurtful for the environment.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	42	70
Laboratory practical	14	0	14
Seminars	7	7	14
Problem solving	26	26	52

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

Methodologies	
	Description
Lecturing	In these sessions, the lecturer will explain in detail the basic theoretical contents of the course, exposing clarifying examples that help to better understand the concepts. Computer presentations and the blackboard will be used, especially to transmit information like definitions, charts, algorithms, schematics etc.
Laboratory practical	Supervised laboratory and computer practices. The didactic method to be followed in the teaching of the practical classes consists in that the lecturer supervises the work and progress done by the different groups. The practices of laboratory are headed to strengthen the theoretical concepts tackled in the sessions in the classroom.
Seminars	In the seminars, the lecturer analyses and proposes a series of problems that have to make individually or in group. The student will have to solve exercises and problems under the supervision and correction of the lecturer.
Problem solving	Intensive course of 15 hours for those students that have failed the subject in first announcement, previous to the examination in second announcement. Tutorships in groups with the professor. Realisation of examinations. Tasks of evaluation and hours of reinforcement.

Personalized assistance	
Methodologies	**Description**
Lecturing	Attention to student will be personalized both in the office hours and through email. Tutorial actions can be classified into academic or personalized tutoring. In the first case, students will have available office hours in which they can ask any questions regarding the contents, organization and planning of the course. Tutoring can also be individualized, but solving problems related to the activities carried out in groups will be encouraged. In personalized tutoring, each student, individually, can discuss with the lecturer any problem that is blocking an adequate progress in the course, in order to find some kind of solution. Combining both types of action tutorial students are intended to compensate for the different rates of learning through attention to diversity. The lecturers will answer the questions and queries of the student in person or by telematic means (email, videoconference, forums of FAITIC, etc.) in the schedule published in the web or under the modality of previous appointment.
Problem solving	Attention to student will be personalized both in the office hours and through email. Tutorial actions can be classified into academic or personalized tutoring. In the first case, students will have available office hours in which they can ask any questions regarding the contents, organization and planning of the course. Tutoring can also be individualized, but solving problems related to the activities carried out in groups will be encouraged. In personalized tutoring, each student, individually, can discuss with the lecturer any problem that is blocking an adequate progress in the course, in order to find some kind of solution. Combining both types of action tutorial students are intended to compensate for the different rates of learning through attention to diversity. The lecturers will answer the questions and queries of the student in person or by telematic means (email, videoconference, forums of FAITIC, etc.) in the schedule published in the web or under the modality of previous appointment.
Laboratory practical	Attention to student will be personalized both in the office hours and through email. Tutorial actions can be classified into academic or personalized tutoring. In the first case, students will have available office hours in which they can ask any questions regarding the contents, organization and planning of the course. Tutoring can also be individualized, but solving problems related to the activities carried out in groups will be encouraged. In personalized tutoring, each student, individually, can discuss with the lecturer any problem that is blocking an adequate progress in the course, in order to find some kind of solution. Combining both types of action tutorial students are intended to compensate for the different rates of learning through attention to diversity. The lecturers will answer the questions and queries of the student in person or by telematic means (email, videoconference, forums of FAITIC, etc.) in the schedule published in the web or under the modality of previous appointment.

Seminars	Attention to student will be personalized both in the office hours and through email. Tutorial actions can be classified into academic or personalized tutoring. In the first case, students will have available office hours in which they can ask any questions regarding the contents, organization and planning of the course. Tutoring can also be individualized, but solving problems related to the activities carried out in groups will be encouraged. In personalized tutoring, each student, individually, can discuss with the lecturer any problem that is blocking an adequate progress in the course, in order to find some kind of solution. Combining both types of action tutorial students are intended to compensate for the different rates of learning through attention to diversity. The lecturers will answer the questions and queries of the student in person or by telematic means (email, videoconference, forums of FAITIC, etc.) in the schedule published in the web or under the modality of previous appointment.

Assessment

	Description	Qualification	Evaluated Competencess		
Lecturing	A final test of continuous evaluation will be done during the evaluation week and will be graded over 10 points. A minimum grade of 4 points in this exam will be necessary to pass the subject in the continuous evaluation. This proof will have a weight of 40% of the grade of continuous evaluation. Two partial proofs of continuous evaluation will be done, which will suppose 30% of the grade of continuous evaluation (15% each one of them).	70	CG1	CE21	CT1 CT2 CT8 CT10 CT14 CT16
Laboratory practical	Lab practices will be performed in small groups. Each group will have to deliver a memory of practices at the end of each practice, or group of practices. The memories of practices will have a weight of 10% of the grade of continuous evaluation.	10	CG1	CE21	CT1 CT2 CT6 CT8 CT10 CT14 CT16 CT17
Seminars	A group work will be done about social, health and industrial security features related to Thermal Engineering, that will be presented by the students in the practice 3 of the subject. The group work will have a weight of 10% of the grade of continuous evaluation.	10	CG1	CE21	CT1 CT2 CT8 CT10 CT14 CT16 CT17
Problem solving	Seminars will be graded through individual or group tests or resolution of exercises performed in some of the seminar sessions when the lecturer request. These will mean 10% of the final grade.	10	CG1	CE21	CT1 CT2 CT8 CT14 CT16 CT17

Other comments on the Evaluation

The evaluation will be considered positive when a score of 5 is reached for the continuous evaluation. The students must attend the ordinary exam, which addresses the whole subject contents, if the total grade of continuous evaluation is lower than 5. They also will have to attend the ordinary exam if any of the following cases happens: - Any of the tests or exams is missed. - A grade lower than 4 points in the final theory exam is obtained. For these cases, the continuous evaluation grade will be the minimum of 4 points and total continuous evaluation grade. In any case, the student who has passed the continuous evaluation, will be allowed to attend to the ordinary exam to increase the grade. Detection of cheating in any kind of evaluation activity (midterms, final terms, laboratory work, test in seminars, etc.) will be penalized with a zero in the evaluated item and, in those evaluations with a mandatory minimum grade to pass the course, the student will not be evaluated by continuous evaluation. This sanction will affect both students cheating during the evaluation tests, and those that facilitate cheating. Cheating in ordinary or extraordinary evaluation will be penalized with a zero so the students must attend the next evaluation. Detection of copies will imply the immediate expulsion of the classroom in the day in which it has been detected. Also, there will be equally penalized those students using unauthorized material during the evaluation exams (unauthorized calculators or other electronic devices, documents, notes, etc.).

Sources of information

Basic Bibliography

Çengel Y.A., Boles M.A., **Termodinámica**, 7ª edición, Mc Graw-Hill, 2012

Morán, M.J. Shapiro, H.N., **Fundamentos de Termodinámica Técnica**, 2ª edición (4ª en español), Reverte, 2018

Complementary Bibliography

Incropera, F.P., De Witt, D.P., **Fundamentos de Transferencia de Calor**, 4ª edición, Pearson, 2000
Wark, K., Richards, D.E., **Termodinámica**, 6ª edición, Mc Graw-Hill, 2001
Haywood, R.W., **Ciclos termodinámicos de potencia y refrigeración**, Limusa, 2000
Segura, J., **Termodinámica Técnica**, Reverte, 1988
Baehr, H.D., **Tratado moderno de termodinámica**, Tecnilibro, 1987
Kreith, F., Bohn, M.S., **Principios de Transferencia de Calor**, 6ª edición, Thomson, 2002
Holman, J.P., **Transferencia de Calor**, 8ª edición, Mc Graw-Hill, 1998
Agüera Soriano, J., **Termodinámica Lógica y Motores Térmicos**, Ciencia 3,
Alarcón Aguín, J.M., **SISCECT, Simulación y Cálculo de Sistemas Termodinámicos**, Bellisco, 1999
Chapman, A.J., **Transmisión de Calor**, 3ª edición, Bellisco, 1990
Lienhard IV, J.H., **A Heat Transfer Textbook**, Phlogiston Press, 2005
Segura, J., Rodríguez, J., **Problemas de Termodinámica Técnica**, Reverte, 1990
Lacalle, Nieto, **Problemas de Termodinámica**, Serv Pub. ETSII Madrid,
Aguirrezabalaga, V., **Transferencia de Calor: Problemas**, Serv Pub. Oviedo, 2006
Vázquez, M, **Problemas Resueltos de Termodinámica Técnica**, Serv Pub. Universidad de Vigo,

Recommendations

Subjects that continue the syllabus

Naval engines and machines/P52G381V01409

Subjects that it is recommended to have taken before

Physics: Physics II/P52G381V01106
Chemistry: Chemistry/P52G381V01108
Thermodynamics and heat transfer/P52G381V01203

Other comments

It is strongly recommended to review the "Thermodynamics and heat transfer" course, especially those topics related to energy balances, thermal properties of materials and ideal gases behavior. It is also recommended to review the chemical reactions fundamentals.

Contingency plan

Description

=== EXCEPTIONAL MEASURES SCHEDULED ===

In front of the uncertain and unpredictable evolution of the sanitary alert caused by the COVID-19, the University of Vigo establishes an extraordinary planning that will activate in the moment in that the administrations and the own institution determine it attending to criteria of security, health and responsibility, and guaranteeing the teaching in a no face-to-face stage or partially face-to-face. These already scheduled measures guarantee, in the moment that was prescriptive, the development of the teaching of a more agile and effective way when being known in advance (or with a wide anticipation) by the students and the lecturers through the tool normalised and institutionalised of the educational guides.

=== ADAPTATION OF THE METHODOLOGIES ===

TEACHING METHODOLOGY

A new teaching methodology is added:

Synchronous online meeting (theory or practical session): it is taught through a platform of videoconference web. Each virtual classroom contains diverse signposts of visualisation and components, whose design can be customised so that it adapts better to the needs of the class. In the virtual classroom, the lecturers (and those participants authorised) can share the screen or archives of their computers, employ a blackboard, chat, transmit audio and video or participate in interactive activities on line (surveys, questions, etc.)

=== ADAPTATION OF THE CONTENTS ===

CONTENTS

The practical laboratories PL1, PL2, PL5 and PL6 take place in laboratories and different equipment, machines and tools are used. As far as possible, these practical sessions will be substituted by demo tasks and exercises, employing virtual visits, videos and other audiovisual means that allow to the student obtain the necessary competitions. In the case that it is not possible to substitute any of these practices, the students will perform a similar practice to PL4, working with other types of

thermal cycles using a computer software.

=== ADAPTATION OF THE EVALUATION ===

EVALUATION

The assessment tests will be made combining the online teaching platform FAITIC-Moodle and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Theory of structures and industrial constructions				
Subject	Theory of structures and industrial constructions			
Code	P52G381V01404			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	Spanish			
Department				
Coordinator	González Gil, Arturo			
Lecturers	González Gil, Arturo Suárez García, Andrés			
E-mail	arturogg@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The main objective of the subject of Theory of Structures and Industrial Constructions is to provide the student with the basic knowledge for the analysis and design of structural elements and systems more frequent in industrial constructions. To do this, the structural typologies and the most common elements in the industrial buildings will be identified. In addition, different tools will be studied for their analysis and design. The students will be also introduced in the management of the current regulations, and in particular the standars for structures made of steel and reinforced concrete, respectively. It is, therefore, a subject that will provide fundamental knowledge for the professional exercise of the graduate in mechanical engineering. In fact, knowledge and ability to calculate and design structures and industrial constructions is one of the competencies that, according to Ministerial Order CIN / 351/2009, of February 9, must be acquired in the official degrees which, as in this case, qualify for the exercise of the Industrial Technical Engineer profession.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
CG5	Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
CG6	Capacity for handling specifications, regulations and mandatory standards.
CG11	Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Industrial Technical Engineer.
CE23	Knowledge and ability to calculate and design of structures and industrial buildings.
CT2	Problems resolution.
CT5	Information Management.
CT8	Decision making.
CT9	Apply knowledge.
CT10	Self learning and work.
CT17	Working as a team.

Learning outcomes	Competences		
Knowing the requirements that the structures must meet to fulfill their functions, taking into account the external loads, the security criteria and the bases of calculation	CG3 CG4 CG5 CG6 CG11	CE23	CT2 CT5 CT8 CT9 CT10 CT17
Acquire capacity to convert a real structure into a model for analysis, and vice versa	CG3 CG4 CG5 CG6 CG11	CE23	CT2 CT5 CT8 CT9 CT10 CT17

Identifying the most important typologies and elements used in industrial structures and constructions	CG3 CG4 CG5 CG6 CG11	CE23	CT2 CT5 CT8 CT9 CT10 CT17
Ability to determine stress laws, stresses and deformations in the elements of structures	CG3 CG4 CG5 CG6 CG11	CE23	CT2 CT5 CT8 CT9 CT10 CT17
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)].	CG3	CE23	
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)].	CG4	CE23	CT2 CT8 CT9
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)].	CG4 CG5	CE23	CT2 CT9
ENAEE learning outcome: ENGINEERING DESIGN: LO3.2.- ability to design using some awareness of the forefront of their engineering specialisation [Basic (1)].	CG4 CG5	CE23	CT9
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 [Basic (1)].	CG6 CG11		CT5
ENAEE learning outcome: INVESTIGATIONS: LO4.2.- ability to consult and apply codes of practice and safety regulations in their field of study [Advanced (3)].	CG6 CG11		
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)].		CE23	CT9
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)].	CG4 CG5		CT2 CT9
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)].			CT8 CT9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.4.- ability to apply norms of engineering practice in their field of study [Intermediate (2)].	CG6 CG11		CT9

Contents

Topic	
Unit 1. Introduction to the analysis and design of structures	Objectives and development: This theme will serve like an introduction to the structural analysis. It will present the fundamental considerations for the idealisation and the analysis of a structure, will identify the main types of structures and their elements and, finally, will describe the different types of loads in a structure. Index: 1.1 Analysis and structural design 1.2 Classification of structures 1.3 Types of loads on structures 1.4 Idealisation of structures 1.5 Basic principles of the structural analysis

Unit 2. Industrial Constructions: Typology and Constructive Elements	Objectives and development: This theme will introduce the concept of industrial urbanism and identify the different types of structures used in industrial buildings, as well as their basic constructive elements. Also, the student will be introduced to the systems and construction processes used in industrial buildings. Index: 2.1 General information on architecture and industrial urbanism 2.2 Types of structures in industrial buildings 2.3 Building elements: Foundations 2.4 Building elements: Beams, pillars and slabs 2.5 Building elements: Enclosures and covers
Unit 3. Normative frame in the calculation and design of structures and industrial constructions	Objectives and development: The codes currentluy in force for the design of industrial constructions and the calculation of their structures will be presented. The criteria of structural security that govern the calculation of structures in Spain and in the European Union will be studied. This includes the determination of the loads on a structure. Besides, an apporach to different criteria that must be taken into account in the design and the construction of industrial buildings: evaluation and prevention of risks in the construction phase, security of utilisation and accessibility, energy saving and use of renewable energies, healthy indoor environment, noise protection, etc. Index: 3.1 Regulatory framework for industrial constructions 3.2 Loads 3.3 Structural security according to the CTE: verification of Limit States 3.4 Load combination 3.5 Social, environmental, security and health aspects in industrial buildings
Unit 4. Introduction to the design of metal structures	Objectives and development: The fundamentals of the design and calculation of metal structures will be explained. The main characteristics of steel structures used in industrial buildings will be presented. An introduction will be made to the sizing and verification of the main elements of steel structures. Index: 4.1 Introduction to metal structures 4.2 Steel: classes and main characteristics 4.3 Standard steel sections 4.4 Introduction to the calculation of steel elements subjected to tensile, compression and bending forces 4.5 Introduction to design of joining elements in steel structures
Unit 5. Introduction to the design of concrete structures	Objectives and development: The main characteristics and behavior of the concrete structures used in industrial buildings will be described. The properties and applications of concrete as a construction material (bulk, reinforced and prestressed concrete) will be studied. Concrete selection and identification criteria will be introduced. Index: 5.1 Introduction to concrete structures 5.2 Concrete: types, components and main properties 5.3 Selection and identification of concrete as a building material
Unit 6. Analysis of reticular structures with articulated knots	Objectives and development: The main features of bar structures with articulated knots will be defined and their main types will be identified. Different analytical methods will be studied to determine stresses and deformations in both isostatic and hyperstatic structures. The results obtained with this type of analysis will be related to the fundamentals of metal structures design, seen in unit 4. Index: 6.1 Characteristics of structures with articulated knots 6.2 Analysis of isostatic structures 6.3 Analysis of hyperstatic structures 6.4 Lines of influence

Unit 7. Analysis of reticular structures with rigid knots	Objectives and development: The behavior of bar structures with rigid knots will be analysed. The fundamentals of the method of Cross of distribution of moments will be presented as tool of analysis of this type of structures. This method will be applied to determine the internal forces in hyperstatic beams and frames. The results obtained with this type of analysis will be related to the fundamentals of design of metal and concrete structures, seen in unit 4 and 5, respectively. Index: 7.1 Characteristics of structures with rigid knots 7.2 Fundamentals of the Cross method 7.3 Analysis of hyperestatic beams using the Cross method 7.4 Analysis of frames using the Cross method
Unit 8. Introduction to matrix methods of structural analysis	Objectives and development: An introduction will be made to the matrix methods of structural analysis, commonly used in the computational analysis of structures. The fundamentals of the stiffness method will be introduced for the analysis of elementary reticular structures. Index: 8.1 Introduction to matrix methods 8.2 Fundamentals of the stiffness method 8.3 Application of the stiffness method to the analysis of elementary bar structures
Unit 9. Cables and Arches	Objectives and development: The fundamentals of the structural analysis of cables and arches will be studied. Both the cables supporting to puntual and distributed vertical loads will be analysed. Three-Hinged arches will be studied as a basic case of the analysis of arches. Index: 9.1 General characteristics of cables 9.2 Analysis of cables supporting vertical concentrated loads 9.3 Analysis of cables supporting vertical distributed loads 9.4 General characteristics of arches 9.5 Analysis of three-hinged arches
Unit 10. Singular structures on the Navy environmente	Objectives and development: Some of the most relevant aspects of the constructions in the units of the Navy will be discussed. Students of Navy Branch will receive applied training on the design of structures in warships, while Marine Corps students will study the design of fortifications. Index: 10.1 Design of structures in warships 10.2 Designing fortifications
Practice 1. Identification and idealization of structures	Objectives and development: The student is expected to put into practice and consolidate the knowledge acquired in unit 1 while reviewing concepts of statics of structures previously acquired in subjects such as Physics and Elasticity and Strength of Materials. For this, different examples of real structures will be proposed to be idealised, determining their design loads and analysing their stability. n addition, this practice will be complemented by a visit to different buildings of the ENM in which students will be able to identify some of the types and structural elements studied.
Practice 2. Determining design loads on industrial buildings	Objectives and development: This practice aims to introduce the student to the management of the current regulations applicable to the design of structures. For this, an exercise is proposed in which the students must determine the loads actuating on different structural elements of an industrial warehouse. This practice is related to the first three units of the subject.
Practice 3. Sizing structural steel elements	Objectives and development: With this practice, the students are expected to complement and expand their knowledge on calculation and combination of loads, applying them to the dimensioning of different elements of steel structures. For this, the student will solve several practical cases raised by the lecturer. This practice is related to units 2, 3 and 4.

Practice 4. Analysis of reticular structures with articulated and rigid knots	Objectives and development: This practice aims to reinforce the knowledge related to units 1, 2, 6 and 7 of the subject. For this, different demonstrative assemblies of models of articulated knots and rigid knots bar structures will be made, on which the students must carry out different measurements of deformations. In addition, exercises will be solved that will reinforce the understanding of the behavior of this type of structures.
Practice 5. Matrix methods of structural analysis	Objectives and development: This practice is intended to introduce the student to the use of matrix methods for the analysis of structures. A series of exercises will be solved through the programing of the stiffness method in a Matlab-type software. This is a practice related to unit 8.
Practice 6. Introduction to the use of professional structural calculation software	Objectives and development: In this practical session, the student will be introduced to the management of professional structural calculation programs with a dual objective: i) to promote the consolidation of basic knowledge on design and calculation of structures acquired throughout the course; ii) show the possibilities offered by a professional structure calculation software. There will be a brief presentation of the software available at the center (Autodesk Robot Structural Analysis) and the sizing of different structural elements and simple structures will be carried out
Practice 7. Social, environmental, safety and health aspects in the design and construction of industrial buildings	Objectives and development: Students, working in groups of three to five people, must present and defend a work on different social, environmental, safety and health aspects that according to the Technical Building Code and other reference regulations must be taken into account in the design and the construction of industrial buildings. These works will be raised by the lecturers of the subject during the teaching of unic 3. The result of this practice will be evaluated within the Group Work item (TG), according to what is established in the Assesment item of this teaching guide.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	42	70
Laboratory practical	14	7	21
Seminars	7	0	7
Problem solving	28	16	44
Mentored work	0	8	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 methodology of these classes will approximate to a masterful participatory session. The fundamentals of each topic will be explained and explanatory examples will be presented. Also, the student will be guided to study the contents of the subject in an autonomous way. As an expository method, the presentation projector and the blackboard will be used. As far as possible, copies of the presentation slides will be provided to the students prior to the class, focusing the efforts of the lecturer and students on the exposition and understanding of the knowledge. Additionally, collaborative learning will be encouraged in the classroom through group activities. The aim is to motivate the student in the research activity, and encourage personal skills while sharing problems and solutions. With a dedication that will vary throughout the course and depending on the specific needs of the subject, part of the classroom classes will be dedicated to solving problems by teams (problem-based learning).
Laboratory practical	The practical teaching will aim to apply, expand and consolidate the concepts studied in the theoretical classes. With the idea of promoting both the creativity and technical skills of the student, a series of sessions are presented, which include, on the one hand, the performance of laboratory practices, and on the other, the study of cases and the resolution of problems and/or exercises. These sessions will deal with the experimental analysis of deformations in structures, the resolution of exercises of structural analysis by classical methods and with computer software, the handling of specifications, regulations and obligatory standards in the design of industrial buildings. These classes will begin with a presentation of the practice by the lecturer, and if necessary, with an explanation of new theoretical concepts that are necessary for its realisation. Subsequently, the students will carry out the practice in question working in small groups, and under the supervision of the lecturer. At the end of each practice, each group of students must submit a summary report with the results obtained.

Seminars	Classes designed to solve problems and/or exercises and to study cases, which students must carry out individually or in group. The fact that the number of students in these classes is reduced (around 10), allows a greater proximity between lecturer and student, which facilitates the understanding and the comprehension of the fundamental concepts of the subject
Problem solving	Intensive course (15 hours) for those students who have failed the subject at first call, prior to the exam in second call. Group tutoring with the lecturer. Doing examans. Assessment tasks and reinforcement hours.
Mentored work	Students, working in groups of three to five people, must present and defend a work on different social, environmental, safety and health aspects that according to the Technical Building Code and other reference regulations must be taken into account in the design and the construction of industrial buildings. These works will be proposed by the teaching staff of the subject during the teaching of unit 3 and will be presented in the hours allocated to the 7th laboratory practice.

Personalized assistance

Methodologies	Description
Problem solving	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 teledoaching platforms, etc.).

Assessment

	Description	Qualification	Evaluated Competencess		
Lecturing	Written tests: theoretical questions and problems The written tests aim to evaluate the learning of all the theoretical contents of the subject. There will be two partial tests and one final exam. Each partial test will contribute 20% of the final grade of the student. The final exam, which will cover all the subject matter, will have a weight of 40% in the final grade. The written tests will consist of a series of questions and exercises that give priority to the conceptual and logical reasoning, in order to verify the intellectual maturity of the students to obtain conclusions from the notions or theories exposed in class. All tests will be evaluated for a total of 10 points.	70	CG3 CG4 CG5 CG6 CG11	CE23	CT2 CT5 CT8 CT9 CT10
Laboratory practical	The students must present a report of practices for each laboratory practice performed (in case the practice is done in group, only one practice will be delivered per group). Each report will be evaluated on 10 points. The final grade of practices will be the average value of the grades obtained in each practice delivered.	10	CG3 CG4 CG5 CG6 CG11	CE23	CT2 CT5 CT8 CT9 CT10 CT17
Seminars	Throughout the course (in particular during the seminar hours), different exercises will be proposed to students, who may do them in groups or individually. Each of these exercises will be evaluated over 10 points. The grade of this item will be the average value of the grades obtained in each deliverable.	10	CG3 CG4 CG5 CG6 CG11	CE23	CT2 CT5 CT8 CT9 CT10 CT17
Mentored work	Group work that must be accompanied with a memory and an oral presentation. The work will be valued on a maximum of 10 points.	10	CG3 CG4 CG5 CG6 CG11	CE23	CT2 CT5 CT8 CT9 CT10 CT17

Other comments on the Evaluation

A numerical rating 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 evaluation

The continuous evaluation method (EC) will assess the results achieved by the students in the different activities carried out throughout the course, which will be grouped as follows: Final Test (PF), Theoretical-Practical Controls (CT), Memories of Practices (MP), Evaluables Exercises (EE), and Final Work (TF). 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 tests of evaluation of theoretical-practical knowledge (CT) throughout the course. The student must present a report for each laboratory practice provided that it is indicated in the realization of the same, which will be evaluated in item MP. In the seminar and / or theory 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 is unable to attend a session in which exercises that can be evaluated due to force majeure are carried out, the student must notify the teachers by email so that they have a record and this circumstance is taken into account at the time of the evaluation. In addition, the students must carry out and present a group work on the social, environmental, safety and health aspects in the design and construction of industrial buildings (see practice 7), which will be evaluated 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 average to all the evaluated parts; that is, it will be calculated as follows:

NEC= 0.4 PF+0.15 CT1+0.15 CT2+0.1 MP++0.1 EE+0.1 TG

The student will pass the subject by continuous evaluation when each and every one of the following requirements is met:

1. Have completed all evaluable tasks (except duly justified cases)
2. Have a score of at least 4 points out of 10 in the continuous assessment final exam (PF)
3. Have a NEC value greater than or equal to 5 points (out of 10)

In case of not fulfilling any of the first two requirements, the final grade of continuous evaluation will be equal to the minimum value between NEC and 4 points.

