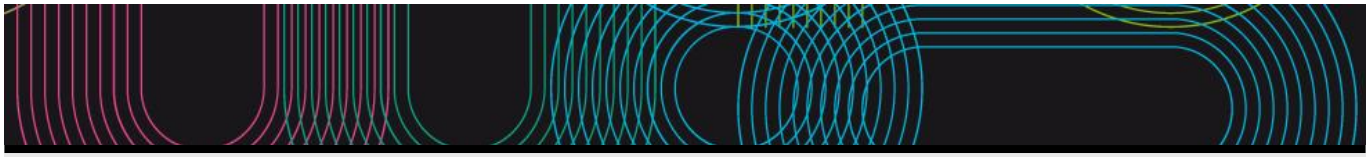

(*)Escola de Enxeñaría Industrial

Degree in Mechanical Engineering

Subjects			
Year 2nd			
Code	Name	Quadmester	Total Cr.
V12G380V01301	Materials science and technology	2nd	6
V12G380V01302	Thermodynamics and heat transfer	1st	6
V12G380V01303	Fundamentals of electrical engineering	1st	6
V12G380V01305	Fundamentals of manufacturing systems and technologies	1st	6
V12G380V01306	Mechanism and machine theory	1st	6
V12G380V01401	Environmental technology	1st	6
V12G380V01402	Resistance of materials	2nd	6
V12G380V01403	Fundamentals of automation	2nd	6
V12G380V01404	Electronic technology	2nd	6
V12G380V01405	Fluid mechanics	2nd	6

IDENTIFYING DATA

Materials science and technology

Subject	Materials science and technology			
Code	V12G380V01301			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician			
Department	Materials Engineering, Applied Mechanics and Construction			
Coordinator	Abreu Fernández, Carmen María			
Lecturers	Abreu Fernández, Carmen María Cortes Redin, María Begoña Figueroa Martínez, Raúl Guitián Saco, María Beatriz Iglesias Rodríguez, Fernando Pena Uris, Gloria María Riobó Coya, Cristina Vázquez Castro, Alfonso			
E-mail	cabreu@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The aim that pursues with this subject is to initiate to the student in the Science and Technology of the Materials and his applications in the Engineering.			

Competencies

Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
B6	CG6 Capacity for handling specifications, regulations and mandatory standards.
C9	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.
D1	CT1 Analysis and synthesis
D5	CT5 Information Management.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.

Learning outcomes

Expected results from this subject	Training and Learning Results		
1. Know the internal structure and composition of the Earth.			
1. Know the internal structure and composition of the Earth.			
It comprises the fundamental concepts of link, structure and microestructure of the distinct types of materials	B3	C9	D10
It comprises the relation go in to microestructure of the material in his mechanical behaviour, electrical, thermal and magnetic	B3	C9	
It comprises the mechanical behaviour of the metallic materials, ceramic, plastics and compound	B4 B6		
It knows how they can modify the properties by means of mechanical processes and thermal treatments	B4	C9	D9
It knows the basic technicians of structural characterisation of the materials	B3 B6	C9	
It purchases skills in the handle of the diagrams and charts			D1 D5
It purchases skill in the realisation of essays	B6	C9	D10
It analyses the results obtained and extracts conclusions of the same			D1 D9
It is able to apply norms of essays of materials	B6		D1 D9