Ordinary call: ordinary exam

Those students who fail 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 suppose 100% of the student's final grade, being an essential requirement to pass the course to obtain a grade of at least 5 points out of 10.

Students who have passed the subject by continuous evaluation will have the possibility of taking the ordinary exam to improve their grade.

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 Royal Decree 1791/2010 of December 30, 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 (copying, 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.

Sources of information
Basic Bibliography
Hibbeler, R.C, **Análisis estructural**, 8ª ed., Pearson Educación, 2012
McCormac, J.C, **Análisis de estructuras. Métodos clásico y matricial**, 4ª ed., Ed. Marcombo, 2011

Argüelles Álvarez, R. y otros, **Estructuras de acero. Tomo 1: fundamentos y cálculo según CTE, EAE y EC3**, 3ª ed., Ed. Bellisco, 2013
Martín, A., Suarez, F., Del Coz, J.J, **Tipología Estructural en Arquitectura Industrial**, 1ª ed., Ed. Bellisco, 2005
Ministerio de Fomento, **Instrucción de acero estructural (EAE)**, http://www.fomento.gob.es/MFOM/LANG_CASTELLANO/ORG, 2011
Ministerio de Fomento, **Instrucción de Hormigón Estructural EHE-08**, http://www.fomento.gob.es/MFOM/LANG_CASTELLANO/ORG, 2008
Ministerio de Vivienda, **Código Técnico de la edificación**, www.codigotecnico.org, 2006

Complementary Bibliography

Argüelles Álvarez, R, **Cálculo de estructuras. Vol 1 y 2**, 1ª ed., Ed. Bellisco, 1981
Beer, F.P, Johnston, E.R, Mazurek, D.F., **Mecánica vectorial para ingenieros: Estática**, 10ª ed., McGraw Hill, 2013
Leet, K.M, Uang, C.M, Gilbert, A.M, **Fundamentals of structural analysis**, 4ª ed., McGraw Hill, 2011
Serrano López, M.A., Castrillo Cabello, M.A., López Aenlle, M., **Estructuras. Formulario-Prontuario: volúmenes 1 y 2**, 2ª ed., Ed. Bellisco, 2009
Vázquez Fernández, M, López Pérez, E, **El método de los elementos finitos aplicado al análisis estructural**, 1ª ed., Ed. Noela, 2001
Comisión Permanente del Hormigón, Secretaría General Técnica, **Guía de aplicación de la Instrucción de Hormigón Estructural (EHE-08) EDIFICACIÓN**, 1ª ed., Centro de publicaciones del Ministerio de Fomento, 2014
Fiol Femenía, F, **Acciones en la Edificación: Exposición y Ejemplos según SE y SE-AE del CTE**, 1ª ed., Autor Editor, 2008
Fiol Femenía, F, Fiol Oliván, F, **Manual de Cimentaciones**, 1ª ed., Editorial Monte Carmelo, 2009
Jiménez Montoya, P, García Meseguer, A, Morán Cabré, F, Arroyo Portero, J.C, **Hormigón Armado**, 15ª ed., Gustavo Gili, 2010
Montalvá Subirats, J.M, Hospitaler Pérez, A, Saura Arnau, H, **Proyecto Estructural de Edificio Industrial: diseño y cálculo de estructura metálica**, 2ª ed., Universidad Politécnica de Valencia, Servicio de P, 2014
Montalvá Subirats, J.M, Saura Arnau, H., **Construcción y arquitectura industrial: Colección de problemas resueltos**, 2ª ed., Universidad Politécnica de Valencia, Servicio de P, 2014
Rolando Ayuso, A, **Cerramientos ligeros y pesados en los edificios**, 1ª ed., Ed. Bellisco, 1999
Urbán Brotóns, P., **Construcción de estructuras metálicas**, 5ª ed., Ed. Club Universitario, 2015

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/P52G381V01102
Materials science and technology/P52G381V01202
Resistance of materials/P52G381V01204
Elasticity and additional topics in resistance of materials/P52G381V01303

Other comments

For a correct follow-up of this subject, the students must have solid knowledge of vector calculus and master the concept of static equilibrium. In addition, they must have the ability to analyse tensions and deformations in elementary structures. They should also be familiar with the mechanical properties of structural materials such as steel. It is therefore highly recommended that the students have completed and passed the following subjects of the curriculum: Physics I, Materials Science and Technology, Resistance of materials and Elasticity and Advanced strength of materials.
The knowledge acquired in the structural analysis part of this subject can be useful to the student in the follow-up of subjects such as Machine design (second term of the fourth year) or Theory of the ship and shipbuilding (first term of the fifth year). Also, the knowledge acquired in the construction part will be complemented by the subject of Basics of topography, which is only taught to students of the mention of Marine Corps.

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

MODIFICATIONS IN CASE OF EXTRAORDINARY SITUATIONS THAT INVOLVE THE SUSPENSION OF THE PRESENTIAL ACADEMIC ACTIVITY.

CONTENTS

The laboratory practices PL1 and PL4 are face-to-face, since they imply, respectively, the visit to different buildings of the ENM and the assembly of models of structures on which different measurements must be made. As far as possible, these tasks will be replaced by the resolution of exercises and/or practical cases that, with the support of the appropriate audiovisual media, allow the student to achieve the objectives set for such practices.

TEACHING METHODOLOGY
A new teaching methodology is added:
Synchronous online meeting (theory or practical session): It is taught through a web video conferencing platform. Each virtual classroom contains a variety of display panels and components, the design of which can be customized to best suit the needs of the class. In the virtual classroom, lecturers (and those authorized participants) can share their computer screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).

EVALUATION
The evaluation tests would be carried out by combining the FAITIC-Moodle remote teaching platform and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Deseño de máquinas				
Subject	Deseño de máquinas			
Code	P52G381V01405			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4	2c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Casqueiro Placer, Carlos			
Lecturers	Casqueiro Placer, Carlos Núñez Nieto, Xavier			
E-mail	ccasqueiro@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Esta materia permitirá ao alumno aplicar os fundamentos básicos da Teoría de Máquinas e Mecanismos ao Deseño de Máquinas e coñecer, comprender, aplicar os conceptos relacionados co Deseño de Máquinas e a súa aplicación na Enxeñaría Mecánica. Achegaralle coñecementos, sobre os conceptos máis importantes relacionados co Deseño de Máquinas. Coñecerá e aplicará as técnicas de análises para Deseño de Máquinas, tanto analíticas como mediante a utilización eficaz de software de simulación.			

Competencias	
Code	
CG4	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.
CG5	Coñecementos para a realización de medicións, cálculos, valoracións, taxacións, peritaxes, estudos, informes, planes de labores e outros traballos análogos.
CG6	Capacidade para o manexo de especificacións, regulamentos e normas de obrigado cumprimento.
CG9	Capacidade de organización e planificación no ámbito da empresa, e outras institucións e organizacións.
CG10	Capacidade para traballar nun medio multilingüe e multidisciplinar.
CG11	Coñecemento, comprensión e capacidade para aplicar a lexislación necesaria no exercicio da profesión de Enxeñeiro Técnico Industrial.
CE13	Coñecemento dos principios de teoría de máquinas e mecanismos.
CE20	Coñecementos e capacidades para o cálculo, deseño e ensaio de máquinas.
CT2	Resolución de problemas.
CT9	Aplicar coñecementos.
CT10	Aprendizaxe e traballo autónomos.
CT17	Traballo en equipo.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Aplicar os fundamentos básicos da Teoría de Máquinas e Mecanismos ó Deseño de Máquinas.	CG4 CG5 CG6 CG9 CG10 CG11	CE13 CE20	CT2 CT9 CT10 CT17
Coñecer, comprender, aplicar os conceptos relacionados co Deseño de Máquinas.	CG4 CG5 CG6 CG9 CG10 CG11	CE13 CE20	CT2 CT9 CT10 CT17
Resultado de aprendizaxe ENAEE: 1.2 Coñecemento e comprensión das disciplinas de enxeñaría propias da su especialidad, no nivel necesario para adquirir o resto de competencias do título, incluíndo nocións dos últimos adelantos. Nivel: adecuado.		CE13 CE20	
Resultado de aprendizaxe ENAEE: 2.2 Capacidade para identificar, formular e resolver problemas de enxeñaría na súa especialidade; escoller e aplicar métodos analíticos, de cálculo e experimentos adecuadamente establecidos; eecoñecer a importancia das restricións sociais, de saúde e seguridade, ambientais, económicas e industriais. Nivel: adecuado.	CG4	CE20	CT2 CT9

Resultado de aprendizaxe ENAEE: 3.1 Capacidade para deseñar, deseñar e desenvolver produtos complexos (pezas, compoñentes, produtos acabados, etc.), procesos e sistemas da súa especialidade, que cumpran os requisitos establecidos, incluíndo o coñecemento dos aspectos sociais, de saúde e seguridade, e ambientais económico e industrial; así como seleccionar e aplicar métodos de proxecto apropiados. Nivel: adecuado.	CG4 CG5	CE20	CT2 CT9
Resultado de aprendizaxe ENAEE: 3.2 Capacidade do proxecto utilizando algúns coñecementos avanzados da súa especialidade de enxeñaría. Nivel: adecuado.	CG4 CG5	CE20	CT9
Resultado de aprendizaxe ENAEE: 4.1 Capacidade para realizar buscas bibliográficas, consultar e utilizar bases de datos de criterios e outras fontes de información, para realizar simulacións e análises co obxectivo de realizar investigacións sobre temas técnicos da súa especialidade. Nivel: básico.	CG6 CG11		
Resultado de aprendizaxe ENAEE: 4.2 Capacidade para consultar e aplicar códigos de boa práctica e de seguridad na súa especialidade. Nivel: básico.	CG6 CG11		
Resultado de aprendizaxe ENAEE: 4.3 Capacidade e destreza para proxectar e levar a cabo investigacións experimentais, interpretar resultados e obter conclusións no seu campo de estudo. Nivel: adecuado.		CE13 CE20	CT9
Resultado de aprendizaxe ENAEE: 5.2 Competencia práctica para resolver problemas complexos, realizar proxectos complexos de enxeñaría e realizar investigacións específicas para a súa especialidade. Nivel: adecuado.	CG4 CG5		CT2 CT9
Resultado de aprendizaxe ENAEE: 5.3 Coñecemento da aplicación de materiais, equipos e ferramentas, procesos de tecnoloxía e enxeñería e as súas limitacións no ámbito da súa especialidade. Nivel: adecuado.			CT9
Resultado de aprendizaxe ENAEE: 5.4 Capacidade para aplicar normas da práctica da inxeñaría da súa especialidade. Nivel: adecudo.	CG6 CG9 CG11		CT9
Resultado de aprendizaxe ENAEE: 6.2 Capacidade para xestionar actividades ou proxectos técnicos ou profesionais complexos da súa especialidade, asumindo a responsabilidade da toma de decisións. Nivel: básico.	CG9		

Contidos	
Topic	
Tema 1. Predición de falla por carga estática. (T1)	Resistencia estática. Concentración do esforzo. Teorías de falla. Selección de criterios de falla.
Tema 2. Predición de falla por carga cíclica. (T2)	Introdución á Fatiga. Esforzos cíclicos. Resistencia á fatiga e límite de fatiga. Factores de modificación do límite de fatiga. Esforzos variables e fluctuantes: dano por fatiga acumulada.
Tema 3. Lubricación, fricción e desgaste. (T3)	Lubricación. Fricción. Desgaste.
Tema 4. Vibracións en deseño de máquinas. (T4)	Frecuencia natural e vibracións forzadas en sistemas de 1GL. Frecuencias naturais e modos de vibración en sistema de máis de 1GL. Frecuencias naturais e modos de vibración en sistemas continuos.
Tema 5. Eixos e árbores. (T5)	Deseño de árbores segundo tensións. Velocidades críticas de árbores.
Tema 6. Rodamientos e coxinetes. (T6)	Comparación entre coxinetes e rodamientos. Tipos de rodamientos. Deseño de rodamientos. Selección de rodamientos por catálogo. Tipos de coxinetes. Teoría da lubricación hidrodinámica. Deseño de coxinete hidrodinámico.
Tema 7. Engrenaxes. (T7)	Condición de engrane. Tipos de engrenaxes. Parámetros xeométricos. Interferencia. Análise de forzas. Deseño e dimensionamiento de engrenaxes. Trens de engrenaxes.
Tema 8. Embragues e freos. (T8)	Freos de cinta, de tambor e de disco. Embragues cónicos e de disco. Par transmisible. Enerxía disipada.
Tema 9. Unións roscadas e parafusos de potencia. (T9)	Morfoloxía das unións roscadas. Normas. Dimensionamiento. Parafuso de potencia.
Tema 10. Sistemas flexibles de transmisión de potencia. (T10)	Correas e cadeas de transmisión. Cálculo e dimensionamiento.
Tema 11. O uso do MEF no deseño mecánico. (T11)	Mallado. Aplicación de condicións de contorno.
Tema 12. Enxeñaría inversa e prototipado. (T12)	Adquisición e tratamento de xeometría. Prototipado e impresión 3d.
Prácticas 1 e 2. Análise estática mediante FEM con software CAE. (PL1 e PL2)	Mallado da/s xeometría/s, aplicación de materiais, restricións e cargas. Análise de resultados.
Práctica 3. Análise estática de conxuntos mediante FEM con software CAE. (PL3)	Mallado da/s xeometría/s, aplicación de materiais, restricións e cargas. Análise de resultados.
Práctica 4. Análise de vibracións mediante FEM con software CAE. (PL4)	Mallado da/s xeometría/s, aplicación de materiais, restricións e cargas. Análise de resultados.

Práctica 5 e 6. Adquisición de xeometrías e o seu tratamento. (PL5 e PL6)	Emprego de escáner tridimensional para a adquisición de xeometrías. Tratamento das nubes de puntos.
Práctica 7. Cálculo de elementos de máquinas mediante software. (PL7)	Utilización de software de cálculo de rodamientos, engrenaxes, correas, cadeas,...

Planificación			
	Class hours	Hours outside the classroom	Total hours
Resolución de problemas	7	7	14
Prácticas con apoio das TIC	14	7	21
Resolución de problemas de forma autónoma	11	14	25
Seminario	15	10	25
Lección maxistral	28	37	65
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Resolución de problemas	Resolución de problemas utilizando os conceptos teóricos presentados en aula.
Prácticas con apoio das TIC	Realización de tarefas prácticas en aula informática.
Resolución de problemas de forma autónoma	Empregados nas probas de avaliación con obxecto de verificar as capacidades adquiridas polo alumno.
Seminario	Curso intensivo de 15 horas para aqueles alumnos que suspenderon a materia en primeira convocatoria, previo ao exame en segunda convocatoria. Titorías grupais co profesor.
Lección maxistral	Clase maxistral na que se expoñen os contidos teóricos.

Atención personalizada	
Methodologies	**Description**
Prácticas con apoio das TIC	O alumno recibe atención personalizada durante a realización das prácticas. O profesor da materia atenderá persoalmente as dúbidas e consultas dos alumnos, tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.
Seminario	Titorias grupais co profesor da materia. O profesor da materia atenderá persoalmente as dúbidas e consultas dos alumnos, tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.

Avaliación					
	Description	Qualification	Evaluated Competencess		
Prácticas con apoio das TIC	Valorarase as memorias das prácticas de laboratorio e os traballos realizados a partir delas.	30	CG4 CG5 CG9	CE13 CE20	CT2 CT9
Resolución de problemas de forma autónoma	Realizaranse dous Controis teórico-prácticos de avaliación continua (15% cada un). A súa valoración realizarase sobre 10 puntos cada un e deberase ter unha nota media de 4 ou máis puntos no conxunto destas dúas probas para poder optar ao aprobado por avaliación continua. A Proba Final (PF) de avaliación continua (cun peso do 40%) 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.	70	CG4 CG5 CG6 CG9 CG11	CE13 CE20	CT2 CT9 CT10

Other comments on the Evaluation

O alumno deberá presentarse ao exame ordinario de todos os contidos da materia, que suporá o 100% da nota, nos seguintes supostos: A nota final de avaliación continua (NEC) é menor de 5. A non realización ou entrega da memoria de prácticas, salvo que sexa eximido por causa xustificada, ou a non superación do mínimo de 4 puntos nas mesmas. Obter unha nota inferior a 4 puntos sobre 10 no exame final de avaliación continua. Obter unha nota media dos controis teórico-

prácticos inferior ao 4. A nota de avaliación continua en caso de non cumprir algún do tres últimos requisitos será obtida mediante a expresión: NECS = min (4, NEC) En calquera caso, o alumno que superase a avaliación continua, terá a posibilidade de presentarse ao exame ordinario para subir nota. Nota importante: Un dos deberes de cada estudante universitario é "Abstenerse de empregar ou cooperar en procedementos fraudulentos nas probas de avaliación, nos traballos que se realicen ou nos documentos oficiais da universidade". (Real decreto 1791/2010, do 30 de decembro, polo que se aproba o Estatuto do Estudante Universitario). A participación en calquera procedemento fraudulento, así como a posesión de material non autorizado durante a realización de calquera das probas (como dispositivos electrónicos, notas ou calquera outra documentación relacionada co asunto) conducirá á suspensión na convocatoria actual (valorada 0) e informar á Dirección do Centro.

Bibliografía. Fontes de información

Basic Bibliography

Budinas, Richard, **Diseño en Ingeniería Mecánica de Shigley**, 9ª, McGraw Hill,

Norton, Robert L, **Diseño de Máquinas**, 4ª, Editorial Pearson,

Complementary Bibliography

Budinas, Richard, **Shigley□s Mechanical Engineering Design**, 9ª, McGraw Hill,

Norton, Robert L, **Machine Design**, 5ª, Editorial Pearson,

Juvinall, Robert C, **Diseño de Elementos de Máquinas,**, 2ª, Wiley,

Juvinall, Robert C, **Fundamentals of Machine Component Design**, 5ª, Wiley,

Mott, Robert, **Diseño de elementos de máquinas**, 4ª, Editorial Pearson,

Mott, Robert, **Machine Elements in Mechanical Design**, 5ª, Editorial Pearson,

Recomendacións

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

=== ADAPTACIÓN DOS CONTIDOS ===
Prácticas 5 e 6 (PL5 e PL6)
O contido das prácticas modificarase evitando o uso dos dispositivos de escaneo en laboratorio, substituído por alternativas a disposición dos alumnos a distancia (uso de cámara de fotos) así como emprego de software con alternativa en diferentes plataformas, que permita asegurar a dispoñibilidade a calquera alumno.

=== ADAPTACIÓN DAS METODOLOXÍAS ===
Engádese ás previstas na guía docente a sesión maxistral e/ou sesión práctica virtual síncrona: Impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

=== ADAPTACIÓN DA AVALIACIÓN ===
En caso de non poder realizarse de maneira presencial, as probas de avaliación realizaranse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
English II				
Subject	English II			
Code	P52G381V01406			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	2nd
Teaching language	English			
Department				
Coordinator	Tomé Rosales, María de los Ángeles			
Lecturers	Beasley , Jeffrey Foley , Mary Christina Rich Stephens, Christopher Martin Tomé Rosales, María de los Ángeles			
E-mail	externo.angelestome@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this subject, students are expected to improve their mastery of the four basic skills of English (listening, speaking, reading, writing) at B2 Level CEFR (Common European Framework of Reference for Languages) in order to foster the use of the language in the professional military environment.			

Competencies	
Code	
CG10	Ability to work in a multidisciplinary and multilingual environment.
CE34	To promote, through speaking and writing in Spanish and English, communication skills to ease the transmission and understanding of orders, ideas and concepts.
CT4	Oral and written proficiency in a foreign language.
CT5	Information Management.
CT7	Ability to organize and plan.
CT8	Decision making.
CT9	Apply knowledge.
CT15	Objectification, identification and organization.
CT17	Working as a team.
CT18	Working in an international context.

Learning outcomes	Competences		
OVERALL ORAL PRODUCTION To give clear, systematically developed descriptions and presentations, with appropriate highlighting of significant points, and relevant supporting details. SUSTAINED MONOLOGUE: DESCRIBING EXPERIENCE To give clear, detailed descriptions on a wide range of subjects related to his/her field of interest. SUSTAINED MONOLOGUE: PUTTING A CASE To develop an argument systematically with appropriate highlighting of significant points, and relevant supporting detail. ADDRESSING AUDIENCES To give a clear, prepared presentation, giving reasons in support of or against a particular point of view and giving the advantages and disadvantages of various options. To take a series of follow up questions with a degree of fluency and spontaneity which poses no strain either him/herself or the audience. OVERALL SPOKEN INTERACTION To use the language fluently, accurately and effectively on a wide range of general, academic, vocational or leisure topics, marking clearly the relationships between ideas. To communicate spontaneously with good grammatical control without much sign of having to restrict what s/he wants to say, adopting a level of formality appropriate to the circumstances.	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18

OVERALL WRITTEN PRODUCTION To write clear, detailed texts on a variety of subjects related to his/her field of interest, synthesising and evaluating information and arguments from a number of sources. REPORTS AND ESSAYS To write an essay or report which develops an argument systematically with appropriate highlighting of significant points and relevant supporting detail.	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18
OVERALL LISTENING COMPREHENSION To understand standard spoken language, live or broadcast, on both familiar and unfamiliar topics normally encountered in personal, social, academic or vocational life. Only extreme background noise, inadequate discourse structure and/or idiomatic usage influences the ability to understand. UNDERSTANDING CONVERSATION BETWEEN NATIVE SPEAKERS To keep up with animated conversation between native speakers. LISTENING AS A MEMBER OF A LIVE AUDIENCE To follow the essentials of lectures, talks and reports and other forms of academic/professional presentation which are propositionally and linguistically complex. LISTENING TO ANNOUNCEMENTS AND INSTRUCTIONS To understand announcements and messages on concrete and abstract topics spoken in standard dialect at normal speed. LISTENING TO AUDIO MEDIA AND RECORDINGS To understand recordings in standard dialect likely to be encountered in social, professional or academic life and identify the speaker viewpoints and attitudes as well as the information content.	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18
OVERALL READING COMPREHENSION To read with a large degree of independence, adapting style and speed of reading to different texts and purposes, and using appropriate reference sources selectively. READING FOR ORIENTATION To scan quickly through long and complex texts, locating relevant details. READING INSTRUCTIONS To understand lengthy, complex instructions in his/her field, including details on conditions and warnings, provided s/he can reread difficult sections.	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18
ENAEE Learning Outcome: KNOWLEDGE AND UNDERSTANDING: LO1.3.- Awareness of the wider multidisciplinary context of engineering [Intermediate (2)].	CG10		
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)].			CT5
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)].		CE34	CT4 CT18
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)].		CE34	CT4 CT7 CT8 CT17 CT18
ENAEE Learning Outcome: LIFELONG LEARNING: LO8.1.- Ability to recognise the need for and to engage in independent life-long learning [Basic (1)].			CT8
ENAEE Learning Outcome: LIFELONG LEARNING: LO8.2.- Ability to follow developments in science and technology [Basic (1)].			CT8

Contents	
Topic	
Unit 6	6.1. Music and emotion 6.2. Sleeping Beauty
Unit 7	7.1. Don't argue 7.2. Actors acting
Unit 8	8.1. Beat the robbers... and the burglars 8.2. Breaking news
Unit 9	9.1. Truth and lies 9.2. Megacities
Unit 10	10.1. The dark side of the moon 10.2. The power of words

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	20	20	40
Mentored work	20	20	40
Essay questions exam	30	24	54
Essay	4	4	8
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	
Tests	**Description**
Essay questions exam	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, FAITIC forums, etc.) on appointment.
Oral exam	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, FAITIC forums, etc.) on appointment.
Essay	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, FAITIC forums, etc.) on appointment.

Assessment					
	Description	Qualification	Evaluated Competencess		
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% Mid-term exam - 30% Final exam - 40%	70	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18
Essay	Activity 1 (15%)	15	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18
Oral exam	Activity 2 (15%)	15	CG10	CE34	CT4 CT5 CT7 CT8 CT9 CT15 CT17 CT18

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 4 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 (Exam 2) 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.
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 on the same compulsory subject of the Degree in Mechanical Engineering of the Defense College, English II. 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.