Contents

Topic	
Introduction	Introduction to the Science and Technology of Material. Classification of the materials. Terminology. Orientations for the follow-up of the matter.
Crystalline arrangement.	Crystalline and amorphous solids. Crystalline lattices, characteristics and imperfections. Allotropic transformations.
Properties of materials. Laboratory practices.	Mechanical, chemical, thermal, electric and magnetic properties. Standars for materials analysis. Compressive and tensile deformation. Principles of fracture mechanisms. Toughness. Hardness. Main test methods. Fundamentals of thermal analysis. Fundamentals of non-destructive esting. Introduction to metallography. Binary isomorphous and eutectic systems. Microstructure in eutectic alloys. Analyses of practical situations.
Metallic materials.	Solidification. Constitution of alloys. Grain size. Main binary phase diagrams. Processing. Carbon steels: classification and applications. Cast iron alloys. Heat treatments: ims, fundamentals and classification. Annealing, normalizing, quenching and tempering. Nonferreous alloys.
Polymers and composites	General concepts. Classification. Properties. Types of polymers. Processing. Classification of composite materials. Polymer matrix composite materials. Processing of composite materials. Problems related to polymeric and composite materials.
Ceramic materials	Structure and bonding in ceramic materials. Silicates structure. Glasses. Properties of ceramic materials. Processing of ceramic materials. Applications.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1.5	0	1.5
Lecturing	31	55.8	86.8
Laboratory practices	18	18	36
Autonomous problem solving	0	12	12
Objective questions exam	0.5	0.5	1
Short answer tests	1	0.95	1.95
Problem solving	1.25	3	4.25
Essay	0.5	6	6.5

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

Methodologies

	Description
Introductory activities	Presentation of the subject. Introduction to the science and Technology of Materials
Lecturing	Exhibition by part of the professor of the contents on the matter object of study, of the bases and/or guidelines of the work /exercise/ project to develop by the student. Use of manipulative Activities or experiences of chairs
Laboratory practices	Application to practical level of the theory in the field of the knowledge of Science and Technology of materials
Autonomous problem solving	The student has to be able to develop the capacity to resolve problems and/or exercises of autonomous form.

Personalized attention

Methodologies	**Description**
Lecturing	The professor, in his schedule of tutorials, will clear the doubts that can have the student.
Laboratory practices	The professor, in his schedule of tutorials, will clear the doubts that can have the student.
Tests	**Description**
Problem solving	The professor, in his schedule of tutorials, will clear the doubts that can have the student.
Essay	The professor, in his schedule of tutorials, will clear the doubts that can have the student.

Assessment

	Description	Qualification	Training and Learning Results

Laboratory practices	Assistance, participation and reports that delivered periodically. Results of learning: it Comprises the mechanical behaviour of the metallic materials, ceramic, plastics and compounds Knows the basic technicians of structural characterisation of the materials Purchases skills in the handle of the diagrams and charts. It is able to apply norms of essays of materials Purchases skill in the realisation of essays. It analyses the results obtained and extracts conclusions of the same	2	B3 B6	C9	D1 D5 D9 D10
Short answer tests	In the final examination will include questions of short answer and/or type test. The examination will realise in the date fixed by the centre. Results of learning: it Comprises the fundamental concepts of link, structure and microestructure of the distinct types of materials. It comprises the relation go in to microestructure of the material in his mechanical behaviour, electrical, thermal and magnetic. It comprises the mechanical behaviour of the metallic materials, ceramic, plastics and composed Know how can modify the properties by means of mechanical processes and thermal treatments Knows the basic technicians of structural characterisation of the materials Purchases skills in the handle of the diagrams and charts Is able to apply norms of essays of materials Purchases skill in the realisation of essays Analyses the results obtained and extracts conclusions of the same	43	B3 B4 B6	C9	D1 D5 D9 D10
Problem solving	It will value the exercises posed along the course (25%). In the final examination will include similar exercises (20%). Results of learning: it Comprises the fundamental concepts of link, structure and microestructure of the distinct types of materials. It comprises the relation go in to microestructure of the material in his mechanical behaviour, electrical, thermal and magnetic. It comprises the mechanical behaviour of the metallic materials, ceramic, plastics and composed Know how can modify the properties by means of mechanical processes and thermal treatments Knows the basic technicians of structural characterisation of the materials Purchases skills in the handle of the diagrams and charts Is able to apply norms of essays of materials Purchases skill in the realisation of essays Analyses the results obtained and extracts conclusions of the same	50	B3 B4 B6	C9	D1 D5 D9 D10
Essay	They posed works along the course and will indicate the guidelines for his preparation. Results of learning: it Comprises the fundamental concepts of link, structure and microestructure of the distinct types of materials. It comprises the relation go in to microestructure of the material in his mechanical behaviour, electrical, thermal and magnetic. It comprises the mechanical behaviour of the metallic materials, ceramic, plastics and composed Know how can modify the properties by means of mechanical processes and thermal treatments Knows the basic technicians of structural characterisation of the materials Purchases skills in the handle of the diagrams and charts Is able to apply norms of essays of materials Purchases skill in the realisation of essays Analyses the results obtained and extracts conclusions of the same	5	B3 B4 B6	C9	D1 D5 D9 D10