Sources of information

Basic Bibliography

Latham-Koenig, Christina & Clive Oxenden, **English File. Upper-intermediate. Student's Book**, 3ª, Oxford University Press, 2014

Complementary Bibliography

Collie, J. and S. Slater, **Cambridge Skills for Fluency: Listening**, 1ª, Cambridge University Press, 2008

Collie, J. and S. Slater, **Cambridge Skills for Fluency: Speaking**, 1ª, Cambridge University Press, 2008

Collie, J. and S. Slater, **Cambridge Skills for Fluency: Reading**, 1ª, Cambridge University Press, 2008

Collie, J. and S. Slater, **Cambridge Skills for Fluency: Writing**, 1ª, Cambridge University Press, 2008

Comfort, J., **Effective Presentations**, 1ª, Oxford University Press, 1995

Craven, M., **Cambridge English Skills. Real Listening and Speaking. Level 3.**, 1ª, Cambridge University Press, 2008

Eastwood, J., **Oxford Practice Grammar**, 1ª, Oxford University Press, 1999

Gower, R., **Cambridge English Skills. Real Writing. Level 3.**, 1ª, Cambridge University Press, 2008

Hancock, M., **English Pronunciation in Use**, 1ª, Cambridge University Press, 2008

Hashemi, L. and B. Thomas, **Grammar for First Certificate**, 1ª, Cambridge University Press, 2008

Ibbotson, M., **Cambridge English for Engineering**, 1ª, Cambridge University Press, 2008

Ibbotson, M., **Professional English in Use. Engineering**, 1ª, Cambridge University Press, 2009

Mccarthy, M. and F. O'Dell, **English Vocabulary in Use**, 1ª, Cambridge University Press, 2002

Murphy, R., **English Grammar in Use**, 16ª, Cambridge University Press, 2003

Redman, S., **Idioms and Phrasal Verbs. Advanced**, 1ª, Oxford University Press, 2011

Swan, M., **Practical English Usage**, 1ª, Oxford University Press, 2005

Thomas, B. and B. Matthews, **Vocabulary for First Certificate**, 1ª, Cambridge University Press, 2007

Vince, M., **First Certificate Language Practice**, 1ª, Macmillan, 2009
Cambridge Dictionary of American English, Cambridge University Press, 2001
Cambridge Dictionary of American Idioms, Cambridge University Press, 2003
Cambridge Phrasal Verbs Dictionary, Cambridge University Press, 2006
Collins Cobuild Active English Dictionary, Collins Cobuild, 2003
Longman Dictionary of Contemporary English, Pearson Longman, 2009
Macmillan English Dictionary, Macmillan, 2004
Oxford Dictionary of English, Oxford University Press, 2010
Oxford Wordpower Dictionary, Oxford University Press, 2001
Random House Webster Unabridged Dictionary, Random House Reference Publishing, 2005
The BBC,
The British Army,
The British Council,
The British Forces Broadcasting Service,
The CNN,
The Guardian,
The Naked Scientists,
The National Army Museum,
The New York Times,
The Royal Air Force,
English Listening,
Lingo Rank,
NATO,
US Department of Defence Dictionary of Military and Associated Terms,
US-based military English website,
Military definitions,
Airforce magazine,
Dudley Knox library, a directory of military information,

Recommendations

Subjects that it is recommended to have taken before

English I/P52G381V01209

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 haven 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 B2. Therefore, to be able to succeed, it is advisable to have the following skills:
-Reading and listening skills
-Writing and speaking skills
-Skill to think abstractly and summarise information
-Skill for group work and communication

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo has established an extraordinary plan that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

Teaching methodology:
Classes would become synchronous online sessions, taught by combining FAITIC-Moodle and Campus Remoto of the University of Vigo.

Assessment:
Assessable activities and exams would be carried out by combining FAITIC-Moodle and Campus Remoto of the University of Vigo.

IMPORTANT NOTES:
1. When doing assessable activities or exams, teachers should be able to see students on the screen all the time (except during breaks, when teachers should be able to see the computer screen, the desk and the chair). If teachers are not able to see a student, that student's mark will be 0 in those activities they have done while hiding from teachers.

2. If when doing assessable activities or exams students are systematically looking at a point which is not on the screen just before answering the items of the assessable task or of a task from the exam, the mark of that task will be 0.

3. If when doing assessable activities or exams FAITIC-Moodle registers a student is using two different IP addresses, the mark of those activities will be 0.

4. It is forbidden to use a translation extension on the browser students are using to do activities on FAITIC-Moodle. If students use them, they will be responsible for the consequences derived from its use (for instance, automatic translation into a different language).

5. Unless students are using their mobiles to get connected to Campus Remoto, their mobile must not be in the room where they are doing the exam.

6. If in any of the production activities, examiners realise that a student has plagiarised and they can prove it, that student's mark will be 0.

IDENTIFYING DATA				
Manufacturing engineering and dimensional quality				
Subject	Manufacturing engineering and dimensional quality			
Code	P52G381V01407			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Arce Fariña, María Elena			
Lecturers	Arce Fariña, María Elena Febrero Garrido, Lara			
E-mail	elena.arce@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The main objective of Manufacturing Engineering and Dimensional Quality is to complement the knowledge acquired in the subject "Fundamentals of Systems and Manufacturing Technologies" on manufacturing processes. The student will acquire skills to identify and plan the different stages of the production process from the product design specifications, selecting the different phases, machines, equipment, tools, and verification techniques more convenient. In addition, the knowledge of the student in the development of simple computer numerical control computer-aided design and manufacturing techniques programs will be strengthened.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG8	Ability to apply the principles and methods of quality.
CE26	Applied knowledge of systems and manufacturing processes, metrology and quality control.
CT2	Problems resolution.
CT8	Decision making.
CT9	Apply knowledge.
CT10	Self learning and work.
CT17	Working as a team.
CT20	Ability to communicate with people not expert in the field.

Learning outcomes	Competences		
To know the technological base and basic aspects of manufacturing processes.	CG3 CG8		CT2 CT8 CT9 CT10 CT17 CT20
To understand basic aspects of manufacturing systems.	CG3 CG8		CT2 CT8 CT9 CT10 CT20
To acquire skills to select manufacturing processes and to plan manufacturing.	CG3 CG8	CE26	CT2 CT8 CT9 CT10 CT20
To develop skills to manufacture groups and elements in CAD-CAM environments.	CG3	CE26	CT8 CT9 CT10

Application of CAQ technologies	CG3	CE26	CT2 CT8 CT9 CT10 CT17 CT20
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. Advanced (3).	CG3	CE26	
ENAEE learning outcome: ENGINEERING ANALYSIS LO2.1.- Ability to analyse complex engineering products, processes and systems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to correctly interpret the outcomes of such analyses. Intermediate (2).		CE26	CT2 CT8 CT9
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).	CG8	CE26	CT2 CT9
ENAEE learning outcome: ENGINEERING DESIGN LO3.2.- Ability to design using some awareness of the forefront of their engineering specialisation. Advanced (3).		CE26	CT9
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. Intermediate (2).			CT8 CT9
ENAEE learning outcome: ENGINEERING PRACTICE LO5.4.- Ability to apply norms of engineering practice in their field of study. Basic (1).			CT9
ENAEE learning outcome: LIFELONG LEARNING LO8.1.- Ability to recognise the need for and to engage in independent life-long learning. Basic (1).			CT8

Contents	
Topic	
THEORY	
1.- Introduction	Topic 1. Introduction to industrial production.
2.- Engineering of Manufacture	Topic 2. Modelling and simulation of mechanical manufacturing processes. Topic 3. Analysis, implementation and optimization of forming processes. Topic 4. Lines and systems of mechanical manufacturing and their simulation: CAM systems. Transfer" systems. Production lines. Systems and cells of flexible manufacturing. Integrated manufacturing. Topic 5. Planning of the manufacturing processes: Design plan analysis. Selection of the processes and determination of the manufacturing sequence. Process sheet definition. Technological management of manufacturing.
3.- Systems of quality	Topic 6. The field of dimensional metrology Precision in industry. Measurement errors. Measurement chains. Topic 7. Calibration. The metrological organization. Uncertainty in measurement. Traceability and dissemination. Calibration plan. Topic 8. Systems, machines, inspection and verification equipment in mechanical manufacturing. Topic 9. Modelling and measurement of surface quality. Topic 10. Statistical process control. Control charts by variables. Control charts by attributes. Machine and process capacity. Topic 11. Quality of the measures in the industry. Evaluation of the quality of the measurements. Tools and techniques to evaluate the dimensional quality and its costs. Topic 12. Techniques and metrological systems. Legal and industrial metrology.
PRACTICE	

Practical sessions 1 and 2: Computer Aided Manufacturing	These practical sessions are aimed at the computer-aided design of Personal Protective Equipment (PPE) in accordance with Royal Decree 773/1997 (Directive 89/656/EEC) on the use of PPE and Regulation (EU) 2016/425 on its marketing. The PPE designed will be printed in 3D, and the students must select the material, the manufacturing characteristics, as well as carry out the rapid prototyping of these parts. With these practices, the aim is to apply theoretical knowledge to the machining of parts using Autodesk Inventor software.
Practical sessions 3, 4 and 5: Quality in industry	Tools and techniques will be studied to evaluate the dimensional quality and its costs. In addition, the importance and principles of continuous improvement will be presented through the analysis of real cases. All this will allow to train students for the maintenance and improvement of the basic stability in the organizations.
Practical Sessions 6 and 7: Statistical Process Control	Practical cases of analysis of productive systems through control charts by variables, control charts by attributes and the study of machine and process capacities will be carried out.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	36	62
Practices through ICT	14	0	14
Mentored work	0	14	14
Seminars	7	5	12
Seminars	15	8	23
Essay questions exam	2	0	2
Report of practices, practicum and external practices	0	13	13
Essay questions exam	9	0	9
Problem and/or exercise solving	0	1	1

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

Methodologies

	Description
Lecturing	In these sessions, the basic theoretical contents of the subject will be explained in detail, exposing explanatory examples to deepen the understanding of the subject. The slides and the blackboard will be used in combination. As far as possible, a copy of the slides will be provided to the students prior to the lesson, focusing the effort of the lecturer and students on the exposure and understanding of the knowledge. In any case, paper reproductions of slides should never be considered as substitutes for texts or notes, but as complementary material.
Practices through ICT	In order to contribute to the acquisition of generic competences, the evaluation of practice sessions is proposed either with the preparation of individual reports or with reports by group. When the elaboration of the report is collective and in order to ensure that the interdependence is positive, all the members of the group must have worked and contributed to the final product and must dominate, minimally, all aspects of the practical session.
Mentored work	The didactic method to follow in the delivery of practical classes is that the lecturer mentored the work carried out by the groups in which the students are divided. The practices are aimed at strengthening the theoretical concepts addressed in the lecturing sessions and facilitate the assimilation of the concepts with regard to their application in the design of structures and elements of machines.
Seminars	Given that the tutorial action is addressed as a group support action to the student's learning process by solving problems and exercises, the sessions will be carried out preferably in seminars and in the format of small meeting groups.
Seminars	Intensive course of 15 hours for those students who did not pass the subject in the first call, prior to the examination of the second call. Tutorial groups with the lecturer.

Personalized assistance

Methodologies	Description
Seminars	In the seminars lecturers propose the resolution of problems and study cases related with the lecturing sessions. The faculty will personally attend to the doubts and queries of the students, both in person (the timetable will be published on the centre's website) and through telematic means (e-mail, videoconference, FAITIC forums, etc.) by appointment.
Mentored work	During the practical sessions of the subject different mentored works will be implemented in groups of students. The lecturer will answer personally questions and queries of the students.

Assessment

	Description	Qualification	Evaluated Competencess		
Essay questions exam	PI. Two mandatory intermediate tests will be held during the course (PI1 and PI2). PI1 for subjects T1-T5 and PI2 for subjects T6-T9. Each test has a weight of 15% on the final grade.	30	CG3 CG8	CE26	CT2 CT9 CT10 CT20
Report of practices, practicum and external practices	MP Delivery of reports to evaluate the knowledge acquired in the practical sessions and mentored works (P1-P7)	20	CG3	CE26	CT2 CT8 CT9 CT10 CT17 CT20
Essay questions exam	PF Writing final test final to evaluate the global knowledge of the subject (official date of evaluation)	40	CG3 CG8	CE26	CT2 CT8 CT9 CT10 CT20
Problem and/or exercise solving	CT. Questionnaires and tests will be carried out through online teaching platforms corresponding to the subject matter taught.	10	CG3 CG8	CE26	CT2 CT8 CT9 CT10 CT17 CT20

Other comments on the Evaluation

The final evaluation of the student will be the sum of the score awarded to each of the parts mentioned above and taking into account the requirement of a minimum of 4 in the final exam.

Being, therefore, the continuous evaluation grade:

- In case of meeting the requirements,

NEC = 0.40·PF + 0.15·PI1 + 0.15·PI2 + 0.20·MP + 0.1·CT

- In case of not meeting the requirements, the maximum grade obtained will be a 4.

The student must attend to the ordinary examination of all the contents of the subject, which will be 100% of the grade, in the following cases:

- The non-completion or delivery of any of the previous points.

- Get a grade below 4 points out of 10 in the final exam.

- Not having passed the continuous assessment with a 5.

In any case, the student who has passed the continuous assessment, will have the possibility of attending the ordinary exam to raise the grade.

ETHICAL COMMITMENT: Students are expected to have adequate ethical behavior. If unethical behavior is detected (cheating, plagiarism, use of unauthorized electronic devices or others), the student will be penalized with the impossibility of passing the subject by the continuous assessment modality (in which he/she will obtain a grade of 0.0). If this type of behavior is detected in ordinary or extraordinary exam, the student will obtain in the call a score in 0.0.

Sources of information

Basic Bibliography

Kalpakjian, Schmid, **Manufactura, ingeniería y tecnología**,

Pereira Domínguez, Alejandro; Diéguez Quintas, José L., **Tecnología y sistemas de fabricación**,

Bootrhoyd, Geoffrey, **Product design for manufacture and assembly**,

Bootrhoyd, Geoffrey, **Assembly Automation and Product Design**,

Todd, R.H.; Allen, D.K.; Alting, L, **Fundamental principles of manufacturing processes**,

Alting, L., **Procesos para ingeniería de manufactura**,

Complementary Bibliography

Faura, F, **Prácticas de tecnología mecánica**,

Groover, M. P., **Fundamentos de manufactura moderna: materiales, procesos y sistemas**,

Diéguez, J.L.; Pereira, A.; Ares, J.E., **Fundamentos de fabricación mecánica**,

De Garmo, E.P.; Black, J.T.; Kohser, R.A., **Materiales y procesos de fabricación**,

Lasheras J.M., **Tecnología mecánica y metrotecnia**,

Recommendations

Subjects that it is recommended to have taken before

Graphic expression: Graphic expression/P52G381V01101
Resistance of materials/P52G381V01204
Fundamentals of manufacturing systems and technologies/P52G381V01402

Other comments

The student who accesses the fourth year of the mechanics engineering bachelor degree, and in particular to this subject, should have a minimum capacity to:
- Written and oral comprehension.
- Abstraction, basic calculation and synthesis of information.
- Use dimensional measurement and verification instruments in the laboratory/workshop.
- Use statistics in the Quality control.
- Dimension and define tolerances adequately and precisely to mechanical elements.
- Represent using 3D CAD parts and basic sets.
- Use and know the manual machine tools and their basic operations.
- Develop basic programs of numerical control in lathe and milling machine, and select the tools.
- Plan processes of machining, deformation and welding to produce parts and/or basic sets.
- Apply the theory of Elasticity and know how to represent tension states through Mohr circles.

If the student accesses without these competences, he/she will not be able to have an optimal learning process and will need a longer time to acquire and update their skills so that the final training is as expected.

Contingency plan

Description

=== PLANNED EMERGENCY MEASURES ===

In view of the uncertain and unpredictable evolution of the health alert caused by the COVID-19, the University of Vigo has established an extraordinary planning that will be activated at the time when the administrations and the institution itself determine it in accordance with safety, health and responsibility criteria, and guaranteeing teaching in a non-presential or partially presential scenario. These measures, already planned, guarantee the development of teaching in a more agile and effective way when they are known beforehand (or well in advance) by students and teachers through the standardized and institutionalized tool of syllabus.

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Below are those aspects that will be modified in the guide in the event that some action is determined to be derived from safety criteria.

Sections of the syllabus to be modified:

 Contents of the matter.

- Computer Aided Manufacturing Practices 1 and 2 will not include 3D design printing, replacing this part with simulation of the manufacturing process in an Autodesk Inventor CAM environment.

 Teaching methodology

A new teaching methodology is added:

- Synchronous online meeting (theory or practical session):

It is given through a web videoconference platform. Each virtual classroom contains various display panels and components, whose design can be customized to best suit the needs of the lecture. In the virtual classroom, lectures (and those authorized participants) can share their computer screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).

 Learning Assessment

- The evaluation tests will be carried out by combining the FAITIC-Moodle online teaching platform and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Radio-communication systems				
Subject	Radio-communication systems			
Code	P52G381V01408			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Rodríguez Molares, Alfonso			
Lecturers	Núñez Ortuño, José María Rodríguez Molares, Alfonso			
E-mail	molares@cud.uvigo.es			
Web	http://cursos.faitic.uvigo.es/moodle3_1920/course/			
General description	This course, which is part of the specialization module in Naval Technology, introduces the basic principles of radio communication, so much theoretical as practical. During the course we will review the physical phenomena and technological developments that made possible the transmission of information using electromagnetic waves. We discuss the propagation of radio-waves, the organization of the radio-electric spectrum, the operation and design of antennas, and the design criteria for a radio link. Finally, we review the radio-communication systems in use nowadays, with focus on those used in the Navy.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CE27	To acquire the ability to understand the mechanisms of propagation of electromagnetic waves and the corresponding organization of the radioelectric space.
CE28	To know the mechanism of operation of antennas and their different types.
CE29	To acquire the ability to select equipment, media and transmission systems.
CT1	Analysis and synthesis
CT2	Problems resolution.
CT3	Oral and written proficiency
CT8	Decision making.
CT9	Apply knowledge.
CT10	Self learning and work.
CT16	Critical thinking.
CT17	Working as a team.

Learning outcomes			
Learning outcomes		Competences	
To know the technological base of telecommunication systems	CG3	CE27 CE29	CT1 CT2 CT3 CT8 CT9 CT10 CT16 CT17
To understand the fundamentals of electromagnetic wave propagation and the organisation of the radio-electric spectrum.	CG3	CE27	CT1 CT2 CT3 CT9 CT10 CT16 CT17

To understand the basic mechanisms of operation of antennas	CG3	CE28 CE29	CT1 CT2 CT3 CT9 CT10 CT16 CT17
To understand the basic operation of naval communication systems	CG3	CE29	CT1 CT3 CT8 CT10 CT16
ENAEE learning outcome: KNOWLEDGE AND UNDERSTANDING: LO1.3.- Be aware of the multidisciplinary context of engineering [level of achievement (basic (1), intermediate (2) and advanced (3)) of this learning outcome: Basic (1)].		CE27 CE28 CE29	
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 recognize the importance of non-technical societal, health and safety, environmental, economic and industrial constraints [Intermediate (2)].			CT1 CT2 CT8 CT9 CT16
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 [Advanced (3)].		CE27 CE28 CE29	CT8 CT9
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 [Basic (1)].			CT3 CT8 CT10 CT17
ENAEE learning outcome: CONTINUOUS TRAINING: LO8.1.- Ability to recognize the need of continuous training, to be carried out along a their own career in an independent way [Advanced (3)].			CT8 CT10
ENAEE learning outcome: CONTINUOUS TRAINING: LO8.2.- Ability to be keep updated on the last developments in science and technology [Intermediate (2)].			CT8 CT10

Contents	
Topic	
Chapter 1. Introduction	Aims and development: The aim of this chapter is to introduce basic concepts needed to understand the propagation of electromagnetic waves, and the tools needed to analyse the operation and characteristics of radio systems, tools such as spectral analysis and decibels units. Index of the subject 1.1 Historical Perspective: from Oersted to Marconi 1.2 Review of fundamental concepts 1.3 Equation of the travelling wave 1.4 Electromagnetic spectrum 1.5 Decibels
Chapter 2. Antennas	Aims and development: The aim of this chapter is to present the operation of antennas and how to characterize their performance, numerically and graphically. We will see different types of antennas and their application. Index of the subject 2.1 Radiation in free space 2.2 Parameters of the antennas 2.3 Radiation pattern 2.4 Types of antennas
Chapter 3. Link	Aims and development: The aim of this chapter is to present the radio communication system as a whole, and to quantify its feasibility and performance in real circumstances using the link budget. Index of the subject 3.1 Friis Equation 3.2 Noise 3.3 Interference 3.4 Availability

Chapter 4. Radio-propagation	Aims and development: The aim of this chapter is to introduce the mechanisms of propagation of electromagnetic waves in more complex and realistic scenarios. Different strategies are discussed for communication over long distances Index of the subject 4.1 Influence of the terrain. 4.2 Surface wave 4.3 Ionospheric wave 4.4 Space wave
Chapter 5. Modulations	Aims and development: The aim of this chapter is to explain how can electromagnetic propagation be harness to transport information. We introduce the concept of modulation, we discuss its types, characteristics and limitations. Index of the subject 5.1 Basic concepts 5.2 Analog modulation 5.3 A/D conversion 5.4 Digital modulation 5.5 Multiplexing
Chapter 6. Current systems	Aims and development: The aim of this chapter is to present and discuss some of the radio communication systems that are currently in use. Index of the subject 6.1 Management of radio-electric spectrum 6.2 Mobile communication systems 6.3 Satellite communication systems 6.4 Radio-navigation systems 6.5 Radio-communication systems in the Navy
R&D project	Aims and development: The aim of the R&D project is give the student the opportunity to tackle the study of a subject of his election, as long as it is compatible with the contents of the course. We encourage the student to find solutions to open problems using the methods and tools at hand. The R&D project encourages the student to synthesize the acquired results into a multimedia format. During this session the class will review and discuss a selection of the results of the R&D project. The selection criteria will be: quality and compatibility with the course curriculum.
Lab session 1. Introduction	Aims: This first session poses a number of challenges and open exercises that will reinforce some fundamental concepts and units. Virtual laboratories will be used to visualize the propagation of electromagnetic waves, and other fundamental parameters. Students will practice operation with natural and logarithmic units, often making conversions between them, using either manual calculator and Matlab for verification.
Lab session 2. Antennas	Aims: The Lucas-Nülle training station will be used to study the characteristic parameters of a number of antennas (monopole, dipole, Yagi-Uda, slot antenna, etc.). Array antenna will be experiences using simulation software.
Lab session 3. Link	Aims: The students will practice evaluating the radio link budget, identifying and manipulating all the terms involved in Friis equation, as well as other parameters that are used to characterize the performance and overall quality of a radio link, such as SNR, CIR, availability. A practical case will be considered using simulation software.
Lab session 4. Satellite	Aims: The students will establish communication with one or several geostationary satellites. They will have to locate the position of the satellite, aim the antenna, and describe the characteristics of the received signal.

Lab session 5. Radio-propagación	Aims: Students will experience the various modes of propagation of electromagnetic waves, and how that can impact the communication. Several modes of propagation will be studied. The students will identify the propagation mode with the help of a calibrated antenna and a field measuring unit. In case the instrumentation is not available, simulation software will be used to study radio propagation via ionospheric and surface wave.
Lab session 6. Analog modulation	Aims: Basic concepts such as base-band or transmission bandwidth will be reviewed from a practical perspective. Software-defined-radio (SDR) software will be used to compare various analog modulations in terms of quality and bandwidth efficiency. We will review also the demodulation AM and FM signals.
Lab session 7. Digital modulation	Aims: Using SDR software a number of concepts will be reviewed, such as the impact that the digital modulation has on the bit error rate (BER). The students will compare different modulation schemes (ASK, QPSK and QAM) and the differences between their respective characteristic parameters.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	39	65
Laboratory practical	14	14	28
Seminars	7	0	7
Project based learning	2	13	15
Seminars	14	0	14
Essay questions exam	13	8	21

*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 class. In these sessions, the contents of the program are presented. Examples are used to help students understand the matter. Computer presentations and the blackboard will be used as the main media for content transmission. As much as possible, results will be supported by experiments, either done inside the classroom or shown via videos or other interactive content. A copy of the slides will be available for students prior to the lecture, so that both the lecturer and the students can focus, respectively, on the transmission and reception of the concepts. The slides are provided not as a substitute for textbooks or lecture notes, but as supplementary material. Project-based learning. Two masterclass sessions are programmed to visualize and discuss the results of the R&D projects. A number of projects will be selected according to quality and fitness to the course curriculum, and discussed with the class. Resolution of problems and/or exercises. With these sessions we engage the student in problem solving activities, while boosting skills in collaborative work and interpersonal relations. Active methodologies will be used, as stated in section 4 of this Guide. The student will be presented with a number of problems and challenges that involve other engineering disciplines. This way, students will gain a transversal vision of the contents of the course and will see how it can help addressing the problems in other disciplines. If possible, some time each week will be reserved to group work, although the actual amount of time may vary along the course depending on the current load. During those activities a problem-solving learning method will be followed.