Other comments on the Evaluation

Ethical commitment: it expects that the present student a suitable ethical behaviour. In case to detect a no ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices, for example) will consider that the student does not gather the necessary requirements to surpass the matter. In this case the global qualification in the present academic course will be of suspense (0.0).

It will not allow the utilisation of any electronic device during the proofs of evaluation except permission expresses. The fact to enter an unauthorised electronic device in the classroom of examination will be considered reason of no passing of the matter in the present academic course and the global qualification will be of suspense (0.0).
Continuous evaluation: The continuous evaluation will realise during the period of teaching of the subject, according to the criteria established in the previous section. Anyway, to surpass the subject will be necessary to have reached a minimum punctuation of 40% in the proof realised in the previously fixed date by the centre (http://eei.uvigo.es) Only they will add the two notes (continuous Evaluation (3/10) and Final Examination Theorist (7/10)), if it reaches or surpasses the minimum demanded in the theoretical examination (40%, that means 2,8/7) If the student has not surpassed this condition the final note of the subject will be the one of the continuous evaluation. Those students that do not receive to the continuous evaluation will be evaluated with a final examination on the contents of the whole of the matter, that will suppose 100% of the note.
Examination of July (2ª Edition) In the examination of July will take into account the continuous evaluation. Will be able to obtain 100% of the qualification;in the examination that will realise in the previously fixed date by the centre.

Sources of information

Basic Bibliography

Callister, William, **Materials Science and Engineering: an introduction**, Wiley,
Askeland, Donald R, **The science and engineering of materials**, Cengage Learning,
Shackelford, James F, **Introduction to materials science for engineers**, Prentice-Hall,

Complementary Bibliography

Smith, William F, **Fundamentals of materials science and engineering**, McGraw-Hill,
AENOR, **Standard tests**,
Montes J.M., Cuevas F.G., Cintas J., **Ciencia e Ingeneiría de Materiales**, Paraninfo,

Recommendations

Subjects that continue the syllabus

Materials engineering/V12G380V01504

Subjects that are recommended to be taken simultaneously

Fundamentals of manufacturing systems and technologies/V12G380V01305
Fluid mechanics/V12G380V01405
Thermodynamics and heat transfer/V12G380V01302

Subjects that it is recommended to have taken before

Computer science: Computing for engineering/V12G350V01203
Physics: Physics I/V12G380V01102
Physics: Physics II/V12G380V01202
Mathematics: Algebra and statistics/V12G380V01103
Mathematics: Calculus I/V12G380V01104
Chemistry: Chemistry/V12G380V01205

Other comments

To enrol in this matter is necessary to have surpassed or enrol of all the subjects of the inferior courses to the course in that it is situated this matter.

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

IDENTIFYING DATA

Thermodynamics and heat transfer

Subject	Thermodynamics and heat transfer			
Code	V12G380V01302			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department	Mechanical Engineering, Heat Engines & Machines, and Fluids			
Coordinator	Santos Navarro, José Manuel			
Lecturers	Cid Rodríguez, Natalia Giraldez Leirado, Alejandro Rodríguez Fernández-Arroyo, Juan Ignacio Román Espiñeira, Miguel Ángel Santos Navarro, José Manuel Sieres Atienza, Jaime Vidal López, Antonio José			
E-mail	josanna@uvigo.es			
Web				
General description	Thermodynamics studies the energy, its transformations and the relationships among the properties of substances. Therefore, its knowledge is of primary importance for the analysis, design and construction of any thermal machine or equipment; and, in general, for the industrial applications of thermal engineering. On the other hand, it is interesting to know the mechanisms for energy transfer, mainly due to the existence of a temperature difference, with a focus in the three modes of heat transfer and the mathematical models that allow calculating the heat transfer rate. At the end of the course, students are expected to be able to properly state and solve heat transfer engineering problems.			

Competencies

Code	
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
B5	CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
B6	CG6 Capacity for handling specifications, regulations and mandatory standards.
B7	CG7 Ability to analyze and assess the social and environmental impact of the technical solutions.
B11	CG11 Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Industrial Technical Engineer.
C7	CE7 Knowledge of applied thermodynamics and heat transfer. Basic principles and their application to solving engineering problems.
D2	CT2 Problems resolution.
D7	CT7 Ability to organize and plan.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
D17	CT17 Working as a team.

Learning outcomes

Expected results from this subject	Training and Learning Results		
Know and understand the Laws of Thermodynamics, the modes of heat transfer and the relations to calculate heat transfer rates	B4 B5 B6 B7	C7	D2 D7 D9 D10 D17
Know and understand the basic notions of the physics involved in the different modes of heat transfer	B5 B6 B7 B11	C7	D2 D7 D9 D10 D17

3.- Know and comprise the basic principles of the mechanics of *fluidos. *Capacidad Of *síntesis and concretion of the #phenomenon in the that take part the *fluidos and dominance of the laws that govern to his behaviour. Skills stop the resolution of practical cases of application in Sciences of the Sea. Know collaborate in the work with other people of communicative and constructive form in the manufacture of one experience with *fluidos.			
3.- Know and comprise the basic principles of the mechanics of *fluidos. *Capacidad Of *síntesis and concretion of the #phenomenon in the that take part the *fluidos and dominance of the laws that govern to his behaviour. Skills stop the resolution of practical cases of application in Sciences of the Sea. Know collaborate in the work with other people of communicative and constructive form in the manufacture of one experience with *fluidos.			
Identify the relevant heat transfer mechanisms involved in any heat transfer engineering application	B4 B6 B7 B11	C7	D2 D7 D9 D10 D17
Analyze thermal systems operation, such as heat pumps, refrigeration systems or power systems. Know the main components of these kinds of systems and the thermodynamic cycles used to model them	B4 B5 B6 B7 B11	C7	D2 D7 D9 D17

Contents
Topic
REVIEW OF THE FIRST And SECOND LAW OF THE THERMODYNAMICS
PROPERTIES OF PURE SUBSTANCES: TABLES And DIAGRAMS OF PROPERTIES
ANALYSIS OF OPEN SYSTEMS ACCORDING TO THE FIRST And SECOND LAW OF THE THERMODYNAMICS
APPLICATIONS OF THE ENGINEERING THERMODYNAMIC: POWER CYCLES And REFRIGERATION CYCLES
BASICS CONCEPTS And FUNDAMENTAL PRINCIPLES OF THE HEAT TRANSFER
HEAT TRANSFER BY CONDUCTION. ONE-DIMENSIONAL, STEADY-STATE HEAT FLOW
HEAT TRANSFER BY CONVECTION: FUNDAMENTALS And CORRELATIONS FOR CONVECTION HEAT TRANSFER COEFFICIENTS
HEAT TRANSFER BY RADIATION: FUNDAMENTALS. THERMAL RADIATION
INDUSTRIAL APPLICATIONS: HEAT EXCHANGERS

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	65	97.5
Laboratory practices	6	0	6
Autonomous problem solving	0	18.5	18.5
Problem solving	12	12	24
Problem solving	0	3	3
Other	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	Lecturer□s introduction of the contents of the matter object of study