Laboratory practical	Small participatory lectures. Sometimes, it will be convenient to tackle some concepts before the laboratory sessions in this form, to review and expand on the concepts that will be used during the session. Guided laboratory sessions. The procedure in these sessions is as follows: smaller groups of students are formed to solve a number of challenges and problems, with minimal intervention by the lecturer. The aim is to let students arrive to solutions using the knowledge and the tools at their disposal. The lecturer will merely guide the work of the students, by adjusting the difficulty of the tasks to the capacity of each group.
Seminars	Problems sessions. These sessions seek to support the learning process by means of problem solving, either as a group activity or individually. Problems and challenges will be posed to the group. Students will have to reach a solution through discussion and collaboration. Sessions will be preferably held in groups of around 10 students, although individual sessions can also be arranged.
Project based learning	We propose a R&D project with an open topic to be carried out by a group of 2 students. The procedure is as follows: we provide the students with a list of videos, as reference. Said videos show demonstrations or tutorials related to the course curriculum; for example: the design and implementation of a AM receptor or an experimental demonstration of ionospheric refraction using a scale model. We ask the students to make a similar video, with free topic but within the course contents. The aim of this project is to encourage students to acquire knowledge by themselves, employing any tool or method at their disposal. On top of that, we boost skills for autonomous investigation, problem solving, and capabilities in synthesis and presentation.
Seminars	This corresponds to an intensive course that reviews the main concepts and problems in preparation for the extraordinary exam.

Personalized assistance

Methodologies	Description
Seminars	We offer students both group and individualized tutoring. In the former, students have access to tutoring hours where lecturers are available to discuss any topic related to the course content, organisation, and planning. During these hours the lecturer can propose problems related to the course curriculum, either to reinforce the contents already presented or to challenge and deepen the student mastery of the subject. In the latter, the lecturer is available to each student to address any issue that may be hindering the student performance, or preventing him/her to follow the course. The aim of these sessions is to find, between both, some solution to these problems. Using both types of tutoring we adapt for the different learning speeds, and we address diversity outreach. The course lecturers will respond personally to all the doubts and questions that the students may rise. This will be done either in face-to-face meetings, according to the schedule published in the website of the center, or through telematic means (such as email, videoconference, FAITIC forums, etc.) if the course is held online

Assessment

	Description	Qualification	Evaluated Competencess		
Lecturing	It consists of 3 written exams: containing theoretical questions and problems covering the curriculum of the course. The distribution of the three exams is as follows: First mid-term: it covers chapters 1 and 2, and has a weight of 15% of the final grade. Second mid-term: covers chapters 3 and 4, and has a weight of 15% of the final grade. Final examination: covers all chapters (from 1 to 6) and has a weight of 40% of the evaluation. The R&D project grade is awarded by the lecturer in terms of quality and relevance to course curriculum. It has a weight of 10% of the final grade.	80	CG3	CE27 CE28 CE29	CT1 CT2 CT3 CT8 CT9 CT10 CT16

Laboratory practical	Groups of 2/3 students follow the laboratory procedures and deliver a log of the work done in each lab session. The lecturers will grade each deliverable, in terms of correctness and mastery of the session contents. The lab grade, calculated as the arithmetic mean of the grades of all deliverable, has a weight of 20% of the final grade.	20	CG3	CE27 CE28 CE29	CT1 CT3 CT9 CT10 CT17

Other comments on the Evaluation

On the lab sessions

If a lab session is missed, or if the log is not delivered before deadline, the grade for that deliverable would be 0.0. The student will be responsible for notifying the reason of absence before the publication of the session grades. It is up to the lecturer to decide whether the provided reason constitutes proper justification.

In case one session is missed, and it is properly justified, the final lab grade will be computed using the remaining grades. If more than one session is missed, and all are properly justified, the student will be given de opportunity to carry out the lab work on another date, or, alternatively, deliver an essay that covers the contents of the relevant lab work.

A minimum grade of 4,0 points over 10 is required in the lab sessions to pass the course.

Final grade and requirements to pass the course in continuous evaluation

To ensure that the student acquires the skills specified in the course plan a minimum grade is required in the following sections:

- 4,0 points over 10 in the final exam grade, and
- 4,0 points over 10 in the lab sessions grade.

The student will pass the course if, having complied with the requirements above, the calculation of the continuous evaluation grade (CEG) is equal or higher than 5,0 points over 10. Failing to comply with the requirements, the CEG cannot be greater than 4,0. If a student does no pass the course in the continuous evaluation modality, he/she will have to attend the regular exam. Students may decide to attend the regular exam to improve their grade.

Regular exam

The regular examination grade (REG) uses the same weights as in continuous evaluation: 80% for the theory and 20% for lab sessions.

It will consist of a single written exam, that will cover all the course curriculum, both theory and practical. The exam will have a duration of 3 hours, and can take the form of a multiple-choice test, a short answers test, a problem exam, or a combination of the former.

The student will pass the course if the REG is equal or greater than 5,0 points over 10. The student that fails the regular exam has to attend the make-up exam.

First call grade

The grade of the first call is calculated as the maximum of the continuous evaluation grade (CEG) and the regular examination grade (REG)

Second call grade (Make-up exam)

A make-up exam is offered for those that have not reached the course requirements in the first call. The format and requirements are the same than those of the regular exam.

Ethical commitmentThe Center is both a military academy and a university center, and the student must therefore comply with the obligations imposed by both institutions.

As a university student, he/she must "abstain of the use of fraudulent means, or cooperation with, in any examination, deliverable, or official document from/to the university" as stated in the Statute of the University Student ("Estatuto del Estudiante Universitario"), approved by the Royal decree 1791/2010 of 30 December, in article 12, point 2nd.

As a military student, he/she "will fulfill with accuracy his duties and obligations promoted by a feeling of honor, [□]" as stated in the Military Career Law ("Ley de la Carrera Militar"), in its fifteenth rule.

If an unethical behavior is detected (either copy, plagiarism, use of unauthorized electronic devices, or any other mean) in any examination or deliverable, during continuous evaluation, all the students involved in the deed will be awarded a 0.0 grade in that test (either theoretical or practical). If unethical behavior is detected in a regular or make-up exam, the students involved in the deed will be awarded a 0.0 grade in said call.

Sources of information

Basic Bibliography

Hernando Rábanos, José María, **Transmisión por radio**, 6ª, Centro de Estudios Ramón Areces, 2008

Arias Acuña, Alberto Marcos; Rubiños López, José Oscar, **Radiocomunicación**, Andavira, 2011

Apuntes da asignatura,

Complementary Bibliography

Balanis, Constantine A., **Antenna Theory. Analysis and Design**, 4ª, John Wiley & Sons, 2016

Griffiths, John, **Radio wave propagation and antennas: an introduction**, Prentice Hall, 1987

Couch, Leon W., **Digital & analog communication systems**, 8ª, Pearson Education, 2013
Burillo Martínez, Vicente [et. al., **Comunicaciones analógicas y digitales Vol. I**, 1ª, UPM, Dpto. Ing. Sistemas Telem., 1991
Kim, John C.; Muehldorf, Eugene I., **Naval shipboard communications systems**, 1ª, Prentice Hall, 1995

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/P52G381V01102
Physics: Physics II/P52G381V01106
Mathematics: Calculus 1/P52G381V01103
Fundamentals of electrical engineering/P52G381V01205
Mathematics: Calculus II and differential equations/P52G381V01201
Electronic technology/P52G381V01301

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

In case of extraordinary circumstances in-person teaching may be replaced by online teaching, and the following changes will be carried out:

=== ADAPTATION OF CONTENTS ===
6.1 Theoretical content
The course curriculum should not be affected by the change to online teaching. However, if the number of teaching hours is significantly reduced, the course contents must be adapted in order to ensure that the students gain the sought capabilities and that the course learning goals are achieved.

6.2. Practical content
Since it will be impossible to work with lab instrumentation, the affected lab sessions will be replaced by equivalent activities that can be carried out in a virtual environment. Namely, the following changes will be made:

Lab session 2: Antennas
This session will be replaced by a simulation in a virtual laboratory. The student will characterize the radiation pattern of several types of antenna, following a procedure analogous to that of the Lucas-Nülle training set.

Lab session 4: Satellite
This session will be replaced by a simulation in a virtual laboratory. The student will establish a link with a virtual satellite using virtual equipment, but following the same procedure as with the real instrumentation.

Lab session 5: Radiopropagation
To adapt this session to online teaching, the physical equipment will be replaced by simulators or video tutorials that explain the functioning of each piece of equipment. The field measurements will be carried out in a virtual environment, that will illustrate the phenomena presented in the theory sessions.

=== ADAPTATION OF METHODOLOGIES ===
A new methodology will be added:

Real time master class and/or virtual laboratory sesión:
These sessions will be held in virtual classroom, accesible via a web. Said classroom will count with a number of visualization panels and components, that can be arranged by the lecturer to better suit the needs of the course. In the virtual classroom, any presenter can share screen, files, use the blackboard, chat, send audio and video feeds, or participate in interactive online activities (tests, questions, etc.).

=== ADAPTATION OF ASSESSMENT ===

During online teaching, the assessment of the student capabilities will remain unaltered, in terms of contents, weights, minimum requirements, and number of tests.

The only difference will be in the format that said tests will take, that will combine the online learning platform FAITIC-Moodle with the Virtual Campus of the University of Vigo (and/or other similar platforms).

IDENTIFYING DATA				
Máquinas e motores navais				
Subject	Máquinas e motores navais			
Code	P52G381V01409			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4	2c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Álvarez Feijoo, Miguel Ángel			
Lecturers	Álvarez Feijoo, Miguel Ángel Lareo Calviño, Guillermo			
E-mail	alvarezfeijoo@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Nesta guía docente recóllense as competencias que os alumnos deben adquirir neste curso, o calendario de actividades docentes previsto, os contidos e a súa programación temporal, unha estimación do volume de traballo do alumno e os criterios específicos de avaliación. En Máquinas e Motores Navais estudaranse os sistemas de propulsión e sistemas auxiliares que se poden atopar nos barcos da Armada. Esta materia do Grao en Enxeñaría Mecánica mostra ao alumno os principais tipos de motores navais, as configuracións dos sistemas de control e propulsión, e os sistemas auxiliares de frío, bombeo, depuración de auga, tratamento de augas fecais, etc.			

Competencias	
Code	
CG3	Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
CG4	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.
CG5	Coñecementos para a realización de medicións, cálculos, valoracións, taxacións, peritaxes, estudos, informes, planes de labores e outros traballos análogos.
CG6	Capacidade para o manexo de especificacións, regulamentos e normas de obrigado cumprimento.
CG7	Capacidade para analizar e valorar o impacto social e ambiental das solucións técnicas.
CE35	Coñecemento aplicado dos sistemas de enerxía e propulsión naval.
CE36	Coñecemento dos equipos e sistemas auxiliares navais.
CE37	Coñecemento aplicado dos sistemas eléctricos navais.
CT1	Análise e síntese.
CT2	Resolución de problemas.
CT3	Comunicación oral e escrita de coñecementos.
CT5	Xestión da información.
CT7	Capacidade para organizar e planificar.
CT8	Toma de decisións.
CT9	Aplicar coñecementos.
CT10	Aprendizaxe e traballo autónomos.
CT15	Obxectivación, identificación e organización.
CT16	Razoamento crítico.
CT17	Traballo en equipo.
CT20	Capacidade para comunicarse con persoas non expertas na materia.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Coñecer a base tecnolóxica sobre a que se apoian as máquinas de combustión interna	CG3 CG4	CE35 CE36	CT3 CT5 CT7 CT9 CT10 CT15 CT17 CT20

Coñecer e comprender o funcionamento dunha planta propulsora dos buques da Armada	CG3 CG4	CE35 CE36 CE37	CT1 CT2 CT3 CT5 CT7 CT9 CT10 CT15 CT17 CT20
Resultados da aprendizaxe ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.3.- Ser conscientes do contexto multidisciplinar da enxeñaría [nivel de desenvolvemento (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CG3	CE35 CE36 CE37	CT1 CT2 CT3 CT5 CT9
Resultados da aprendizaxe ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.2.- 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 (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CG4 CG5		CT1 CT2 CT5 CT9 CT16
Resultados da aprendizaxe ENAEE: APLICACIÓN PRÁCTICA DA ENXEÑARÍA: RA5.2.- 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), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CG6 CG7		CT7 CT8 CT9 CT20
Resultados da aprendizaxe ENAEE: APLICACIÓN PRÁCTICA DA ENXEÑARÍA: RA5.5.- Coñecemento das implicacións sociais, de saúde e seguridade, ambientais, económicas e industriais da práctica da enxeñaría [nivel de desenvolvemento (básico (1), adecuado (2) e avanzado (3)) deste sub-resultado: Adecuado (2)].	CG4 CG5		CT2 CT9 CT15 CT16 CT17

Contidos	
Topic	
Motores de combustión interna	Repaso de motores térmicos Motores diésel. Clasificación dos motores diésel Motores diésel de 2 e 4 tempos Diagramas Comparativa Otto-Diésel
Motores Diesel	Compoñentes principais de motores diésel Elementos fixos e móbiles Sistema de admisión e escape Sistema de inxección de combustible Sistema de distribución Sistemas de lubricación, refrixeración, sobrealimentación e regulación
Turbinas de gas	Sistemas propulsores en buques de superficie Turbinas mariñas Turbina GE tipo LM2500
Sistemas actuais de propulsión	Presentación de sistemas de propulsión CODAD, CODOG/CODAG, COGAG, CODEOG A propulsión eléctrica Propulsión azipodal Transmisión de potencia
Sistemas de control do buque	Goberno. Transmisión electrohidráulica. Servomotor do temón electrohidráulico. Transmisión electromecánica. Servomotor do temón electromecánico Estabilización e manobra. Principios de aletas estabilizadoras. Tanques anti-balance. Gyro-estabilizadores. Temóns estabilizadores. Ascensores. Chigres. Cabrestantes. Molinetes de áncoras

Sistemas complementarios e auxiliares	Instalación eléctrica dun buque. Planta eléctrica dunha F-100. Sistema integrado de control da plataforma (SICP). Esquema xeral da planta eléctrica dunha F-100 e modos de traballo Sistemas de bombeo en buques. Bombas de fluxo continuo e desprazamento positivo Sistemas de frío en buques Sistemas de produción de auga. Destilación. Ósmosis inversa. Produción de auga desalinizada Sistemas de apoio ás plantas propulsoras. Depuradoras centrífugas. Circuítos de refrixeración por auga doce e auga salgada Sistemas auxiliares e de control do medioambiente. Plantas fecais. Tratamento de augas fecais. Plantas de tratamento por decantación e por célula electrolítica. Separación de sentinas por decantación. Separador de sentinas coalescente Equipos de medida. Medida de temperatura, presión, caudal. Medidores de nivel e de velocidade de xiro

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	28	24	52
Prácticas de laboratorio	14	14	28
Resolución de problemas	3	0	3
Aprendizaxe baseado en proxectos	4	24	28
Seminario	15	0	15
Exame de preguntas de desenvolvemento	15	9	24

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

Metodoloxía docente

	Description
Lección maxistral	Exposición por parte do profesor dos contidos sobre a materia obxecto de estudo, bases teóricas e/ou directrices dun traballo, exercicio ou proxecto a desenvolver polo estudante.
Prácticas de laboratorio	Actividades de aplicación dos coñecementos a situacións concretas e de adquisición de habilidades básicas e procedimentais relacionadas coa materia obxecto de estudo. Desenvólvense en espazos especiais con equipamento especializado (laboratorios, aulas informáticas, etc.).
Resolución de problemas	Actividade na que se formulan problema e/ou exercicios relacionados coa materia. O alumno debe desenvolver as solucións adecuadas ou correctas mediante a exercitación de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación da información dispoñible e a interpretación dos resultados. Adóitase utilizar como complemento da lección maxistral.
Aprendizaxe baseado en proxectos	O ensino baseado en proxectos de aprendizaxe é un método no que os estudantes levan a cabo a realización dun proxecto nun tempo determinado para resolver un problema ou abordar unha tarefa mediante a planificación deseño e realización dunha serie de actividades.
Seminario	Curso intensivo de 15 horas para aqueles alumnos que suspenderon a materia en primeira convocatoria, previo ao exame en segunda convocatoria. Tutorías grupais co profesor.

Atención personalizada

Methodologies	Description
Lección maxistral	No ámbito da acción tutorial, distínguense accións de tutoría académica así como de tutoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de tutorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia. Nas tutorías personalizadas, 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. Conxugando ambos os tipos de acción tutorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade. Os profesores da materia atenderán as dúbidas e consultas dos alumnos de forma síncrona en despachos físicos ou virtuais baixo a modalidade de concertación previa ou asíncrona por medios telemáticos (correo electrónico, foros de FAITIC, etc.).

Avaliación

	Description	Qualification	Evaluated Competencess

Lección maxistral	Probas escritas: cuestións teóricas e problemas. As probas escritas teñen como obxectivo a avaliación da aprendizaxe de todos os contidos teóricos seleccionados para a materia. - Probas intermedias (PI): 10% + 15%	25	CG4	CE35 CE36 CE37	CT1 CT2 CT7 CT9 CT15 CT16
Prácticas de laboratorio	A avaliación das prácticas realizarase valorando as memorias de prácticas (MP) que o alumno deberá entregar	10	CG4	CE35 CE36 CE37	CT1 CT2 CT7 CT9 CT10 CT15 CT16 CT17 CT20
Aprendizaxe baseado en proxectos	O proxecto consistirá nun traballo en grupos de alumnos. Avaliarase de maneira que se garanta a exixibilidad individual e a interdependencia positiva, isto é, todos os membros do grupo deben traballar e contribuír ao produto final e deben dominar, minimamente, todos os aspectos do proxecto.	25	CG4	CE35 CE36 CE37	CT3 CT5 CT7 CT8 CT9 CT10 CT15 CT16 CT17 CT20
Exame de preguntas de desenvolvemento	Exame final de avaliación continua (avalíanse todos os contidos da materia)	40	CG4	CE35 CE36 CE37	CT1 CT2 CT7 CT9 CT15 CT16

Other comments on the Evaluation

A proba final ten como obxectivo a avaliación da aprendizaxe de todos os contidos teóricos seleccionados para a materia. Confeccionarase atendendo as seguintes características. En primeiro lugar, debe ser completa, é dicir,aspirará a cubrir toda a materia impartida, posto que se trata de xulgaro que o alumno sabe dunha materia, non dunha parte dela. En segundo termo, debe conter problemas e cuestións, a fin de verificar a madurez intelectual dos alumnos para obter conclusións a partir das nocións ondas teorías expostas na clase. Realizarase na semana de avaliación e valorarase sobre 10 puntos.

As probas intermedias (2) teñen por obxecto un mellor seguimento da materia por parte do alumno, e nas que se avaliarán parte dos contidos.

O ensino baseado en proxectos de aprendizaxe realizarase a través de traballo en grupos de alumnos, e suporá o 25% da nota. O proxecto deberá ser avaliado de maneira que se garanta a exixibilidad individual e a interdependencia positiva, isto é, todolos membros do grupo deben traballar e contribuír ao produto final e deben dominar,minimamente,todos os aspectos do proxecto. Todos deben demostrar, por tanto, coñecemento profundo do produto entregado, independentemente da parte na que centraran os seus esforzos.

A avaliación das prácticas levará a cabo mediante memorias, onde se avaliará o alumno sobre os coñecementos adquiridos no laboratorio. Suporá o 10% da nota.

A avaliación sumativa final de alumno atenderá á suma da puntuación outorgada a cada unha das partes antes comentadas, sendo a súa nota de avaliación continua (NEC).

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

NEC = 0,04·PF +0,10·PI1 + 0,15·PI2 + 0,25·EBP + 0,1·MP

Se a NEC é menor de 5, o alumno deberá presentarse ao exame ordinario de todos os contidos da materia, que suporá o 100% da nota. Ademais, o alumno deberá presentarse ó exame ordinario nos seguintes supostos:

- A non realización ou entrega dalgún dos puntuables anteriores.

- Obter unha nota inferior a 4 sobre 10 en calquera das dúas partes do exame final de avaliación continua.

En calquera destes supostos, a nota de avaliación continua calcularase como: NEC FINAL = min (4,NEC).

Tamén poderán acudir ao exame ordinario todos aqueles alumnos que desexen mellorar a súa cualificación obtida por avaliación continua.

Tanto no exame ordinario como no extraordinario (convocatoria de xullo) avaliaranse todas as competencias da materia.

COMPROMISO ÉTICO: Espérase que os alumnos teñan un comportamento ético adecuado. Se se detecta un comportamento pouco ético (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros) penalizarase ao alumno coa imposibilidade de superar a materia pola modalidade de avaliación continua (na que obterá unha cualificación de 0.0). Se este tipo de comportamento detéctase en exame ordinario ou extraordinario, o alumno obterá na devandita convocatoria unha cualificación en acta de 0,0.

Bibliografía. Fontes de información

Basic Bibliography

Heywood J.B., **Internal Combustion Engine Fundamentals**,

Muñoz M. y Payri F., **Motores de combustión interna alternativos**,

Cabronero Mesas, **Motores de combustión interna**, 2ª Ed,

Monografías ENM, **Introducción a las turbinas de gas marinas**,

Monografías ENM, **Principios básicos de las turbinas de gas navales**,

Complementary Bibliography

Recomendacións

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

=== ADAPTACIÓN DAS METODOLOXÍAS ===
* Metodoloxías docentes que se manteñen
- Sesión maxistral.
- Resolución de problemas e/ou exercicios.
- Prácticas de laboratorio.
- Traballo tutelado.

* Metodoloxías docentes que se engaden
- Sesión maxistral e/ou sesión práctica virtual síncrona. Impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

* Mecanismo non presencial de atención ao alumnado (tutorías)
Os profesores da materia atenderán as dúbidas e consultas dos alumnos de forma síncrona en despachos físicos ou virtuais baixo a modalidade de concertación previa ou asíncrona por medios telemáticos (correo electrónico, foros de FAITIC, etc.).

* Modificacións (si proceden) dos contidos a impartir
Neste apartado proponse a substitución das prácticas descritas no apartado 6 polas seguintes:
Neste apartado proponse a substitución das prácticas descritas 3 polas seguintes:
- PL 3. Motores de combustión.
Estudo do funcionamento dos motores de combustión baseándose en esquemas e vídeos. Clasificación das máquinas, e particularmente dos motores de combustión interna.
- PL 4. Motores Diesel.
Estudo do funcionamento dos motores diésel mariños baseándose en esquemas e vídeos. Estudo das partes e dos sistemas (lubricación, refrixeración, distribución, etc.) dun motor.

- PL 5. Motores de 2T.
Estudo e análise de funcionamento dos motores de 2 tempos baseándose en esquemas e vídeos.
- PL 6. Motores de 4T.
Estudo e análise de funcionamento dos motores de 4 tempos baseándose en esquemas e vídeos.
- PL 7. Turbinas de gas.
Parametrización e funcionamento de turbinas de gas baseándose en esquemas e vídeos. Estudo das partes e dos sistemas (lubricación, refrigeración, distribución, etc.) dun motor.

=== ADAPTACIÓN DA AVALIACIÓN ===
Nun escenario de docencia virtual, as probas de avaliación realizaranse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto de la Universidad de Vigo.

IDENTIFYING DATA				
Basics of topography				
Subject	Basics of topography			
Code	P52G381V01410			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Solla Carracelas, María Mercedes			
Lecturers	Solla Carracelas, María Mercedes			
E-mail	merchisolla@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The course of Basics of Topography is composed of a total of seven units (theoretical teaching) that are complemented with practical classes. Depending on the objectives of the units, this course is divided into two different sections: - Section I: Topography. Composed of four units including basics aspects of topography, preparation of plans and their application to land works. - Section II. Other geomatic techniques. Composed of three units, including complementary techniques most commonly used for the recognition and representation of the terrain.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
CG5	Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
CE42	The level of topographic skills to trace and follow trails over unknown terrain
CE43	Acquire knowledge of topography and its application to the representation of the land and works.
CT2	Problems resolution.
CT3	Oral and written proficiency
CT7	Ability to organize and plan.
CT8	Decision making.
CT9	Apply knowledge.
CT10	Self learning and work.
CT17	Working as a team.
CT20	Ability to communicate with people not expert in the field.

Learning outcomes	Competences		
To know the technological base on which the topography and elaboration of plans are based.	CG3 CG4 CG5	CE42 CE43	CT2 CT3 CT7 CT8 CT9 CT10 CT17 CT20
To understand the basic aspects of the application of Topography to land works.	CG3 CG4	CE42 CE43	CT2 CT9
To know other complementary geomatic techniques for the recognition and representation of the land.	CG3 CG4 CG5	CE42 CE43	CT2 CT3 CT7 CT8 CT9 CT10

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)].	CG3		
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)].	CG4		CT2 CT8 CT9
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)].			CT9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.2.- practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Intermediate (2)].	CG4 CG5		CT2 CT9
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 [Intermediate (2)].		CE42 CE43	CT8 CT9
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large [Intermediate (2)].	CG4		CT3 CT20
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)].			CT7 CT8 CT10 CT17

Contents

Topic	
Unit 1. Introduction to Topography. Objectives: to update and review the concepts acquired by the students in the previous subjects of Topography within the specific military training. To consolidate a scientific knowledge of the basics of Topography.	1.1 Definitions. Relation of Topography with other sciences. Geodesy and Topography. Shape of the Earth: geoid and ellipsoid. Geodesic methods. Geodesic reference systems. Datum or fundamental astronomical point. Base and geodesic triangulation. Geodesy by satellite. Limit of a topographic survey. Influence of the Earth curvature in planimetry and altimetry. 1.2 Graphic representation systems. Projections. Orthogonal projection and system. Graphic representation of the terrain. Maps, charts and planes. Graphic and numerical scales. Triangulation, geodesic and topographic networks. 1.3 Cartography. Cartographic projections. Deformations and local scale. Classification of the projections. Mercator's Projection. UTM Projection. UTM grid. 1.4 Coordinates: Cartesian and polar coordinates. Geographic coordinates. Transformation of coordinates. Lines and distances. Concept of geodesic line. Angles and alignments. The terrestrial magnetic field. Magnetic declination. Magnetic and grid azimuths.
Unit 2. Instruments and systems used in Topography. Objectives: To identify and know the different instruments and systems commonly used in Topography. To acquire the necessary ability and skills for a basic management of real Topographic equipment to be used by the students during the practical sessions of the subject.	2.1 Topographic observations. Uncertainty and errors in Topography. General concepts of geometrical optics. Optical instruments. Prisms and lens. Telescopes. Topographic telescope. 2.2 Auxiliary Topographic elements: tripods, levels, platforms for levelling, plummets. Theodolites and tachymeters. Horizontal and vertical circles, vernier and micrometers. Goniometers. 2.3 Total Station. Operation of the Total Station. 2.4 Global Positioning System (GPS). Application of the GPS in geodesy and topography. 2.5 Units of measure: length, surface, angular units. Centesimal and sexagesimal systems. Transformation of units between systems. 2.6 Horizontal and vertical angles. Errors.
Unit 3. Topographic methods: planimetry and altimetry. Objectives: To know and apply the planimetric methods to properly represent a terrain into a flat surface. To know and apply the altimetric methods to properly represent the altitude and morphology of a terrain.	3.1 Planimetric methods. Method of abscissas and ordinates to an unique axis. Method of decomposition in triangles. Method of alignments. Method of radiation. Itinerary or poligonation. Method of intersections: direct and inverse intersection, mixed intersection, graphic and numerical solutions. 3.2 Altimetric methods. Levels and telescopic sights: description. Comparison plane: heights, differences of level and altitude. Trigonometric levelling. Geometrical levelling. 3.3 Digital Model of the Terrain (MDT). Contour lines. 3.4 Interpretation of planes. Visibility between two points in the terrain.

Unit 4. Applications of the Topography. Objectives: To be able to apply the theoretical and practical contents of the topography for the realisation of the different topographic works and its applications on construction as well as in other fields.	4.1 Topographic, cadastral and urban surveys. Topography in mining and tunnelling. Surveying for engineering projects. Design of a topographic project. 4.2 Profiles: longitudinal and transversal. Land movement: slope and land clearing. Civil work. Construction stakeout surveys. 4.3 Defensive organisation of the terrain. Construction of tracks and forest paths.
Unit 5. Introduction to Geomatic. Objectives: To know the different geomatic techniques for cartographic production.	5.1 Definition and fundamentals of the geomatic as source of data for cartographic production. 5.2 Introduction to long-range systems: spatial remote sensing. Landsat and Spot sensors. 5.3 Introduction to close-range systems: photogrammetry and LiDAR technology (aerial and terrestrial systems). 5.4 Introduction to the geophysical prospection: georadar and acoustic (sonar). Bathymetries.
Unit 6. Geographic Information Systems (GIS). Objectives: To know and apply the fundamentals of Geographic Information Systems, as well as the management of large amounts of cartographic and geographic data in different formats.	6.1 Concept of Geographic Information System (GIS). Differences between GIS, database and CAD. 6.2 Concepts about geographic and spatial information: data and metadata. Raster and vectorial models. Geoprocessing. Digitization and georeferencing of data. 6.3 Main applications of GIS for the management and planning of the territory. Military GIS. 6.4 Phases of a GIS project. Basic concepts of Thematic Cartography. 6.5 Cartographic data sources. Web GIS and Spatial Data Infrastructure (SDI).
Unit 7. Photogrammetry and its applications. Objectives: To know the techniques of the photogrammetry and its applications, both in civil and military fields. To understand the importance of the photogrammetry as a tool to produce maps and plans, as well as its utility for georeferencing a territory.	7.1 Aerial photogrammetry and its applications. The photography as a conical perspective. Types of aerial photographs. Aerial photography and plane: comparison. Photogrammetry. Generalities and definitions. Applications. The problem of the photogrammetry. Perspective beams. The aerial and the metric cameras. Internal data of the projective beams. Identification of homologous rays. External data of the projective beams. Control points. Intersection of homologous rays. Photogrammetric restitution. Accuracy of photogrammetric surveys. 7.2 The orthophoto. Close-range photogrammetry. Instruments and data acquisition: cameras. Measuring instruments. Methods. Applications: industrial photogrammetry, photogrammetry applied to civil engineering and architecture.
Practical Activity 1. First contact with topographic instrumentation.	Total Station and the measurement of areas.
Practical Activity 2. Planning a topographic survey in the field and design of a closed itinerary.	Method of itinerary in the field.
Practical Activity 3. Method of radiation in the field.	Acquisition of strategic and filling points.
Practical Activity 4. Elaboration of the point cloud and calculation of coordinates.	Generation of planimetry.
Practical Activity 5. MDT. Contour lines. Longitudinal and transversal profiles.	Generation of altimetry.
Practical Activity 6. Development of a GIS case study.	Geoprocessing and Thematic Cartography.
Practical Activity 7. Session dedicated to the presentation of the final projects.	Evaluation of the field project regarding the elaboration of a topographic survey.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	28	42	70
Field practice	6	6	12
Problem solving	7	7	14
Practices through ICT	4	4	8
Seminars	15	9	24
Project based learning	4	4	8
Essay questions exam	14	0	14

*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 subject. The presentations will be screened and the blackboard will be simultaneously used, as well as to the sporadically use of computerized systems. The student will have copies of the material projected, to facilitate them for taking notes and follow-up the sessions. The students will be able to consult basic bibliography for the follow-up of the subject. The participation will be encouraged through questions, motivational techniques such as intentional errors, incomplete solutions, etc.
Field practice	During the field sessions, the student will use topographic instrumentation in groups of 3-4, in order to learn the process of data acquisition. The students have to deliver, individually or as a group according to previous indication by the lecturer, the resolution of some practical case studies proposed at the end of each session. The lecturer will evaluate both the deliver of the proposed exercise as well as the results presented. If the report is delivered blank with the name of the student, it will be failed (0,0). If the report is a plagiarism of another one, the evaluation for all the practical section (outdoor study and Project) will be failed (0,0). These deliveries will serve to evaluate the phase of development of a topographic survey and data processing in the final Project. The lecturer will establish the deadline for each deliver at the end of the sessions, although it should not be extended more than two weeks from their realization.
Problem solving	The lecturer will propose activities to solve exercises related to the contents explained in the theoretical sessions, following a learning methodology based on problems.
Practices through ICT	The practical sessions in the computer room will be carried out using the means available in the center. For some sessions, the software MDT (AutoCAD) to manage different tools for the generation of plans and other concepts explained in the theoretical sessions. Software gvSIG will be also used for the geospatial analysis of geographic data, as well as for the elaboration of thematic cartography.
Seminars	Intensive course (15 hours) for those students who have failed the subject at first call, prior to the exam in second call. Group tutoring with the lecturer.
Project based learning	The students have to submit, at the end of the semester, a final Project. This Project must include all the practical procedures carried out during the outdoor study in order to perform a topographic survey, the data processing in laboratory and the elaboration of the planimetric and altimetric planes. The Project will be carried out in group (3-4 students) and the results will be presented in both forms: (1) a Project report and (2) a public presentation to the lecturer and the rest of the students in the subject. The lecturer will evaluate both the content on the report and the quality in the presentation. All the students have to participate in the public presentation. Otherwise, the project assessment will be failed (0,0).

Personalized assistance

Methodologies	Description
Problem solving	The lecturer will solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD, as well as through telematic means (email, videoconference, FAITIC forums, etc.) with previous appointment.
Project based learning	The lecturer will solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD, as well as through telematic means (email, videoconference, FAITIC forums, etc.) with previous appointment.
Seminars	Group tutoring with the lecturer, either personally or through telematic means.

Assessment

	Description	Qualification	Evaluated Competencess		
Lecturing	A mid-term exam, in a continuous assessment, to evaluate the knowledge acquired by the students in the theoretical sessions of initiation to the topography and topographic surveys.	15	CG3 CG4	CE42 CE43	CT2 CT8 CT9
Problem solving	Practical tests of laboratory/seminar to evaluate the resolution of exercises or case studies and the implementation of the theoretical knowledge acquired.	15	CG3 CG4 CG5	CE42 CE43	CT2 CT7 CT9 CT10
Project based learning	Project evaluation. The development of the project is evaluated, as well as the final report delivered, results and quality of the public presentation.	30	CG3 CG4 CG5	CE43	CT2 CT3 CT7 CT8 CT9 CT17 CT20

Essay questions exam	A final exam, in a continuous assessment, covering all the contents of the subject.	40	CG3 CG4	CE42 CE43	CT2 CT8 CT9

Other comments on the Evaluation

A numerical rating system with values from 0.0 to 10.0 points will be used according to current legislation (R.D. 1125/2003 of September 5, B.O.E. No. 224 of September 18). The subject will be considered passed when the student achieves a minimum qualification of 5.0 points.

The evaluation techniques of the subject will be:

- Final exam in continuous assessment (up to 40% of the total qualification): a final exam will be carried out covering all the contents of the subject, both theoretical and practical. It is required to achieve a minimum score of 4.0 points over 10 possible to pass the subject. The action of cheating in an exam will be penalized, and the student will be qualified in this component with 0.0 (failed).
- Mid-term test in continuous assessment (up to 15% of the total qualification): An evaluation test will be carried out throughout the semester. The test will be carried out, proposed by the lecturer, at the most appropriate times within the theory classes of the subject. This test will be mandatory and required to pass the subject. The action of cheating in an exam will be penalized, and the student will be qualified in this component with 0.0 (failed).
- Individual work based on a GIS case study (up to 15% of the total qualification): The students, individually, have to present a work based on a practical case study to be solved with GIS tools, including: purpose of the analysis, input data, analysis tools and / or geoprocessing, the results obtained and the thematic cartography elaborated.
- Development of a project (up to 30% of the total qualification): During the semester, the students have to develop a topographic survey in groups of 3-4 students. At the end of the semester, the students have to present the project in a public presentation. The presentation will be planned on the day and time previously communicated to the students and with the evaluation criteria previously indicated by the lecturer (evaluation rubric). All the students have to participate in the public presentation. Otherwise, the Project qualification will be 0.0 (failed).

Regarding the evaluation criteria and qualification of the project-based learning, the total score of the activity (30%) will be the sum of the following partial evaluations: project development (10%), content of the project report (10%) and contents and quality of the presentation (10%). In the project development, the delivery of the partial results of the project, which are obtained after each field session, will be taken into account. Both the delivery of documents and the calculation procedures and the correct resolution will be assessed. The deliveries have to be presented on time (except for properly justified reasons). Otherwise, the student will be qualified in this component with 0.0. The final qualification of this component will be reduced depending on the number of deliveries not presented on time.Those students who have not reached the minimum score in any of the qualifying tests in continuous assessment will obtain a maximum score of 4.5 in continuous evaluation.
All the students who have not passed the subject during the continuous evaluation will have the right to recover the subject in an ordinary call. Those students who wish to raise their score in continuous assessment may present this ordinary call, in which case the final exam will constitute 100% of the final score, being necessary to reach a minimum of 5.0 points to pass the subject. It is understood that the score obtained in the ordinary exam substitutes, if higher, the one obtained in the continuous evaluation.
Similarly, all the students who have not passed the subject during the first call will have the right to recover the subject in an extraordinary exam (second call). This exam will constitute 100% of the final score, being necessary to reach a minimum of 5.0 points to pass the subject.
The action of cheating in an exam will be penalized, and the student will be qualified in this component with 0.0 (failed).

Sources of information

Basic Bibliography

DOMÍNGUEZ M. Y BELDA M., **Topografía y sistemas de información geográfica.**, Universidad nacional de educación a distancia, 2003

LÓPEZ M.; MARTÍNEZ E. Y BLASCO J.J, **Topografía para estudios de grado: geodesia, cartografía, fotogrametría, topografía**, Bellisco, 2009

MUÑOZ C., **Problemas básicos de topografía. Planteados y resueltos.**, Bellisco, 2000

SÁNCHEZ A., **Problemas de métodos topográficos. Planteados y resueltos.**, Bellisco, 2015

Complementary Bibliography

DOMÍNGUEZ GARCÍA-TEJERO F., **Topografía general y aplicada**, Mundi-Prensa, 1992

FERRER R. Y PIÑA B., **Topografía aplicada a la ingeniería**, ETSICCP Universidad de Cantabria, 1992

CHUECA PAZOS M., **Topografía**, Dossat S.A., 1983

RUIZ MORALES M., **Problemas Resueltos de Geodesia y Topografía**, Comares, 1992

RUIZ MORALES M., **Nociones de topografía y fotogrametría aérea**, 2003

Recommendations

Subjects that continue the syllabus

Technical Office/P52G381V01501

Subjects that it is recommended to have taken before

Graphic expression: Graphic expression/P52G381V01101

Other comments

In order to successfully pass the subject, the student must consider the following recommendations:
1. A regular and active attendance to classes, both theoretical and practical.
2. To maintain a minimum daily study.

It is recommended that the student of the subject Basics of Topography have completed and passed previous subjects of design and spatial vision such as Graphic Expression and Graphic Engineering.
For the correct development of the theoretical classes, as well as laboratory and seminars sessions, it is recommended to have the basic calculation tools.

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE CONTENTS ===

 In the case of suspension of the face-to-face teaching, the topographic software to use for the treatment of data and cartographic elaboration will be TOPOCAL, instead of MDT.

=== ADAPTATION OF THE METHODOLOGIES ===

 A new methodology will be added: Synchronous online meeting (theory or practical session): it is given through a web videoconference platform. Each virtual classroom contains various display panels and components, whose design can be customised to best suit the needs of the class. In the virtual classroom, the lecturer (and authorised participants) can share their computer screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).

 Modification of the methodology project-based learning. In the case of suspension of the face-to-face teaching, the development of the project will follow one of the following itineraries: (1) In the case that field practices and data collection for the project can be done: in-situ data collection and processing, until the points cloud is obtained, will be carried in groups (3-4 students each group). Later, the data will be treated individually in topographic software and each student must present the project in the form of a report and presentation (speech) to the lecturer; (2) In the case that field practices and data collection for the project cannot be done: the lecturer will provide topographic data (from a real survey) to the student so that, individually, he/she must process such data until the generation of the points cloud is done. Later, the data will be treated individually in topographic software and each student must present the project in the form of a report and presentation (speech) to the lecturer

=== ADAPTATION OF THE EVALUATION ===

 The evaluation tests will be carried out by combining the FAITIC-Moodle platform for online teaching and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Technical Office				
Subject	Technical Office			
Code	P52G381V01501			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	5th	1st
Teaching language	Spanish			
Department				
Coordinator	Núñez Nieto, Xavier			
Lecturers	Núñez Nieto, Xavier Rodríguez Rodríguez, Francisco Javier			
E-mail	xnnieto@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course, common to the industrial branch, pursues to orient the student in the acquisition of the knowledge and the skills that enable them for the handle and application of methodologies and technical tools, regarding with the organisation and management of engineering projects and another technical documentation of usual use in a Technical Office. To achieve this mentioned aims there are applied a wide approach of the units composing the course, looking for the integration of the knowledge adquired along the degree and its application by means of a methodology, organisation and management of distinct modalities of technical works, as true essence of the profession of engineer, in the frame of his attributions and fields of activity. It promotes the development of the competences of the matter by means of active and technical methodologies of collaboration. In this way, the exposed contents in theoretical classes implement in the development of the practical activities, oriented to the industrial reality of the profession, assimilating the agile and precise employment of the distinct rule of application and of the professional best practices established, supporting in the new technologies to document, elaborate, manage and present the technical documentation that correspond.			

Competencies	
Code	
CG1	Skills for writing, signing and developing projects in the field of industrial engineering, whose purpose is, specializing in Mechanics, according to the knowledge acquired pursuant to paragraph 5 of this order, construction, alteration, repair, maintenance, demolition, manufacturing, installation, assembly or operation of: structures, mechanical equipments, energy facilities, electrical systems and electronic installations and industrial plants, and manufacturing processes and automation.
CG2	Ability to manage the activities object of the engineering projects described in CG1.
CE18	Knowledge and skills to organize and manage projects. To know the organizational structure and functions of a project office.
CT2	Problems resolution.
CT3	Oral and written proficiency
CT5	Information Management.
CT7	Ability to organize and plan.
CT8	Decision making.
CT9	Apply knowledge.
CT10	Self learning and work.
CT12	Research skills.
CT14	Creativity.
CT15	Objectification, identification and organization.
CT17	Working as a team.
CT20	Ability to communicate with people not expert in the field.

Learning outcomes	Competences		
Manage of methods, technics and tools of design, organisation and management of projects	CG1 CG2	CE18	CT3 CT5 CT7 CT8 CT9 CT14 CT15 CT17 CT20

Ability in the handle of information an communication systems in the industrial field.	CG1 CG2	CE18	CT3 CT5 CT7 CT8 CT9 CT10 CT14 CT15 CT17 CT20
Ability to generate the documents of the project and other similar technical documents.	CG1		CT3 CT5 CT20
Ability in the facultative direction of projects in the field of the industrial engineering.	CG2	CE18	CT5 CT7 CT8 CT17 CT20
Skills to communicate properly the knowledge, procedures, results of the field of the Industrial Engineering.	CG1		CT3 CT20
ENAEE LEARNING OUTCOME: KNOWLEDGE And UNDERSTANDING: LO1.3.- Awareness of the wider multidisciplinary context of engineering (Level of achievement: Intermediate (2)).		CE18	
ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS: LO2.1.- Ability to analyse complex engineering products, processes and systems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to correctly interpret the outcomes of such analyses (Level of achievement: Intermediate (2)).	CG1 CG2		CT2 CT8 CT9
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 (level of achievement: Intermediate (2)).			CT2 CT8 CT9 CT14
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 (level of achievement: Intermediate (2)).		CE18	CT2 CT7 CT9
ENAEE LEARNING OUTCOME: ENGINEERING DESIGN: LO3.2.- Ability to design using some awareness of the forefront of their engineering specialisation (level of achievement: Intermediate (2)).	CG1	CE18	CT7 CT9
ENAEE LEARNING OUTCOME: INVESTIGATIONS: LO.4.1.- 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 (level of achievement: Intermediate (2).		CE18	CT5 CT12
ENAEE LEARNING OUTCOME: INVESTIGATIONS: LO4.2.- Ability to consult and apply codes of practice and safety regulations in their field of study (level of achievement: Intermediate (2)).		CE18	
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: Intermediate (2)).		CE18	CT2 CT9 CT12 CT15
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: Intermediate (2)).			CT8 CT9
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICE: LO5.4.- Ability to apply norms of engineering practice in their field of study (level of achievement: Intermediate (2)).		CE18	CT9
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICE: LO5.5.- Awareness of non-technical - societal, health and safety, environmental, economic and industrial implications of engineering practice (level of achievement Intermediate (2)).		CE18	
ENAEE LEARNING OUTCOME: MAKING JUDGEMENTS: LO6.2.- Ability to manage complex technical or professional activities or projects in their field of study, taking responsibility for decision making (level of achievement: Intermediate (2)).	CG1 CG2	CE18	
ENAEE LEARNING OUTCOME: COMMUNICATION AND TEAM-WORKING: LO7.1.- Ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large (level of achievement: Intermediate (2)).	CG1		CT3 CT5 CT20

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: Intermediate (2)).	CG1	CT3 CT5 CT7 CT8 CT10 CT17 CT20

Contents	
Topic	
Unit 1. The technical office	1.1 Concept of technical office 1.2 Functions and scope of work 1.3 Departmental infrastructure 1.4 Exercise of the engineer profession 1.5 Attributions and professional competences 1.6 Professional engineering associations
Unit 2. Stages of the project	2.1 Previous study 2.2 Preliminary engineering 2.3 Detail engineering 2.4 Material execution
Unit 3. Project management	3.1 Methodology 3.2 Organisation of the project 3.3 Planning procces 3.4 Management software
Unit 4. Documents of the project	4.1 Memory 4.2 Planes 4.3 Folder of Conditions 4.4 Budget 4.5 Own entity documents 4.6 Attachments
Unit 5. Transaction and contracting	5.1 Criteria and procedure rules 5.2 Licenses, authorizations and permits 5.3 Bidding and contracting
Unit 6. Facultative direction	6.1 Protagonists in the execution of a project 6.2 Functions of the facultative direction 6.3 Obligations and responsibilities
Unit 7. Legal framework	7.1 Legislative basis and scope of the project 7.2 Specifications and technical standards 7.3 Standardization, certification and homologation 7.4 Standardization and certification entities
Laboratory: Engineering Project	Description: During the laboratory sessions, the group development of a traditional Mechanical Engineering project will be carried out, applying the knowledge acquired during the theoretical sessions, which will cover the overall content of the whole subject. This project will include all the technical documentation associated with the elaboration of its content, namely: Memory, Plans, Folder of Conditions and Budget. Objectives: Analysis of the problem, situation, conditioning characteristics and feasibility study. Preparation of the technical documentation associated with the project, including descriptive memory, measurements and calculations. Handling, scaling, plotting and folding of planes. Study and elaboration of the technical, optional, economic and legal specifications. Estimate of the material execution budget. Exhibition and public oral defence of the projected work. Duration: The students will have the practical laboratory sessions, under the supervision of the teachers, to carry out the development of the project, which will culminate with its defense and oral presentation.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	28	42	70
Laboratory practical	12	24	36

Seminars	23	0	23
Practices through ICT	6	6	12
Objective questions exam	6	0	6
Project	2	0	2
Problem and/or exercise solving	1	0	1

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

Methodologies

	Description
Lecturing	Master class. Each thematic unit will be presented by the lecturer, complemented with the comments of the students with base in the bibliography assigned or another pertinent. In these sessions, there will be explained in detail the basic theoretical contents of the program, exposing explanatory examples from which deepen in the understanding of the subject. They will be used computer presentations and the blackboard, especially to transmit information like definitions, charts and so on. Whenever is possible, there will be provided a copy of the slides to the students before the exhibition, focusing the effort of the lecturer and the student on the exposure and understanding of the knowledge. Anyway, the reproductions in paper of the slides never have to be considered like substitutes of the texts or notes, but like complementary material.
Laboratory practical	It will be proposed a project of realisation in group that will cover the knowledge and the total length of the course. For the realisation of that task there will be employed the methodology of project-based learning. It will be provided the needed material for the realisation of the work. Finally there will be carried out a public exhibition of the project.
Seminars	An intensive review course will be held, aimed at students who fail to pass the subject in the first call.
Practices through ICT	There will be proposed exercises that will be solved in group or individually. By means of this methodology and the suitable software of project management, there will be carried out diverse activities, whose final result will suppose the whole planning process corresponding to a constructive project considering all its stages.

Personalized assistance

Methodologies	Description
Seminars	The teaching staff of the subject will attend to the doubts and queries of the students in a presential and telematic way (email, videoconference, virtual forums and etc), during the tutoring schedule available on the website of the center.

Assessment

	Description	Qualification	Evaluated Competencess		
Objective questions exam	There will be carried out two written exams with questions test type and/or of development on the theoretical sessions: One Intermediate Exam (PI) with an average weight of 20% on the grade of the course and a Final Exam (PF) with an average weight on the grade of the matter of 40%.	60	CG1	CE18	CT5 CT8 CT14 CT15
Project	Project report and defence by means of oral presentation.	30	CG1 CG2	CE18	CT2 CT3 CT5 CT7 CT8 CT9 CT10 CT12 CT14 CT15 CT17 CT20
Problem and/or exercise solving	Planning report that will cover all the sessions in this regard.	10	CG2	CE18	CT2 CT5 CT7 CT8 CT9 CT15 CT17

Other comments on the Evaluation

The final evaluation will be the sum of the punctuation awarded to each one of the before commented parts, being the Note of Final Continuous Evaluation (FCE):

FCE = 0,6 * THEORY + 0,3 * PROJECT + 0,1 * REPORT

In addition to reaching a final qualification of at least 5 points on 10 (FCE ≥ 5), to surpass the matter by continuous evaluation there will be demanded some minimum requirements, that guarantee the balance between all the types of skills. These requirements are the following:

- To obtain a note of at least 4 points on 10 in the continuous evaluation final exam (PF).