Laboratory practices	Real processes experimentations in the laboratory which complement the contents covered in the course. PRACTICAL CONTENTS (at least 3 of the following laboratory practices will be done): 1) Application of the First Law of Thermodynamics: experimental determination of isothermal and adiabatic processes. 2) Evaluating thermodynamic properties of pure substances by means of computer software. 3) Experimental study of a vapor cycle. 4) Experimental study of a vapor compression refrigeration cycle and heat pump cycle. 5) Experimental determination of thermal conductivity. 6) Evaluating heat transfer by radiation: the Stefan-Boltzmann law.
Autonomous problem solving	Troubleshooting and / or exercises related to the subject that the student take place by consulting the literature
Problem solving	Troubleshooting and / or exercises related to the subject that the student take place in the classroom and/or laboratory. Examples of simple application of the contents studied as well as practical examples will be solved. The methodology will be focused on explaining how to solve the problems rather than on the determining the final numerical solution.

Personalized attention

Methodologies	Description
Lecturing	Students questions or doubts about any of the course contents will be solved during the instructor s office hours
Laboratory practices	Students questions or doubts about any of the course contents will be solved during the instructor s office hours
Problem solving	Students questions or doubts about any of the course contents will be solved during the instructor s office hours

Assessment

	Description	Qualification	Training and Learning Results		
Problem solving	Final exam consisting of solving problems of lengthy response , or exercises and / or theoretical questions concerning the contents of the developed material (theory sessions, labs, etc.), and time / conditions established / as by professor	80	B4 B5 B6 B7	C7	D2 D7 D9 D10
Other	Throughout the semester several tests will be performed. The corresponding note to the different proofs of follow-up will be based will be based on written tests of short answer. This note will correspond with the denomination of Continuous Evaluation	20	B6	C7	D2 D7 D9 D10

Other comments on the Evaluation

Continuous Evaluation Mode .

The final qualification (CF) of the student is determined by adding the points obtained in the final exam (EF) and those obtained by Continuous Evaluation (EC).

A minimum number of points in the final exam is not required to take into account the points obtained during the course (Continuous Evaluation). In any case, it is necessary to obtain a final qualification greater or equal than 5 points in order to to pass the subject.

Each new enrollment in the course involves resetting the ratings in the continuous evaluation activities obtained in previous courses.

According to the Continuous Assessment Regulations, those students subject to the continuous evaluation mode that take part in any assessable activity included in theTeaching Guide of the subject, will be considered as "presented" and will be taken into account for the final qualification of the course.

To carry out the different tests considered in the continuous evaluation mode (along the course) students should bring the materials and / or documentation required to perform these tests, sucha as: calculator (non- programmable), tables and diagrams of properties of substances. Any kind of form or similar complementary document will not be allow during these tests.

For the continuous evaluation tests and the final exam, it is recommeded that students clearly justify all their results. None of the results obtained by the student will be "understood" by default. The procedure used by the students during the solution of the differernt problems will also be taken into account.

Non-continuous Evaluation Mode

Those students that have renounced to be evaluated during the course (Continuous Evaluation) using the official procedure established by the Center, will be evaluated in the official dates set in the two calls (same day and time) by a specific assesment. This specific assessment will take into account all contents (theory, problems and laboratory practices) of the course, and will account for 100% of the maximum score. It will take place as follows:

1.- Written test (EF), with a weight of 80% of the final qualification, identical to the final test of all other students that follow the continuous evaluation mode.

2.- A Specific test (EC) , with a weight of 20% of the final qualification. This specific test will include both the contents of laboratory practice and the contents covered during the master sessions of the course.

Qualification criteria:

First call: the final qualification is calculated as

CF=0.2·EC+0.8·EF

Second call: the final qualification is calculated as

CF=max(N1, N2), where

N1 = 0.2·EC + 0.8·EF

N2 = EF

A score system from 0 to 10 points will be used (RD 1125/2003 de 5 de septiembre, BOEde 18 de septiembre)

The exams for the "final de carrera" call may have a different format to the formerly detailed one.

All tests, either during the course (continuous evaluation) or the final exam, must be done wit a pen, preferably blue. The use of a pencil or a red pen is not allowed. The use of electronic devices such as tablets, smartphones, laptops, etc, are also not allowed.