In case of not surpassing the matter by continuous evaluation, the students will have to attend the ordinary examination of first call. Likewise, in the particular supposition of not to fulfil the minimum requirements established, the qualification of the continuous evaluation will be calculated as follows: FCE FINAL = min (4, FCE). On the other hand, the students that surpass the matter by continuous evaluation will be able to attend to the ordinary examination of first call to improve their qualification.

Both, in the ordinary examination of first call and the extraordinary (second call), will be evaluated all the skills of the course, including those referred to the theoretical sessions, practical, seminars and to the realisation of the group project.

The detection of academic fraud during the development of the continuous evaluation will suppose automatically the impossibility to surpass the matter by means of the mentioned modality and will imply a qualification of 0 points in that. The detection of academic fraud, either in ordinary announcement or extraordinary, will imply automatically a qualification of 0 points in both cases.

Sources of information

Basic Bibliography

Brusola Simón, Fernando, **OFICINA TÉCNICA Y PROYECTOS**, Servicio de Publicación de la Universidad Politécnica de Valencia, 1ª Edición, 2011

Santos Sabrás, Fernando, **INGENIERÍA DE PROYECTOS**, Eunsa, 2ª Edición, 2002

Complementary Bibliography

Arenas Reina, J.M., **OFICINA TÉCNICA**, Fundación General de la Universidad Politécnica de Madrid, 3ª Edición, 2010

Cano, J.L., **MANUAL DE GESTIÓN DE PROYECTOS**, Asociación Española de Ingeniería de Proyectos (AEIPRO), 1ª Edición, 2003

De Cos Castillo, Manuel, **TEORIA GENERAL DEL PROYECTO I: GESTIÓN DE PROYECTOS**, Síntesis, 4ª Edición, 1997

De Cos Castillo, Manuel, **TEORIA GENERAL DEL PROYECTO II: INGENIERIA DE PROYECTOS**, Síntesis, 3ª Edición, 1997

Díaz Martín, Ángel, **EL ARTE DE DIRIGIR PROYECTOS**, Servicio de Publicación de la Universidad Politécnica de Valencia, 3ª Edición, 2010

Gómez-Senent Martínez, Eliseo; González Cruz, Mª Carmen, **TEORÍA Y METODOLOGÍA DEL PROYECTO**, Servicio de Publicación de la Universidad Politécnica de Valencia, 1ª Edición, 2008

Martínez de Pisón Ascacíbar, Francisco Javier, et al., **LA OFICINA TÉCNICA Y LOS PROYECTOS INDUSTRIALES**, Asociación Española de Ingeniería de Proyectos (AEIPRO), 1ª Edición, 2002

Serer Figueroa, Marcos, **GESTIÓN INTEGRADA DE PROYECTOS**, Ediciones UPC, 3ª Edición, 2010

Canito Lobo, José Luis, **Autodesk Inventor 2017**, Anaya, 1ª Edición,

Chatfield, Carl, Johnson, Tymothy, **MICROSOFT PROJECT 2013: STEP BY STEP**, Microsoft Press, 4ª Edición, 2013

Hervo, Corinne, **MICROSOFT OFFICE 2013: WORD, EXCEL POWERPOINT Y OUTLOOK 2013: FUNCIONES BÁSICAS**, Ediciones ENI, 1ª Edición, 2014

Leach, James A., **AUTOCAD 2016 INSTRUCTOR**, SDC Publications, 1ª Edición, 2016

Reyes Rodríguez, Antonio Manuel, **AUTOCAD 2016**, Anaya, 1ª Edición, 2015

Recommendations

Subjects that continue the syllabus

Final Year Dissertation/P52G381V01991

Subjects that it is recommended to have taken before

Graphic expression: Graphic expression/P52G381V01101
Graphic engineering/P52G381V01304

Other comments

For the successfull development of this subject it is recommended to possess a personal profile in which they are present the following qualities and skills:

- Capacity of written and oral understanding.
- Autonomous capacity for research and information compilation.
- Skills for the work in group.
- Basic notions related with the field of the design in the engineering, the calculation of installations and the industrial construction.

Contingency plan

Description

ANNEX: MODIFICATIONS IN CASE OF SITUATIONS INVOLVING THE SUSPENSION OF PRESENTIAL ACADEMIC ACTIVITY

6. Contents

Both blocks of the subject, theoretical and practical, will be carried out using online teaching platforms, either synchronously (Remote Campus / Adobe Connect) or asynchronously (FaiTIC / Moodle).
The practical sessions (project and seminars) will take place virtually, through the use of specific software relevant to each situation and, if strictly necessary, the implementation of these activities will be used in a demonstrative manner.

8. Teaching methodology

A new teaching methodology is added:
Synchronous online meeting (theory or practical session): It is taught through a web video conferencing platform. Each virtual classroom contains various display panels and components, the design of which can be customized to best suit the needs of the class. In the virtual classroom, teachers (and those authorized participants) can share their computer screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).

10. Assessment

The evaluation tests will be carried out by combining the FAITIC-Moodle remote teaching platform and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Naval sensors				
Subject	Naval sensors			
Code	P52G381V01502			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	5th	1st
Teaching language	Spanish			
Department				
Coordinator	Gómez Pérez, Paula			
Lecturers	Gómez Pérez, Paula Rodríguez Molares, Alfonso			
E-mail	paula@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject gets framed into the Intensification in Naval Technology, and its goal is to provide the student with a theoretical and practical training over the basic operation of radar, sonar and optoelectronic sensors in naval and terrestrial environments. Along this subject, students learn the concept of naval sensor and will acknowledge the most usual sensors in their operative environment. The main concepts for all remote sensing system will be provided, so the student understand the multidisciplinary character of this subject, applying different knowledge from previous subjects, such as radiocommunication systems, electronic circuits and filters, automatic control, electrotechnics of physics (electromagnetic fields). It will be mainly focused on radar sensors, both continuous and pulsed wave systems, analysing the parameters that limit the radar range, the probability of detection and of false alarm, the concept of radar cross section, clutter, etc. We will also analyse the basic and most common techniques for radar signal processing, most of them used in other remote sensing systems (such as sonar), emphasizing the multidisciplinary nature of the subject. The student will be able to understand the proper acoustic characterisation of the underwater environment, and the propagation issues associated, such as noise and reverberation. The architecture and characterisation of the active and passive sonar systems will also be studied, along with their acoustics tranducers. Lastly, the optical spectrum and the classification of the existing emitting sources will be analysed, understanding the operation of the distinct types of optoelectronic sensors and their main characteristics.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CE30	To understand the principles that govern the operation of communications systems and naval sensors.
CT1	Analysis and synthesis
CT2	Problems resolution.
CT5	Information Management.
CT8	Decision making.
CT9	Apply knowledge.
CT10	Self learning and work.
CT16	Critical thinking.

Learning outcomes	Competences		
To know the technological basis supporting naval sensors.	CG3	CE30	CT1 CT5 CT10
To understand the basic operation of naval sensors.	CG3	CE30	CT1 CT2 CT8 CT9 CT10 CT16

ENAEE LEARNING OUTCOME: KNOWLEDGE AND UNDERSTANDING LO 1.2 Knowledge and understanding of the engineering disciplines of their specialty, at the proper level to acquire the rest of the competences of the degree, including notions of the latest advances. (level of development of this sub-learning outcome: Medium (2))	CG3	
ENAEE LEARNING OUTCOME: KNOWLEDGE AND UNDERSTANDING LO 1.3 Be aware of the multidisciplinary context of engineering. (Medium (2))	CE30	
ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS LO 2.2 Ability to identify, formulate and solve engineering problems within an specialty; choose and apply properly analytical methodologies; recognize the importance of social, health and safety, environmental, economic and industrial restrictions. (Medium (2))		CT1 CT2 CT8 CT9 CT16
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICAL APPLICATION LO 5.15.1 Understanding the applicable techniques and methods for analysis, planning and research and their limitations in the field of their specialty. (Medium (2))		CT9
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICAL APPLICATION LO 5.3 Application knowledge on materials, equipment and tools, technology and engineering processes and their limitations within the field of their specialty. (Medium (2))	CE30	CT8 CT9
ENAEE LEARNING OUTCOME: CONTINUOUS EDUCATION LO 8.1 Ability to realize the need for continuous training and undertake this activity throughout their professional life on their own. (Basic (1))		CT8 CT10

Contents

Topic	
Chapter 1. Introduction to Naval Sensors	1.1 Basic concepts of naval sensors. 1.2 Frequency bands. 1.3 Introduction to radar systems. 1.4 Fundamental parameters of radar systems: PRF/PRI, range resolution, angular resolution, maximum non-ambiguous range, time of observation, ... 1.5 Monostatic, bistatic and multistatic radar systems 1.6 Pulsed wave and continuous wave radar systems. 1.7 Radar cross section (RCS) and simplified radar range equation. 1.8 Simplified block diagram of a radar system.
Chapter 2. Pulsed wave radar systems	2.1 Introduction 2.2 Signal-to-noise ratio and probability of detection. 2.3 Pulse integration techniques. 2.4 Attenuation losses in radar range equation: 2.4.1 Fluctuating targets. 2.4.2 Propagation losses. 2.4.3 Atmospherical losses. 2.4.4 Interferences: clutter, jamming, ... 2.5 Radar Cross Section (RCS) and stealth technologies.
Chapter 3. Continuous wave radar systems	3.1 Introduction: 3.1.1 Doppler effect. 3.1.2 Pulsed wave (PW) radar vs. continuous wave (CW) radar systems. 3.2 CW radars modulated in frequency (CWFM). 3.2.1 With sawtooth modulation (CHIRP). 3.2.2 With triangular modulation. 3.3 Radar range equation for CW radar systems. 3.4 Advantages and disadvantages of CW radar systems.
Chapter 4. Digital signal processing	4.1 Pulse compression techniques. 4.1.1 Frequency pulse compression. 4.1.2 Phase pulse compression. 4.2 MTI systems and pulse-Doppler systems. 4.3 PRF Staggering
Chapter 5. Optoelectronical sensors	5.1 Optical spectrum. 5.2 Infrared sensors (thermal, medium-IR) 5.3 Night-vision sensors (near-IR). 5.4 Optoelectronic emitters: Laser vs. LED. 5.5 Optoelectronic sensors: photodetectors. 5.6 Other sensors and applications: laser telemeter, luxometer, etc.

Chapter 6. Acoustic sensors and sonar systems	6.1 Introduction. 6.2 Acoustic oceanography. 6.3 Underwater signal propagation. 6.4 Active and passive sonar systems. 6.5 Noise and reverberation.
Chapter 7. Specific purpose radar systems	7.1 Multifunction radars. 7.2 Secondary radar (IFF). 7.3 LPI radars. 7.4 Sinthetic aperture radars (SAR).
Practice 1: Introduction to remote sensing and radar systems	The goal of this practice is introducing the basic concepts of remote sensing and radar systems analysed in the theoretical classes. By means of short Matlab scripts, the influence of each one of the parameters in the simplified radar range equation will be illustrated. The relationship between resolution and pulse spreading for a target conformed by several primary scatterers will be analysed. Students will be able to check whether some common techniques (such as pulse integration) effectively improve the probability of detection.
Practice 2: Pulsed wave radars (PW radars)	This practice enhances the comprehension of the operative differences between PW and CW radars, as well as their different applications and limitations. Radar simulators will be used instead real radar systems, because, on the one hand, it is neither operative nor safe to activate several of such systems within a short range, and in the second hand, simulators allow to create different tactical scenarios which could not be possible in a real environment. An overview of radar cross section concepts explained in theory will also be analysed. The dependence on the geometry of the radar cross section and radar response will be studied, as well as Swerling models for fluctuating targets.
Practice 3: Movement detector radar	This practice describes a simple CW radar system works, by means of a movement sensor. The student will set up a basic CW radar system within the Laboratory, where the ability of the student to handle instrumentation equipment will also be evaluated.
Practice 4: Digital signal processing	The goal of this practice is to help the comprehension of the digital signal processing techniques used in radar systems nowadays. It will include: MTI systems, filter banks and pulse compression techniques.
Practice 7: Electronic warfare systems and antimissile defence	The goal of this practice is to understand in depth the existing methodologies for electronic warfare regarding the antimissile defence for surface platforms.
Practice 6: Underwater acoustics	This practice focuses on recognizing and differentiating the underwater noises that might affect a sonar system. The student should be able to extract the parameters of interest in each of the cases under studio, in order to be able to differentiate the analyzed sound.
Practice 5: Optoelectronic systems	The goal of this practice is to get the student to know about optoelectronic sensors operating either in visible or in non-visible spectrum. Hence, in the Laboratory they will learn to operate different optoelectronic equipment, such as thermal cameras, night-vision cameras, telemeters, □ They will also learn about the primary light-emitting devices, such as LEDs or LASER.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	28	42	70
Laboratory practical	14	7	21
Seminars	21	5	26
Problem and/or exercise solving	9	12	21
Problem and/or exercise solving	2	4	6

Objective questions exam	1	1	2
Essay	1	3	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	Lectures. These sessions will be used to explain in detail the theoretical contents of the syllabus. Whiteboard and slides will be used as the basic methodology. Whenever slides are used, a copy in paper will be provided beforehand. However, slides should not be considered as a replacement for lectures, since they are only complementary material.
Laboratory practical	Lectures If necessary, a prior explanation of some particular concepts will be performed beforehand, in order to optimize the practical sessions. Laboratory practices: Students will be working in groups and the professor will take care of their work. The goal of these sessions is to strengthen the theoretical concepts studied in theoretical lectures. Practical sessions have a series of rules that the student must abide: - Practical sessions are compulsory and in-person classes. - Lost sessions cannot be recovered, unless justified absences.
Seminars	Some weekly hours will be dedicated to solve problems, where small groups will be encouraged. This section includes the intensive course designed for preparing the extraordinary exam.

Personalized assistance

Methodologies	Description
Seminars	Two types of tutorial actions might be distinguished: the academic tutoring and the personalized tutoring. In the academic tutoring, office hours will be at the student disposition where they can consult any doubt related with the contents, organisation and/or schedule of the subject. Tutorials can be individualized, encouraging group sessions for problem-solving hours. In the personalized tutoring, each student, individually, will be able to comment with the professor any problem with the subject, with the goal of finding a proper solution. Combining both types of tutorial actions, the different paces of learning will be attended through attention to diversity. Lectures will properly assist the students through the learning process, both in-person and/or online formats (email, VTC, FAITIC forums,...), and always under prior appointment.

Assessment

	Description	Qualification	Evaluated Competencess		
Problem and/or exercise solving	Midterm exam: It will evaluate 30% of the theoretical knowledge of the subject. Individual, of about approximately 1 hour. Over 10 points. Can have the form of test, short questions, problems or a combination of all of them. No minimum required.	30	CG3	CE30	CT1 CT2 CT5 CT8 CT9 CT10 CT16

Problem and/or exercise solving	Final term exam: It will evaluate the 40% of the theoretical knowledge of the subject. Individual, about 2-3 hours. Over 10 points. Can have the form of test, short questions, problems or a combination of all of them. A minimum of 4.0 points over 10 is required in each of the parts to be able to pass the subject.	40	CG3	CE30	CT1 CT2 CT5 CT8 CT9 CT10 CT16
Objective questions exam	Laboratory exams: It will evaluate 20% of the practical knowledge of the subject, divided in 2 test of a 10%. Individual, of about 10-20 min. Over 10 points. Can have the form of test, short questions, problems or a combination of all of them. A minimum of 4.0 over 10 is required in the 20% assigned to laboratory training.	20		CE30	CT1 CT2 CT5 CT8 CT9 CT16
Essay	Multimedia video: It will evaluate 10% of the full knowledge of the subject (theoretical and practical). Video recorded by the students, performing an easy subject-related experiment. Maximum length: 3 min. Individual, or in groups of two students. Over 10 points.	10	CG3	CE30	CT1 CT2 CT9 CT10

Other comments on the Evaluation

Ordinary exam:

The weight of the distinct parts in the final note of the ordinary exam (*NEO*) gets distributed as follows:

- Theory (*T*): 80%
- Practices (*L*): 20%

Theory:

Consists of:

- A single exam, of approximately 2-3 hours, to be performed within the course calendar.
- Ranked over 10 points (*T*).
- Individual.
- It can include tests, short questions and/or problems or a combination of them.

Laboratory:

Consists of:

- A single exam, of approximately 20-30 min., regarding the contents of the practical sessions.
- Ranked over 10 points (*L*).

- Individual.
- It can include tests, short questions and/or problems or a combination of them.

Final mark and minimum requirements to pass the subject:

The final mark (*NEO*) will be computed following the next equation:

NEO = 0.8 * T + 0.2 * L

A minimum of 4.0 points over 10 is required for both the L exam and the T exam. Once obtained these minimums, a minimum of 5.0 points over 10 in the total computation of *NEO* is mandatory to pass the subject.

Extraordinary exam:

The students that did not pass the subject on first convocatory must attend the second convocatory (or extraordinary exam), that will have the same structure, exam duration, percentages and minimum points required thant in the ordinary exam.

Code of Honor:

During exams, the use of non-allowed electronic devices, notes or books is forbidden.

Exams lacking some of the sheets will not be graded.

Results obtained must be properly justified in all cases, in any of the exams or activities. None of the numerical results will be considered if no explanation is given about the methodoly used to obtain them.

It is expected that all the students abide to these considerations. If a non-ethical behaviour is detected, the student will automatically be graded with a 0.0 at the current examination.

Sources of information

Basic Bibliography

Curry, G. Richard, **Radar Essentials. A concise handbook for radar design and performance analysis**, 1ª ed., Scitech Publishing Inc., 2012

Complementary Bibliography

Denny M., **Blip, Ping & Buzz. Making sense of radar and sonar**, 1ª ed., The Johns Hopkins University Press, 2007
Skolnik, Merril I., **Introduction to Radar Systems**, 3ª ed., McGraw□Hill, 2003
Eaves J., Reedy E., **Principles of Modern Radar**, 2ª ed., Springer, 2011
Marage J., Mori Y.,, **Sonars and Underwater acoustics**, 1ª ed., Wiley, 2010
Mahafza B. R., **Radar systems analysis and design using Matlab**, 3ª ed., CRC Press, 2010

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics II/P52G381V01106
Fundamentals of electrical engineering/P52G381V01205
Electronic technology/P52G381V01301
Radio-communication systems/P52G381V01408

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION INTO A DISTANCE-LEARNING ENVIRONMENT ===

If a new lockdown situation might appear, leading to a non-presential and online scenario, the following modifications might

apply:

=== CONTENTS ADAPTATION ===

3.1 Theoretical contents

Theoretical classes and contents should not be affected by an online scenario. In case the schedules are tighten, contents will be adapted to the new situation, in order to guarantee the proper achievement of the competences and learning outcomes of the subject.

3.2 Laboratory sessions

Since it will not be possible to provide laboratory classes, those practices will be replaced by their equivalents in an online environment.

In particular, the next changes will be applied:

Practice 3: Movement detector radar
The contents of this laboratory class will be replaced by experimentation with a continuous-wave radar simulator. In the maximum extent possible, similar scenarios will be replicated, so that the student might be seeing similar effects to a real environment.

Practice 5: Optoelectronic systems
The loss of this practical class might have an important impact in the learning outcomes (specially LO 5.3). In this case, real equipment will be replace by the demonstrative videos (or similar multimedia resources) to explain how these devices work.

Practice 6: Underwater acoustics
This practice will be replaced by underwater acoustic simulators, in order to provide similar or equivalent results.

The rest of the laboratory sessions should not be affected by an online situation.

=== METHODOLOGIES ADAPTATION ===

A new lecturing methodology should be added:

Virtual session:
Classes will be provided by means of videoteleconference (VTC) within a virtual room. Resources will depend on the platform used, but will include virtual blackboards/whiteboards, chats, file sharing, audio and video transmission, polls,

=== ASSESSMENT ADAPTATION ===

Assessment methodologies regarding weights, minimums, and number of tests will be the same in any scenario (in-person or online classes).
In an online environment, the difference might be the format of the assessment test, that will take place within the platform FAITIC-MOODLE and Campus Remoto from the University of Vigo (and/or similar platforms).

IDENTIFYING DATA				
Fundamentos de redes de ordenadores				
Subject	Fundamentos de redes de ordenadores			
Code	P52G381V01503			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	5	1c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Fernández Gavilanes, Milagros			
Lecturers	Fernández García, Norberto Fernández Gavilanes, Milagros Rodelgo Lacruz, Miguel			
E-mail	mfgavilanes@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Esta materia enmárcase dentro da Intensificación en Tecnoloxías Navais, e nela perséguese dotar ao alumnado dunha formación, tanto teórica como práctica, sobre os conceptos fundamentais das redes de comunicación e servizos telemáticos: a base tecnolóxica da transmisión de datos, a arquitectura das redes e os servizos de comunicación, os principais compoñentes das infraestruturas TIC, os métodos de xestión e planificación de redes e os aspectos básicos da seguridade nas redes de computadores. Na parte final da materia introdúcense cuestións básicas relacionadas coa ciberdefensa e a ciberseguridad. As clases de aula utilizaranse para a introdución dos conceptos teóricos, que se complementarán con distintas prácticas de laboratorio e a resolución de problemas durante as sesións de titoría e os seminarios.			

Competencias	
Code	
CG3	Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
CE31	Adquirir a capacidade para comprender os conceptos de arquitectura de rede, protocolos e interfaces de comunicacións.
CE32	Adquirir a capacidade de diferenciar os conceptos de redes de acceso e transporte, redes de conmutación de circuítos e de paquetes, así como coñecemento dos métodos de interconexión de redes e encamiñamento.
CE33	Coñecer e utilizar correctamente os sistemas de información.
CT1	Análise e síntese.
CT2	Resolución de problemas.
CT3	Comunicación oral e escrita de coñecementos.
CT6	Aplicación da informática no ámbito de estudo.
CT8	Toma de decisións.
CT9	Aplicar coñecementos.
CT10	Aprendizaxe e traballo autónomos.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Coñecer a base tecnolóxica sobre a que se apoian a telemática e a transmisión de datos.	CG3	CE31 CE32 CE33	CT1 CT3 CT6 CT9 CT10
Comprender os principios básicos e arquitecturas de redes e servizos de comunicación.	CG3	CE31 CE32 CE33	CT3 CT6 CT9 CT10
Coñecer os principais compoñentes das infraestruturas das TIC.	CG3	CE31 CE32 CE33	CT1 CT2 CT3 CT6 CT8 CT9 CT10

Coñecer basicamente os aspectos da seguridade nas redes de computadores.	CG3	CE31 CE32 CE33	CT1 CT3 CT6 CT9 CT10
Resultado de aprendizaxe ENAEE: 1.- Coñecemento e comprensión. Sub-resultado de aprendizaxe 1.3.- Ser conscientes do contexto multidisciplinar da enxeñaría. Nivel de desenvolvemento do sub-resultado: Adecuado (2)		CE31 CE32 CE33	
Resultado de aprendizaxe ENAEE: 5.- Aplicación práctica da enxeñaría. Sub-resultado de aprendizaxe 5.1.- Comprensión das técnicas aplicables e métodos de análise, proxecto e investigación e as súas limitacións no ámbito da súa especialidade. Nivel de desenvolvemento do sub-resultado: Adecuado (2)			CT9
Resultado de aprendizaxe ENAEE: 5.- Aplicación práctica da enxeñaría. Sub-resultado de aprendizaxe 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 do sub-resultado: Adecuado (2)		CE31 CE32 CE33	CT6 CT9

Contidos

Topic	
Introdución, protocolos e capas	Obxectivos e motivación. Uso das redes de computadores. Compoñentes das redes de computadores. Conexións e encamiñamento. Capas de protocolos. Modelos de referencia. Historia de Internet.
As capas físicas e de enlace	Introdución á capa física. Medios de transmisión. Sinais e modulacións. Capacidade límite das canles de comunicación. Introdución á capa de enlace. Entramado. Introdución aos erros de transmisión. Detección e corrección de erros.
Retransmisións, acceso múltiple e conmutación	Retransmisións. Multiplexación. Acceso múltiple aleatorio. Acceso múltiple inalámbrico. Acceso múltiple sen contención. Conmutadores para redes de área local. A árbore de expansión (spanning-tree).
Reenvío de paquetes e conexión de redes	Introdución á capa de rede. Servizos de rede. Conexión entre redes. Prefixos IP. Reenvívos IP. Complementos IP: ARP e DHCP. Fragmentación de paquetes IP. Erros IP (ICMP). IP versión 6. Tradución de direccións de rede (NAT).
Encamiñamento	Introdución ao encamiñamento. Encamiñamento segundo o camiño máis curto. O algoritmo de Dijkstra. Inundación. Encamiñamento segundo o estado dos enlaces. Equipos e encamiñadores. Encamiñamento xerárquico. Subredes e agregación de prefixos. O protocolo da pasarela fronteira.
A capa de transporte, transporte fiable	Introdución á capa de transporte. Protocolos de transporte sen conexión: User Datagram Protocol (UDP). Protocolos de transporte orientados a conexión: Establecemento da conexión. Liberación da conexión. A xanela deslizante. Control de fluxo. Temporizadores de retransmisión. Transmission Control Protocol (TCP). Control de conxestión.

Calidade de servizo	Introdución á calidade de servizo. Transporte en tempo real. Transmisión de datos multimedia.
A capa de aplicación	Introdución á capa de aplicación. Servidores de nomes: DNS. Introdución a HTTP. Prestacións de HTTP. Proxies e cachés HTTP. Redes de distribución de contidos.
Sistemas de información na rede.	Arquitectura e componentes dun sistema de información. Bases de datos e mecanismos de almacenamento de información. Procesado e presentación de información. Sistemas de información distribuidos.
Ciberdefensa e ciberseguridade	Introdución á seguridade nas redes de computadores. Aspectos ético-sociales da seguridade nas redes. Confidencialidade das mensaxes. Autenticide de mensaxes. Seguridade inalámbrica. Seguridade web. Redes privadas virtuais. Xestión de riscos na ciberseguridade. Ciberseguridade, ciberdefensa e ciberguerra
Sistemas de información e mando e control na Armada	Xeneralidades da Intranet. Sistemas de mando e control. NATO Secret WAN. Sistema de mando naval. SIJE. Futuro dos sistemas de información. SIM.

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	28	47	75
Prácticas de laboratorio	12	12	24
Resolución de problemas	7	0	7
Traballo tutelado	15	14	29
Presentación	2	2	4
Práctica de laboratorio	3	0	3
Exame de preguntas de desenvolvemento	2	0	2
Exame de preguntas de desenvolvemento	6	0	6

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

Metodoloxía docente

	Description
Lección maxistral	Exposición por parte do profesor dos contidos sobre a materia obxecto de estudo, bases teóricas e directrices dun traballo, exercicio ou proxecto a desenvolver polo estudante.
Prácticas de laboratorio	Actividades de aplicación dos coñecementos a situacións concretas e de adquisición de habilidades básicas e procedementos relacionados coa materia obxecto do estudo. Desenvólvense en espazos especiais con equipamento especializado (laboratorios, aulas informáticas, etc.).
Resolución de problemas	Actividade na que se formulan problemas e exercicios relacionados coa materia. O alumno debe desenvolver solucións adecuadas ou correctas a través do exercicio de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos para transformar a información dispoñible e a interpretación dos resultados.
Traballo tutelado	Desenvolverase un curso intensivo no que os estudantes que non superasen a materia na convocatoria ordinaria traballarán, baixo a tutela do profesor, revisando os conceptos teóricos e prácticos e realizando actividades, problemas e exercicios a modo de preparación para o exame da convocatoria extraordinaria.

Atención personalizada

Methodologies	Description
Lección maxistral	Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos, tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.

Prácticas de laboratorio	Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos, tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.
Traballo tutelado	Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos, tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.
Resolución de problemas	Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos, tanto de forma presencial, segundo o horario que se publicará na páxina web do centro, como a través de medios telemáticos (correo electrónico, videoconferencia, foros de FAITIC, etc.) baixo a modalidade de cita previa.

Avaliación

	Description	Qualification	Evaluated Competencess		
Presentación	Entrega e presentación dun traballo relacionado coa temática da materia (TL): Avaliación dos traballos relacionados coa materia e as súas presentacións (data aproximada: semana 10 do cuadrimestre)	15	CG3	CE31 CE32 CE33	CT1 CT3 CT6 CT8 CT10
Práctica de laboratorio	Proba puntuable práctica (PL): Proba individual para avaliar os coñecementos adquiridos nas sesións prácticas (data aproximada: semana 15 do cuadrimestre). Consiste na resolución de problemas similares aos analizados nas sesións de prácticas.	15	CG3	CE31 CE32 CE33	CT1 CT2 CT3 CT6 CT9 CT10
Exame de preguntas de desenvolvemento	Proba puntuable de teoría (PT, 30% da cualificación): Proba escrita parcial para avaliar os coñecementos adquiridos nas sesións de teoría T1 a T6 (data aproximada: semana 7 do cuadrimestre). Exame Final (ET, 40% da cualificación): Proba escrita final para avaliar os coñecementos adquiridos nas sesións de teoría T1 a T11 (data aproximada: semana 15 do cuadrimestre). Poden ter a forma de cuestionario tipo test, cuestionario de respostas curtas, resolución problemas ou algunha combinación das anteriores.	70	CG3	CE31 CE32 CE33	CT1 CT2 CT3 CT6 CT8 CT9

Other comments on the Evaluation

Nota final e requisitos mínimos para superar a materia mediante avaliación continua:

Para asegurarse de que o alumno adquirira as habilidades mínimas en cada un dos aspectos da materia, os estudantes terán que obter unha nota mínima de 4.0 sobre 10 no exame final de teoría. Se chamamos MED_CON a nota media de avaliación continua, que se calcula como:

MED_CON = 0.3*PT + 0.4*ET + 0.15*PL + 0.15*TL

A nota final de avaliación continua (NEC) coincidirá con MED_CON no caso de que ET sexa maior ou igual a 4.0 e, se non, calcularase como:

NEC = min(4, MED_CON)

É necesario que esta nota sexa igual ou superior a 5 (nunha escala de 10) para aprobar o curso. O alumno que non aprobe a materia nesta convocatoria deberá participar no exame ordinario.

Nota final e requisitos mínimos para superar a materia no exame ordinario:

A nota final do exame extraordinario calcúlase coa seguinte fórmula:

NEO = 0.7*T + 0.3*L

Onde:

- T representa a parte teórica do exame ordinario da materia. Proba escrita individual para avaliar os coñecementos adquiridos nas sesións de teoría T1 a T11. Pode tomar a forma dun cuestionario de proba, cuestionario de resposta

curta, resolución de problemas ou algunha combinación dos anteriores.

- L representa a parte práctica do exame ordinario da materia. Proba escrita individual para avaliar os coñecementos adquiridos nas sesións prácticas da materia. Consiste en resolver problemas similares aos analizados nas sesións prácticas e/ou preguntas sobre o traballo presentado e/ou as presentacións.

É necesario que esta nota (NEO) sexa igual ou superior a 5 (sobre unha escala de 10) para superar a materia. O alumno que non supere a materia nesta convocatoria ou na avaliación continua debe presentarse á convocatoria extraordinaria.

Nota final e requisitos mínimos para superar a materia no exame extraordinario:

A nota final no exame extraordinario (NEE) calculase coa siguinte fórmula:

NEE = 0.7*T + 0.3*L

Onde:

- T representa a parte teórica do exame ordinario da materia. Proba escrita individual para avaliar os coñecementos adquiridos nas sesións de teoría T1 a T11. Pode tomar a forma dun cuestionario de proba, cuestionario de resposta curta, resolución de problemas ou algunha combinación dos anteriores.

- L representa a parte práctica do exame ordinario da materia. Proba escrita individual para avaliar os coñecementos adquiridos nas sesións prácticas da materia. Consiste en resolver problemas similares aos analizados nas sesións prácticas e/ou preguntas sobre o traballo presentado e/ou as presentacións.

Sendo necesario que esta nota (NEE) sexa igual ou superior a 5 (sobre unha escala de 10) para superar a materia.

COMPORTAMENTO ÉTICO DO ALUMNO

Cualquer intento de fraude na avaliación será perseguido e castigado. O fraude realizado por parte dun alumno ou a súa facilitación a terceiros será penalizado da siguinte maneira:

- **Avaliación continua**: Calificarase cun 0 na parte da asignatura (teoría ou prácticas) onde se produza o fraude.
- **Exame ordinario**: Calificarase cun 0 en tódalas partes do exame.
- **Exame extraordinario**: Calificarase cun 0 en tódalas partes do exame.

Bibliografía. Fontes de información

Basic Bibliography

A. S. Tanenbaum, D. Wetherall, **Computer Networks: International Version**, ISBN: 978-013255317-9, 5a edición, Pearson Education, 2010

Complementary Bibliography

J. F. Kurose , K. W. Ross, **Computer Networking: A Top-Down Approach**, ISBN: 978-0-13-285620-1, 6a edición, Pearson Education, 2012

R. K. Jain, **The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling**, ISBN: 978-047150336-1, 1a edición, Wiley, 1991

K. R. Fall, W. R. Stevens, **TCP/IP Illustrated, Volume 1: The Protocols**, ISBN: 978-0-321-33631-6, 2a edición, Addison-Wesley, 2011

K. R. Fall, W. R. Stevens, **TCP/IP Illustrated, Volume 2: The Implementation**, ISBN: 978-020163354-2, 2a edición, Addison-Wesley, 2011

Recomendacións

Subjects that it is recommended to have taken before

Informática: Informática para a enxeñaría/P52G381V01107

Other comments

Para que o alumno poida superar con éxito esta materia, é recomendable dispor de:

- Capacidade de comprensión escrita e oral ben desenvolvida.
- Capacidade de abstracción e síntese da información.
- Destrezas para o traballo e para a comunicación en grupo.

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

=== ADAPTACIÓN DAS METODOLOXÍAS ===
Para adaptar as metodoloxías didácticas á nova situación será necesario engadir
unha nova metodoloxía docente tendo en conta o tipo de sesión.

Sesión maxistral e/ou sesión práctica virtual síncrona: Impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

Así, as sesións de prácticas da materia realizaranse de forma telemática mediante a utilización da máquina virtual proporcionada para ese efecto a través de plataformas de teledocencia. nun ámbito máis demostrativo.

No caso concreto dos seminarios e as presentacións de traballos na aula, adaptaranse convenientemente para poder realizarse a través de plataformas online
(videoconferencias participativas e/ou similar).

=== ADAPTACIÓN DA AVALIACIÓN ===
A avaliación da materia divídese na avaliación continua nun exame puntuable de teoría, un puntuable de laboratorio, a realización dunha presentación acerca dun tema exposto polo profesorado e unha memoria asociada. Nunha situación de non presencialidade, a avaliación das probas puntuables deberanse adaptar a unha metodoloxía a distancia. O mesmo ocorre coas presentacións que se realizarán a distancia a través de plataformas de teledocencia. Con todo, a entrega da memoria do traballo non se verá alterado.

En canto á avaliación ordinaria e extraordinaria, a avaliación dos exames de teoría e laboratorio adaptarase a unha metodoloxía a distancia.

En calquera caso, as probas de avaliación realizaríanse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Teoría do buque e construción naval				
Subject	Teoría do buque e construción naval			
Code	P52G381V01504			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	5	1c
Teaching language	Castelán			
Department	Departamento do Centro Universitario da Defensa da Escola Naval Militar de Marín			
Coordinator	Cocheteux Lourido, Roberto Ramón			
Lecturers	Cocheteux Lourido, Roberto Ramón González-Cela Echevarría, Gerardo Regueiro Pereira, Araceli			
E-mail	rcoclou@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	Esta asignatura está encadrada entre as específicas de a intensificación en tecnoloxía naval, Mención Corpo Xeral, cuxo obxectivo é aportar destrezas ou habilidades específicas para desempeñar o destino de Oficial de Seguridade Interior. En a Armada denomínase Seguridade Interior a o conxunto de disposicións, técnicas e medios materiais e humanos, destinados a previr, reducir e corrixir os efectos que, sobre un buque ou o seu dotación, poidan derivarse de accidentes ou de a acción de o inimigo. A súa tarefa principal pode resumirse en satisfacer as seguintes esixencias: ter o barco listo para combater, sostelo en o combate e efectuar reparaciones temporais logo de a acción. O enfoque dado a a asignatura é secuencial e pódese resumir en dar resposta a as seguintes preguntas claves: como está construído o buque, en que se basea a súa estabilidade e, para rematar, que medidas son necesarias para recuperala cando o buque está danado.			

Competencias	
Code	
CG3	Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
CG4	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.
CG6	Capacidade para o manexo de especificacións, regulamentos e normas de obrigado cumprimento.
CE38	Coñecer a nomenclatura, os principios elementais dos procedementos da construción e explotación dos buques, os fundamentos básicos da flotabilidade e estabilidade, os materiais para a súa construción e a estrutura.
CE39	Adquirir a capacidade de efectuar cálculos de flotabilidade e estabilidade.
CE40	Aplicar os principios de control de avarías para reducir os riscos do persoal e material, e para toma a de decisións ante emerxencias a bordo.
CT2	Resolución de problemas.
CT8	Toma de decisións.
CT9	Aplicar coñecementos.
CT16	Razoamento crítico.

Resultados de aprendizaxe			
Learning outcomes	Competences		
Coñecer a base tecnolóxica da construción e explotación dos buques e fundamentos básicos da *flotabilidad e estabilidade	CG3 CG6	CE38	
Coñecer os cálculos de *flotabilidad e estabilidade dun buque	CG4	CE39	CT2 CT8 CT9 CT16
Coñecer os principios de Control de avarías a bordo	CG3 CG6	CE40	
Resultados de aprendizaxe ENAEE: COÑECEMENTO E COMPRENSIÓN: RA1.3.-Ser conscientes do contexto multidisciplinar da enxeñaría (nivel de desenvolvemento deste subresultado de aprendizaxe: Adecuado (2))		CE38 CE39	
Resultados de aprendizaxe ENAEE: ANÁLISE EN ENXEÑARÍA: RA2.2.-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. (Adecuado(2))	CG4	CE39	CT2 CT8 CT9 CT16

Resultados de aprendizaxe ENAEE: INVESTIGACIÓN E INNOVACIÓN RA4.2.-Capacidade para consultar e aplicar códigos de boa práctica e de seguridade da súa especialidade.(Adecuado (2))	CG6		
Resultados de aprendizaxe ENAEE: APLICACIÓN PRÁCTICA DA ENXEÑARÍA RA5.3.-Coñecemento de aplicación de materiais, equipos e ferramentas, tecnoloxía e procesos de enxeñaría e as súas limitacións no ámbito da súa especialidade. (Adecuado(2))		CE38 CE39 CE40	CT8 CT9
Resultado de aprendizaxe ENAEE: aplicación práctica da enxeñaría RA5.4.- Capacidade para aplicar normas da práctica da enxeñaría da súa especialidade. (Adecuado(2))	CG6	CE40	CT9

Contidos	
Topic	
1. Xeometría da carena.	1.1 Definicións. 1.2 Liñas de referencia do casco. 1.3 Dimensións principais do buque. 1.4 Coeficientes de afinamiento.
2. Principios fundamentais de flotabilidad e estabilidade transversal.	2.1 Definición de estabilidade. 2.2 Estabilidade inicial, metacentro e altura metacéntrica. 2.3 Radio metacéntrico. 2.4 Evoluta metacéntrica. 2.5 Falsos metacentros. 2.6 Curva de estabilidade estática. 2.7 Características de unha curva de estabilidade.
3. Efectos de o calado en a estabilidade.	3.1 Calado. 3.2 Marcas de calado. 3.3 Lectura de calados. 3.4 Reserva de flotabilidad. 3.5 Francobordo. 3.6 Curvas hidrostáticas. 3.7 Desenvolvemento do GM. 3.8 Toneladas por centímetro e por pulgada de inmersión. 3.9 Variación do calado por cambio de densidad de o auga. 3.10 O calado e a súa relación cos momentos adrizantes. 3.11 Curvas transversales de estabilidade.
4. Experiencia de estabilidade.	4.1 Realización da experiencia. 4.2 Realización práctica da experiencia de estabilidade. 4.3 Libro de experiencia de estabilidade.
5. Condicións de carga.	5.1 Diferenza entre buque en rosca e en carga. 5.2 Condicións de carga. 5.3 Descrición das condicións de carga.
6. Plans de achique, consumo, trasfega e lastrado e alixeiramento de pesos.	6.1 Plan de achique. 6.2 Plan de consumo, trasfega e lastrado. 6.3 Plan de alixeiramento de pesos.
7. Efecto dos pesos na estabilidade transversal.	7.1 Traslado de pesos. 7.2 Embarco e desembarco de pesos.
8. Carenas líquidas.	8.1 Concepto de carena líquida e de superficie libre. 8.2 Efectos das superficies libres. 8.3 Diminución da estabilidade por efecto de superficies libres. 8.4 Momento de superficie libre. 8.5 Influencia da manga da superficie. 8.6 Redución de superficies libres. 8.7 Permeabilidade de superficie. 8.8 Mamparos diafragma. 8.9 Outras consideracións relacionadas coa seguridade do buque.
9. Libre comunicación.	9.1 Diminución da estabilidade en buques avariados. 9.2 Libre comunicación. 9.3 Libre comunicación nun compartimento asimétrico. 9.4 Libre comunicación nun compartimento que vai de banda a banda ou é central e simétrico. 9.5 Consideracións sobre o efecto de libre comunicación. 9.6 Perda de estabilidade por efecto de libre comunicación. 9.7 Momento de libre comunicación. 9.8 Redución do efecto de libre comunicación. 9.9 Cálculo do peso embarcado nun compartimento comunicado co mar e ilimitado en altura. 9.10 Volume de permeabilidade.

10. Estabilidade lonxitudinal.	10.1 Centro de flotación. 10.2 Cambio de asento. 10.3 Altura metacéntrica lonxitudinal. 10.4 Momento para variar o asento un centímetro. 10.5 Traslado lonxitudinal de pesos. 10.6 Efecto nos calados do embarco e desembarco de pesos. 10.7 Efecto do asento na estabilidade. 10.8 Calado no centro de flotación e calado medio calculado.
11. Medios para efectuar os cálculos.	11.1 Diagramas de efectos de inundación e de distribución de cargas líquidas. 11.2 Follas de cálculo. 11.3 Diagrama xeral de estabilidade. 11.4 Gráficos para a determinación de diversos valores. 11.5 Deseño dunha folla de cálculo en formato MS Excel.
12. Escora.	12.1 Pesos asimétricos con altura metacéntrica positiva. 12.2 Altura metacéntrica negativa. 12.3 Altura metacéntrica negativa con pesos asimétricos. 12.4 Corrección da escora permanente.
13. Varada.	13.1 Posibilidade de pór o buque á boia. 13.2 Cálculo da reacción no fondo. 13.3 Resistencia estrutural en varada. 13.4 Estabilidade en varada. 13.5 Calado crítico. 13.6 Alixeiramento de pesos en varada.
14. Buque avariado.	14.1 Preparación do buque para resistir avarías. 14.2 Natureza das avarías. 14.3 Estimación da situación. 14.4 Medidas corretivas.
15. Balance e estabilidade dinámica.	15.1 Período de balance dun buque. 15.2 Balance debido á acción das ondas. 15.3 Características das ondas e a súa formación. 15.4 Efecto combinado do vento e as ondas sobre a estabilidade. 15.5 Estabilidade dinámica.
16. Criterios de estabilidade do buque de guerra.	16.1 Criterios de estabilidade. 16.2 Clasificación dos criterios de estabilidade para mariña mercante. 16.3 Criterios de estabilidade para o buque de guerra.
17 Sistema informático modular para buques da Armada (SIMBAZ)	17.1 Obxectivos de deseño do sistema SIMBAZ. 17.2 Características do SIMBAZ. 17.3 Organización do sistema. 17.4 Proceso de cálculo e unidades.
18. Compartimentación estanca e resistencia estrutural.	18.1 Compartimentación estanca. 18.2 Características de resistencia dos buques ás avarías. 18.3 Límite de estanqueidad en mamparos transversais. 18.4 Consideracións sobre determinación da compartimentación estanca óptima. 18.5 Resumo das prácticas relativas á compartimentación estanca. 18.6 Criterio de estabilidade relativo á compartimentación estanca. 18.7 Resistencia do casco.
19. Achique de compartimentos.	19.1 Servizos de achique fixos. 19.2 Achique con medios portátiles.
20. Estrutura do buque.	20.1 Definición do buque. Partes xerais do buque. Elementos estruturais do casco. Estrutura lonxitudinal e transversal. Outros elementos estruturais.
21. Medidas do buque.	21.1 Medidas do buque: eslora, manga, puntal e calado. Marcas de calados. Desprazamento. Francobordo. Marcas de francobordo.
23. Métodos computacionais en construción naval.	23.1 Xeración do CAD do buque a partir dos planos de formas. 23.2 Determinación das curvas hidrostáticas. 23.3 Determinación das curvas KN de estabilidade transversal. 23.4 Software naval.
Prácticas	Práctica 1: Flotabilidade. Práctica 2: Estabilidade transversal. Práctica 3: Estabilidade lonxitudinal. Práctica 4: Práctica de varada. Práctica 5: Cálculos de estabilidade transversal en Excel. Práctica 6: Cálculos de estabilidade lonxitudinal en Excel. Práctica 7: Estabilidade transversal e lonxitudinal.

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	28	42	70
Prácticas de laboratorio	14	28	42
Seminario	14	17	31
Resolución de problemas	7	0	7

*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 de forma combinada presentacións e a lousa. Na medida do posible, proporcionarase copia das transparencias 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 transparencias nunca deben ser consideradas como substitutos dos textos ou apuntamentos, senón como material complementario
Prácticas de laboratorio	Pequenas sesións maxistrais participativas. Ás veces, será necesario explicar determinados conceptos prácticos fornecendo consellos útiles para o mellor aproveitamento das clases prácticas. Resolución de problemas. As prácticas están dirixidas a afianzar os conceptos teóricos abordados nas sesións de teoría. O método didáctico a seguir na impartición das clases prácticas consiste na resolución de problemas. O profesor resolve un problema *interactuando cos alumnos. A continuación os alumnos resolven problemas en grupo e por último os alumnos resolven un problema de forma individual que será recolleito á finalización da sesión. Prácticas de laboratorio tuteladas. Nas prácticas 5 e 6 o profesor realiza a práctica e explica algúns pasos e o alumno vai seguindo o proceso.
Seminario	Curso intensivo de 15 horas para aqueles alumnos que suspenderon a materia en primeira convocatoria, previo ao exame en segunda convocatoria. *Tutorías *grupales co profesor.
Resolución de problemas	Dado que a acción *tutorial afróntase como unha actuación de apoio *grupal ao proceso de aprendizaxe do alumno, as *tutorías realizaranse preferentemente en seminarios e baixo o formato de reunións de grupo pequeno. Nos seminarios avalíase a actitude do alumno co profesor e co resto dos seus compañeiros a través de anotacións realizadas polo profesor nun anecdotario de clase.

Atención personalizada	
Methodologies	**Description**
Resolución de problemas	No ámbito da acción titorial, distínguense accións de titoría académica así como de titoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de titorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, co desenvolvemento do proxecto, etc. As titorías poden ser individualizadas, pero fomentaranse titorías grupáis para a resolución de problemas relacionados coas actividades a realizar en grupo, ou simplemente para informar ao docente da evolución do traballo colaborativo. Nas *tutorías personalizadas, 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. Conxugando ambos os tipos de acción titorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade. Os profesores da materia atenderán persoalmente as dúbidas e consultas dos alumnos no horario que se publicará na web do centro así como a través de medios telemáticos (correo electrónico, videocnferencia, foros de FAITIC, etc,) baixo a modalidade de cita previa.

Avaliación			
	Description	Qualification	Evaluated Competencess

Lección maxistral	Os coñecementos de teoría impartidos na clase de aula avalíanse a través de probas escritas ao longo do cuadrimestre. As probas intermedias son probas de curta duración (1 hora) realizadas no horario de clase habitual e que teñen por obxecto avaliar a asimilación dos contidos polo alumnado, motivar o estudo autónomo e identificar a aqueles alumnos que requiren de atención en tItorías individualizadas. Durante o curso realízanse dúas probas intermedias que constan de cuestións conceptuais e problemas curtos cunha valoración cada unha dun 20% na nota final. Pola súa banda a proba escrita final é unha proba de longa duración (4 horas) que ten como obxectivo a avaliación da aprendizaxe de todos os contidos teóricos da materia mediante preguntas de teoría e problemas para comprobar a adecuada comprensión desta teoría,a súa influencia na nota final é dun 45%.	70	CG3 CG4 CG6	CE38 CE39 CE40	CT2 CT8 CT9 CT16
Prácticas de laboratorio	(Pr1-Pr4) Problemas entregados (Pr5-Pr6) Programas	20		CE39	CT2 CT9 CT16
Resolución de problemas	Participación (data: avalíase nos seminarios e nos debates en clase de teoría)	10			CT16

Other comments on the Evaluation

Os criterios de avaliación de cada apartado publicaranse ao comezo de o cuatrimestre. Para iso, proporcionaráselles a os alumnos, a través de a plataforma virtual, unha serie de rúbricas que lles permitan evaluar a calidade de o código entregado en as prácticas e a calidade de as memorias ou informes.