Ethical Comminmnet:

The student is expected to present an adequate ethical behavior. In the event that an unethical behavior is detected (copying, plagiarism, unauthorized use of electronic devices, etc.), it will be considered that the student does not meet the necessary requirements to pass the subject. In that case, the overall rating in the current academic year will be 'fail (0.0)'.

The use of any electronic device during the different assesments or tests is not allowed, unless expressly authorized. The fact of introducing such an unauthorized device in the examination room will be considered as a reason for not passing the subject in the current academic year and the overall rating will be 'fail (0.0)'.

IMPORTANT NOTE: this is the english translation of the subject guide. In the event of any conflict between the English and Spanish versions, the Spanish version shall prevail.

Sources of information

Basic Bibliography

Çengel, Yunus y Boles, Michael, **Termodinámica**, 7ª Edición, McGraw-Hill, 2012

Çengel Yunus A., Boles Michael A., **Thermodynamics : an engineering approach**, 7th ed, McGraw-Hill, 2011

Çengel Y.A., y Ghajar A.J., **Transferencia de Calor y Masa. fundamentos y aplicaciones**, 4ª edición, McGraw-Hill, 2011

Çengel, Yunus A., **Heat and mass transfer: a practical approach**, 4th ed, McGraw-Hill, 2011

Complementary Bibliography

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

Moran M.J. y Shapiro H.N., **Fundamentos de Termodinámica Técnica**, 2ª edición - castellano, Ed. Reverté, 2004

Merle C. Porter y Craig W. Somerton, **Termodinámica para ingenieros**, McGraw-Hill/Interamericana de España, 2004

Incropera F.P. y DeWitt D.P, **Introduction to Heat Transfer**, 2002

Wark, K. y Richards, D.E., **Termodinámica**, McGraw-Hill, 2010

Kreith J. y Bohn M.S, **Principios de Transferencia de Calor**, 2001,

Mills A.F., **Transferencia de calor**, 1995

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 2/V12G340V01202
Mathematics: Calculus 1/V12G340V01104
Mathematics: Calculus 2 and differential equations/V12G340V01204

Other comments

To enrol in this subject it will be necessary to have surpassed or to be enrolled in all the subjects of inferior courses.

Given the limitation of time for the "Thermodynamic Heat Transfer" course, it is highly recommended that students have completed the course Física II or that they have the equivalent background in thermodynamics

IMPORTANT NOTE: this is the english translation of the subject guide. In the event of any conflict between the English and Spanish versions, the Spanish version shall prevail.

IDENTIFYING DATA				
Fundamentos de electrotecnia				
Subject	Fundamentos de electrotecnia			
Code	V12G380V01303			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	1c
Teaching language	Castelán			
Department	Enxeñaría eléctrica			
Coordinator	Albo López, María Elena			
Lecturers	Albo López, María Elena Suárez Creo, Juan Manuel			
E-mail	ealbo@uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	Os obxectivos que se perseguen con esta materia son: _ Adquisición dos coñecementos referidos a símbolos, magnitudes, principios, elementos básicos e leis da electricidade. _ Coñecemento de técnicas e métodos de análises de circuítos con excitación continua e en réxime estacionario senoidal _ Descrición de sistemas trifásicos. _ Coñecemento dos principios de funcionamento e características das distintas máquinas eléctricas			

Competencias	
Code	
B3	CG3 Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
C10	CE10 Coñecemento e utilización dos principios de teoría de circuítos e máquinas eléctricas.
D1	CT1 Análise e síntese.
D2	CT2 Resolución de problemas.
D6	CT6 Aplicación da informática no ámbito de estudo.
D10	CT10 Aprendizaxe e traballo autónomos.
D14	CT14 Creatividade.
D16	CT16 Razoamento crítico.
D17	CT17 Traballo en equipo.