A avaliación sumativa final de alumno atenderá a a suma de a puntuación outorgada a cada unha de as partes antes comentadas, sendo a súa nota de avaliación continua (NEC):

NEC = 0,15* PROBA INTERMEDIA 1 + 0,15 * PROBA INTERMEDIA 2 + 0,2 * NOTA PRÁCTICAS + 0,40 * PROBA FINAL+ 0,10*NOTA PARTICIPACIÓN

Para aprobar a asignatura por avaliación continua esíxese unha nota NEC igual ou superior a 5 puntos. Con todo, esixiranse uns requisitos, en algún de os apartados, que garantan o equilibrio entre todos os tipos de competencias. Devanditos requisitos son:

1. realizar as dúas probas intermedias e polo menos 5 de as 6 sesións de prácticas..
2. Obter unha nota igual ou superior a 4 puntos sobre 10 en a proba final de avaliación continua (PF).

Aqueles alumnos con NEC inferior a 5 puntos ou que non cumpran algún de os requisitos anteriores, deberán presentarse a o exame ordinario para poder superar a asignatura. Ademais para os que non cumpran os requisitos a súa nota de avaliación continua calcularase como: NEC FINAL = min (4,NEC). Tamén poderán acudir a o exame ordinario todos aqueles alumnos que desexen mellorar a súa cualificación obtida por avaliación continua.

Tanto en o exame ordinario como en o extraordinario (convocatoria de agosto) se evaluarán todas as competencias de a asignatura. Por iso, en devanditos exames incluiranse cuestións relacionadas con as tarefas realizadas en as prácticas.

COMPROMISO ÉTICO: Espérase que os alumnos teñan un comportamento ético adecuado. Si detéctase un comportamento pouco ético (copia, plagio, uso de dispositivos electrónicos non autorizados ou outros) se penalizará a o alumno con a imposibilidad de superar a asignatura por a modalidade de avaliación continua (en a que obterá unha cualificación de 0.0). Si este tipo de comportamento detéctase en exame ordinario ou extraordinario, o alumno obterá en dita convocatoria unha cualificación en acta de 0.0.

Bibliografía. Fontes de información

Basic Bibliography

Armada Española, **I-CP-03 Estabilidad**,

Armada Española, **I-CP-02 Control de averías**,

Complementary Bibliography

A. Biran, **Ship hydrostatics and stability**,

J. Olivella Puig, **Teoría del buque. Flotabilidad y estabilidad**,

J. Olivella Puig, **Teoría del buque. Estabilidad, varada e inundación**,

J. Olivella Puig, **Teoría del buque. Flotabilidad y estabilidad (Problemas).**,

Bryan Barras and D.R.Derret, **Ship stability for masters and mates**, 6th,

Jesús Victoria Meizoso, **Principios de Ingeniería Naval**,

Recomendacións

Plan de Continxencias

Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===
Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determíneno atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

=== ADAPTACIÓN DAS METODOLOXÍAS ===
Apartado 8 (metodoloxías docentes). Engádese unha nova metodoloxía:
Sesión maxistral e/ou sesión práctica virtual síncrona: Impártese a través dunha plataforma de videoconferencia web. Cada aula virtual contén diversos paneis de visualización e compoñentes, cuxo deseño se pode personalizar para que se adapte mellor ás necesidades da clase. Na aula virtual, os profesores (e aqueles participantes autorizados) poden compartir a pantalla ou arquivos do seu equipo, empregar unha lousa, chatear, transmitir audio e vídeo ou participar en actividades en liña interactivas (enquisas, preguntas, etc.).

=== ADAPTACIÓN DA AVALIACIÓN ===
 Apartado 10 (avaliación): As probas de avaliación realizaríanse combinando a plataforma de teledocencia FAITIC-Moodle e o Campus Remoto da Universidade de Vigo.

IDENTIFYING DATA				
Automobiles				
Subject	Automobiles			
Code	P52G381V01505			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	5th	1st
Teaching language	Spanish			
Department				
Coordinator	Casqueiro Placer, Carlos			
Lecturers	Casqueiro Placer, Carlos			
E-mail	ccasqueiro@cud.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This guide presents relative information to the subject of Automobiles of fifth course of the Bachelor Degree in Mechanical Engineering given in the University Centre of the Defence in the Spanish Naval Academy, which lists the competencies that the students have to achieve, the schedule of educational activities, the contents and its temporary programming, an estimate of the volume of work of the student, the specific criteria for his evaluation and the bibliography recommended for a correct follow-up of the matter. The main objetive of the subject will be to develop the knowledge of the vehicular dynamics. This is an exclusive competency of this subject.			

Competencies	
Code	
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
CE41	Develop knowledge of vehicle dynamics
CT1	Analysis and synthesis
CT2	Problems resolution.
CT3	Oral and written proficiency
CT5	Information Management.
CT8	Decision making.
CT9	Apply knowledge.
CT10	Self learning and work.
CT12	Research skills.
CT16	Critical thinking.
CT17	Working as a team.
CT20	Ability to communicate with people not expert in the field.

Learning outcomes	Competences		
To know the technological basis of the automobile vehicles	CG3 CG4	CE41	CT1 CT2 CT3 CT5 CT8 CT9 CT10 CT12 CT16 CT17
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 [Intermediate (2)].	CG3		
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)].	CG4		CT1 CT2 CT8 CT9 CT16

ENAEE learning outcome: ENGINEERING PRACTICE: 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)].			CT5
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.2.- practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Intermediate (2)].	CG4		CT2 CT9 CT12 CT16
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 [Intermediate (2)].		CE41	CT8 CT9
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large [Intermediate (2)].			CT1 CT3 CT20
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)].			CT17

Contents	
Topic	
Topic 1: Introduction to the theory of the automotive vehicles. (T1)	The automotive vehicle: concept. Main requests of the automotive vehicle. The system man-machine-enviroment. Objectives and scope of the theory of the automotive vehicles.
Topic 2: Introduction to tactical vehicles. (T2)	Basic characteristics of tactical vehicles. Spanish marines' vehicles. Most common faults: diagnosis. Specific legislation of circulation.
Topic 3: Interaction between vehicle and road surface. (T3)	General characteristics of tyres. Mechanical characteristics of tyres. Longitudinal stress (traction, braking). Lateral stress (slip angle). Mathematical models. Rolling characteristics of chain vehicles.
Topic 4: Longitudinal dynamics: perfomances. (T4)	Resistance to movement. Basic equation of longitudinal motion. Maximum tractive effort limited by adhesion. Motor and transmission characteristics. Prediction of the performance of a vehicle.
Topic 5: The powertrain. (T5)	The internal combustion engine. Types of transmissions. Transmission components. The manual gearbox. Automatic gearboxes. Homokinetic joints. The differential, function and types. Differential lock. Reducer gearbox.
Topic 6: Braking of automotive vehicles. (T6)	Moment and forces of the braking process. Adhesion condition: optimal braking. Braking process. Braking system.
Topic 7: Vehicle lateral dynamics. (T7)	Steering geometry. Low speed manoeuvrability.Tipping and skid speed limit. Directional steady-state vehicle behavior. Load influence.
Topic 8: Suspension system. (T8)	Vibrations, vehicle and human effects. Suspension system: mathematical model. Kinematics of suspension. Suspension systems: elastic elements (spring, torsion bars, leaf springs) and dampers. Pneumatic suspension. Influence of suspension on the vehicle dynamic behaviour. Kinematics of suspension and tyre behaviour. Suspension set up.
Topic 9: Driving techniques. (T9)	Driver position. Use of hands. The vision. Specific off road driving techniques. Sand, mud and snow driving.
Topic 10: Vehicle recovery. (T10)	Theory of levers and pulleys: levers of first, second and third genus. Practical examples. Pulleys, forces and tensions. Pulley friction and resistance. Vehicle recovery: definition. Recovery steps. Traction recovery. Forces to consider. Recovery machines: mechanical advantage. Resistance according to the terrain and according to the slope. Recovery of overturned vehicles: forces to consider. Anchors. Exceptional traction and anchoring methods. Expedited methods of hoisting. Traction recovery practices: with return and without return. Practices of anchors: from bar to sand. IM recovery means. Capabilities of the vehicle winches in service of the IM: Hummer, Pegaso 7323 and Iveco 257M trucks. Anchors for towing, recovery and hoisting of the main IM vehicles: Hummer, Pegaso 7323 and Iveco 257M trucks, AAV, CCM M-60, Piranha III. Car M-88 and AAVR: crane and winch capabilities. General description of the M-88 car crane: limitations. Overview of the AAVR Truck Crane: Limitations.

Topic 11: Safety systems. (T11)	Active and passive safety. Driving assistance systems: traction and stability control, ABS. Influence of driving technique. Passive safety: deformable structures, safety cell, seat belts, airbag.
Topic 12: Alternative powertrains. (T12)	The fuel cell. Hybrid vehicles. Electric vehicles. Hydrogen propulsion systems.
Practical session 1 (1 session, 2 hours). Intruduction to the vehicle systems. (PL1)	Analysis of vehicle morphology, location and constitution of different systems. IM vehicles. The student will give a report about the work done and / or will answer a questionnaire.
Practical sessions 2 y 3 (2 sessions, 4 hours). Vehicle monitoring. (PL2 y PL3)	Use of Data Acquisition Systems (DAS) in the automobile: installation of hardware, configuration, reading and interpretation of data. The student will give a report about the work done and / or will answer a questionnaire.
Practical session 4 (1 sesión, 2 hours). Calculation of perfomances and braking characteristics (PL4)	Analysis and prediction of vehicle performance using software. Analysis and prediction of the braking performance of the vehicle using software. The student will give a report with the results and / or will answer a questionnaire.
Practical sessions 5 and 6 (2 sessions, 4 hours). Lateral dynamics. (PL5 y PL6)	Analysis and prediction of lateral dynamic behavior of the vehicle using software. The student will give a report with the results and / or will answer a questionnaire.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	25	22	47
Problem solving	7	14	21
Mentored work	3	6	9
Practices through ICT	12	10.6	22.6
Laboratory practical	2	1.4	3.4
Seminars	15	10	25
Autonomous problem solving	11	11	22

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

Methodologies

	Description
Lecturing	In these sessions, the basic theoretical contents of the program will be explained in detail, explaining examples with which to deepen the understanding of the subject. Computer presentations and blackboard will be used, especially to convey information such as definitions, graphs, etc. The content of these classes will be complemented with notes and the slides will also be available for the student.
Problem solving	Since the tutorial action is treated as a group support action to the student's learning process, the tutorials will preferably be conducted in seminars and in the form of small group meetings, with problem solving, exercises or case studies.
Mentored work	It is intended to motivate the student in the research activity, and to foster personal relationships by sharing problems and solutions. In order to acquire certain competences it is necessary to propose activities based on the use of active methodologies. Part of the theoretical content should be developed and / or applied to practical cases treated in group and presented in class, for which part of the time devoted to theoretical classes will be allocated.
Practices through ICT	Analysis and prediction of lateral and longitudinal dynamic behavior of the vehicle using software. The student will deliver reports with the results and / or answer questionnaires. The didactic method to follow in the delivery of practical classes is that the teacher supervises the work done by the students. The laboratory practices are aimed at strengthening the theoretical concepts addressed in the sessions in the classroom.
Laboratory practical	The didactic method to follow in the delivery of practical classes is that the teacher supervises the work done by the students. The laboratory practices are aimed at strengthening the theoretical concepts addressed in the sessions in the classroom.
Seminars	Intensive course of 15 hours stop those students that suspended the subject in first call, previous to the examination in second call. Group tutoring with teacher.
Autonomous problem solving	Employed in the assessment tests in order to verify the abilities acquired by the student.

Personalized assistance

Methodologies	Description

Problem solving	Student solves exercises or practical cases with lecturer help. In the personalized tutoring, each student, individually, can discuss with the lecturer any problem related to their learning achievements in the subject. The lecturer will personally solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD, as well as through telematic means (email, videoconference, FAITIC forums, etc.) with previous appointment.
Seminars	Group tutorials with the subject teacher. In the personalized tutoring, each student, individually, can discuss with the lecturer any problem related to their learning achievements in the subject. The lecturer will personally solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD, as well as through telematic means (email, videoconference, FAITIC forums, etc.) with previous appointment.

Assessment

	Description	Qualification	Evaluated Competencess	
Mentored work	The student will carry out a research work (TI) about a case proposed by the lecturer and will deal with issues related to topics 11 and 12. The work will be scored from 0 to 10 according to their content and defense, following the rubric provided at the time of assigning the topics to the students	15	CG3 CG4	CT1 CT2 CT3 CT5 CT8 CT9 CT10 CT16 CT17
Practices through ICT	The evaluation of the practical part (NP) will be made from the reports or questionnaires corresponding to each one (a total of 4-5), with a total value of 10 points.	15	CG3 CG4	CT1 CT2 CT3 CT5 CT8 CT9 CT10 CT16 CT17 CT20
Autonomous problem solving	Two theoretical and practical tests of continuous evaluation (15% each) will be carried out at the end of blocks or parts 2 and 3. Their evaluation will be carried out on 10 points each and an average mark of 4 or more points in the two tests in order to qualify the continuous assessment. The Continuous Assessment Final Test (with a 40% weight) will be carried out in the evaluation week and will be valued at 10 points. It will be necessary to obtain a grade higher or equal to 4 points out of 10 in the final exam of continuous evaluation in order to qualify for the one approved by continuous assessment.	70	CG3 CG4	CT1 CT2 CT3 CT5 CT8 CT9 CT16

Other comments on the Evaluation

The final mark of continuous assessment (NEC) shall be calculated as follows: NEC = 0.15 · P1 + 0.15 · P2 + 0.15 · TI + 0.15 · NP + 0.4 · PF The student must submit to the regular examination of all the contents of the subject, which will represent 100% of the grade, in the following cases: The final grade of continuous assessment (NEC) is less than 5. The non-delivery of research work. The non-execution or delivery of the memory of practices, unless it is exempted for good cause. Obtain a grade below 4 points out of 10 on the final continuous assessment exam. Obtain an average grade of theoretical-practical controls below 4. The continuous evaluation note in case of not fulfilling some of the last four previous requirements will be obtained by the expression: NECS = min (4, NEC) In any case, the student who has passed the continuous assessment, will have the possibility to submit to the regular exam to raise grade. In case the student is discovered performing any action that makes possible the copy in some of his/her exams, or in possession of material not allowed during the performance of any of the tests, or whose research work has incurred plagiarism, will be qualified with a zero in the current call.

Sources of information

Basic Bibliography

Luque, P, **Ingeniería del Automóvil. Sistemas y comportamiento dinámico**, Ed. Paraninfo, 2004

Arias-Paz, M., **Manual de automóviles**, Ed. Dossat,

Complementary Bibliography

Arias-Paz, M., **Motocicletas**, Ed. Dossat,

Bosch, **Manual de la Técnica del Automóvil**, Ed. Reverté,
Cascajosa, Manuel, **Ingeniería de vehículos : sistemas y cálculos**, Ed. Tebar,
Técnica de recuperación de vehículos de ruedas, Escuela de Aplicación de Infantería de Marina,
Conducción Todo-Terreno y Recuperación de vehículos, Escuela de Infantería de Marina.,
Manual de Características de los Vehículos de Infantería de Marina, Junta Táctica de Infantería de Marina.,
Guía del conductor militar (OR6-002), Estado Mayor del Ejército de Tierra.,

Recommendations

Other comments

Proper development of the subject requires that the student has competencies in the field of differential calculus, vector and kinematic computation and dynamics of the point and the solid.

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE CONTENTS ===
Practice 2 (PL2)
The content of the practice will be modified avoiding the use of the data acquisition device in the laboratory, going to show its handling and configuration by the teacher, together with the visualization of different application examples.

=== ADAPTATION OF THE METHODOLOGIES ===
The master session and / or synchronous virtual practical session is added to those provided in the teaching guide: It is taught through a web video conferencing platform. Each virtual classroom contains various display panels and components, the Design can be customized to best suit the needs of the class. In the virtual classroom, teachers (and those authorized participants) can share the screen or files of their team, use a whiteboard, chat, stream audio and video or participate in interactive online activities (surveys, questions, etc.).

=== ADAPTATION OF THE TESTS ===
In the event that it cannot be carried out in person, the evaluation tests will be carried out by combining the FAITIC-Moodle teledoaching and the Remote Campus of the University of Vigo.

IDENTIFYING DATA				
Complementary training				
Subject	Complementary training			
Code	P52G381V01506			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	5th	2nd
Teaching language				
Department				
Coordinator				
Lecturers				
E-mail				

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA				
Final Year Dissertation				
Subject	Final Year Dissertation			
Code	P52G381V01991			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	12	Mandatory	5th	2nd
Teaching language	Spanish English			
Department				
Coordinator	Maceiras Castro, María del Rocío			
Lecturers	Maceiras Castro, María del Rocío			
E-mail	rmaceiras@cud.uvigo.es			
Web	http://cud.uvigo.es/index.php?option=com_content&view=article&id=1259&Itemid=253			
General description	The Final Year Project (TFG) forms part, like module, of the curriculum of the Mechanical Engineering Bachelor Degree. It is an original and personal work that each student will make under lecturer supervision, allowing him/her to show in an integrated way the acquisition of the formative contents and the competences associated to the degree. With this work the student applies the knowledges adquired during his/her training, so much of the module of specific mechanical technology as of other fields of knowledge related with the mechanical engineering necessary to carry out the TFG, which reflects its multidisciplinary character. Moreover, it is pretended that the student adquire or reinforce some capacities that allow him/her to project, design and develop complex products, processes and systems of the speciality; have consciousness of the social appearances, of health and security, environmental, economic and industrial; select and apply methods of appropriate project; and look for solutions from a technical point of view as well as its implementation and adequation to the environment. Its definition and contents are explained more extensively in the regulations for the completion of the Final Year Project approved by Centre Board, in its first version, in session celebrated on 2/9/2014, and whose updated content is shown in the website of the Defense University Center, in the section dedicated to the TFG (Student Section -> Final Year Project).			

Competencies	
Code	
CG1	Skills for writing, signing and developing projects in the field of industrial engineering, whose purpose is, specializing in Mechanics, according to the knowledge acquired pursuant to paragraph 5 of this order, construction, alteration, repair, maintenance, demolition, manufacturing, installation, assembly or operation of: structures, mechanical equipments, energy facilities, electrical systems and electronic installations and industrial plants, and manufacturing processes and automation.
CG2	Ability to manage the activities object of the engineering projects described in CG1.
CG3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
CG10	Ability to work in a multidisciplinary and multilingual environment.
CG12	Original exercise to realise individually and present and defend in front of a university committee, consistent in a project in the field of the specific technologies of the Industrial Engineering in the Mechanical speciality of professional nature in which the skills and competences acquired in the educations are summarised and integrated.
CT4	Oral and written proficiency in a foreign language.
CT12	Research skills.

Learning outcomes		
Learning outcomes	Competences	
Research and structuring of information on any subject	CG1 CG2 CG3 CG4 CG10 CG12	CT12

Preparation of a project reportwhich collects : introdcution, problematic or state of the art, aims, phases of the project, development of the project, conclusions and future lines.	CG1 CG2 CG3 CG4 CG10 CG12	CT4 CT12
Design of equipments, prototypes, programs of simulation, etc, according to specifications.	CG1 CG2 CG3 CG4 CG10 CG12	CT12
ENAEE LEARNING OUTCOMES. KNOWLEDGE AND UNDERSTANDING LO1.3.- awareness of the wider multidisciplinary context of engineering (level of development of this learning outcome - Intermediate (2)).	CG10 CG12	
ENAEE LEARNING OUTCOMES. ENGINEERING ANALYSIS LO2.1.- The capacity to analyse products, processes and complex systems in his field of study; choose and apply of pertinent form analytical methods, of calculation and experimental already established and interpret properly resulted of said analysis (Intermediate (2))	CG1 CG2 CG4	
ENAEE LEARNING OUTCOMES. 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))	CG4	
ENAEE LEARNING OUTCOMES. 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))	CG4 CG12	
ENAEE LEARNING OUTCOMES. ENGINEERING DESIGN LO3.2.- ability to design using some awareness of the forefront of their engineering specialisation (Intermediate (2))	CG1 CG4 CG12	
ENAEE LEARNING OUTCOMES. 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))		CT12
ENAEE LEARNING OUTCOMES. 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))	CG12	CT12
ENAEE LEARNING OUTCOMES. ENGINEERING PRACTICE LO5.2.- practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study (Intermediate (2))	CG4	CT12
ENAEE LEARNING OUTCOMES. MAKING JUDGEMENTS LO6.2.- ability to manage complex technical or professional activities or projects in their field of study, taking responsibility for decision making (Advanced (3))	CG1 CG2	
ENAEE LEARNING OUTCOMES. COMMUNICATION AND TEAM WORKING LO7.1.- ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large (Advanced (3))	CG1 CG4 CG12	CT4
ENAEE LEARNING OUTCOMES. 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))	CG1	CT4

Contents

Topic	
Final Year Project	It tries to tackle the resolution of an original and individual exercise in which the student confronts to a real problem of the field of the engineering, uses the methodology acquired during his/her training and proposes a technically valid and viable solution. The contents of each TFG will be defined in the individual proposals offered by the lecturers and approved in the Centre Board, according to the regulations for the realisation of the Final Year Project. Each TFG will have a different content.

Planning

	Class hours	Hours outside the classroom	Total hours
Mentored work	20	0	20

Seminars	12	38	50
Autonomous problem solving	0	210	210
Presentation	5	15	20

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

Methodologies

	Description
Mentored work	The student, in an individual way, guided and supervised by his/her advisor, elaborates, as a result of the developed work, a project according to the indications of the Regulations for the realisation of the Final Year Project of the CUD-ENM. In said memory, the student presents the results of his/her work in which he/she has had to project, design or develop products, processes or systems of the field, as well as propose solutions to the problem posed in the field of the engineering, taking into account in the measure of the possible social factors of health and security, environmental, economic and industrial.
Seminars	The students that fails the Final Year Project will have to improve, in an individual way, guided and supervised by his/her advisor, the project according to the indications of committee.
Autonomous problem solving	Studies/previous activities Before carrying out the work (also during the same), the student will have to make bibliographic researches and consult specific databases, what will allow him/her a better processing and preparation so much of documentation, as of proposals of resolution to the problem proposed in the TFG. These activities will be carried out in the classroom and/or laboratory, independently by the students. Personalised and individualized attention by the advisor The advisor will supervise the progress of the TFG through periodic meetings where he/she will provide feedback to the student. Integrated methodologies The student presents the result obtained in the preparation of a document on the thematic of the matter. It will be carried out individually, both in writing (memory) and orally (presentation). Presentation and public defense The students must prepare and defend the work done in front of a committee. The defense may be carried out in a face-to-face or online session (by using a web conference platform).

Personalized assistance

Methodologies	Description
Mentored work	The advisor will supervise the progress of the TFG through periodic meetings where he/she will provide feedback to the student. The advisor will take time to help personally to each of the TFG students, to guide their work and guide their learning process, as well as to review and correct the report.
Seminars	The advisor will supervise the improvement of the TFG through periodic meetings where he/she will provide feedback to the student. The advisor will take time to help personally to the TFG students, to guide their work and guide their learning process, as well as to review and correct the report.
Tests	**Description**
Presentation	The students must prepare and defend the work done in front of a committee. It will be able to be presentially or telematically, through the platform of videoconference web.

Assessment

	Description	Qualification	Evaluated Competencess	
Mentored work	Report of the TFG advisor	25	CG1 CG2 CG4 CG12	CT12
Presentation	Report of the committee of the TFG Evaluation of the presentation and defense	75	CG1 CG2 CG3 CG4 CG10 CG12	CT4 CT12

Other comments on the Evaluation

At least one committee will be appointed, consisting of three lecturers for each of the following areas: **MAT** (Mathematics), **MEC** (Mechanics), **ENE** (Energy), **QUI** (Chemistry), **TEL** (Telecommunications), **OI** (Industrial Organization), **GEO** (Geomatics)

and **NAV** (Naval and Oceanic Engineering).

The evaluation will be carried out according to the regulations for the completion of the Final Year Project as well as the evaluation rubric, both approved by the Center Board, whose updated contents are shown on the CUD website, in the section dedicated to the TFG (Student Section -> Final Year Projects).

ETHICAL COMMITMENT: Students are expected to have adequate ethical behavior. If a type of unethical behavior is detected (cheating, plagiarism or others), the student will be penalized so that in that call he / she will obtain a qualification of 0.0.

If the student fails, the evaluation committee will make a report with the appropriate recommendations to the student or advisors for improving the work in afuture evaluation.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Other comments

Important information: In the moment of the defense of the TFG, the student must have all the remaining subjects of the degree passed, as established in the article 7.7 of the Regulation for the realisation of the Final Year Project of the University of Vigo.

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE ASSESSMENT ===
The defense of the Final Year Projects will be carried out online by using a web conference platform.