Resultados de aprendizaxe			
Expected results from this subject	Training and Learning Results		
Comprender os aspectos básicos do funcionamento dos circuítos e as máquinas eléctricas.	B3	C10	
Adquirir algúns conceptos básicos de álxebra lineal (bases, matrices, determinantes, autovalores, formas cadráticas)			
Coñecer o proceso experimental utilizado cando se traballa con circuítos eléctricos e máquinas eléctricas			D1 D2
Coñecer as técnicas actuais dispoñibles para a análise de circuítos eléctricos		C10	D6
Coñecer as técnicas de medida de circuítos eléctricos			D6 D10
Adquirir habilidades sobre o proceso de análise de circuítos eléctricos			D1 D2 D10 D14 D16 D17

Contidos	
Topic	
TEMA 1. INTRODUCIÓN.	Carga, corrente , potencial eléctrico, enerxía e potencia eléctrica, lei de Ohm, lei de Joule e leis de Kirchoff.
TEMA 2. ELEMENTOS DE CIRCUÍTOS.	Elementos ideais. Fontes, resistencia, bobina, condensador e transformador
TEMA 3. ELEMENTOS DE CIRCUÍTOS.	Elementos reais. Fontes, resistencia, bobina e condensador.
TEMA 4. ASOCIACIÓNS DE ELEMENTOS.	Asociación serie e paralelo, estrela e triángulo
TEMA 5. FORMAS DE ONDA.	Valores característicos das funcións senoidais. Concepto de fasor

TEMA 6. TEOREMAS.	Substitución, superposición, Thevenin e Norton.
TEMA 7. METODOS SISTEMÁTICOS DE ANÁLISE	Nós e mallas
TEMA 8. RÉXIME ESTACIONARIO SENOIDAL.	Comportamento dos elementos en corrente alterna. Combinacións de elementos.
TEMA 9. POTENCIA E ENERXÍA EN RÉXIME ESTACIONARIO SENOIDAL.	Potencias: complexa, aparente, activa, reactiva. Teorema de Boucherot.
TEMA 10. SISTEMAS TRIFÁSICOS EQUILIBRADOS.	Valores de liña e fase. Redución ao monofásico equivalente. Potencia.
TEMA 11. TRANSFORMADORES MONOFÁSICOS E TRIFÁSICOS.	Constitución, circuíto equivalente, indice horario.
TEMA 12. MÁQUINAS ASÍNCRONAS.	Constitución. Xeración do campo xiratorio.
TEMA 13. MÁQUINAS ASÍNCRONAS.	Circuíto equivalente
TEMA 14. MÁQUINAS ASÍNCRONAS.	Curvas características
TEMA 15. MÁQUINAS ASÍNCRONAS.	Manobras.
TEMA 16. MÁQUINAS DE ALTERNA MONOFÁSICAS	Constitución. Principio de funcionamento. Aplicacións.
TEMA 17. MÁQUINAS SÍNCRONAS.	Constitución. Funcionamento en baleiro e en carga. Sincronización.
TEMA 18. MÁQUINAS DE CORRENTE CONTINUA.	Constitución. Xeneralidades. Curvas características.
PRÁCTICAS	1. Descrición do laboratorio. Medidas en circuítos eléctricos. Automatismos básicos. Seguridade Eléctrica. 2. Asociacións de elementos. Equivalencia estrela-triangulo. 3. Formas de onda senoidais. Utilización do osciloscopio. Desfasamentos entre tensión e intensidade en resistencias, bobinas e condensadores. 4. Determinación experimental do equivalente Thévenin dunha fonte real de tensión. Impedancias en c.a. de elementos simples e de combinacións de elementos. 5. Medida de potencias en circuítos de c.a. monofásicos. 6. Sistema trifásico equilibrado. Comparación de valores de liña e fase. Circuito monofásico equivalente. Potencia en cargas trifásicas. 7. Transformadores. Constitución e determinación mediante ensaios do circuíto equivalente de transformadores monofásicos e trifásicos. Indice horario de transformadores trifásicos. 8. Ensaios na Máquina asíncrona. Determinación do circuíto equivalente. Arranque estrela-triángulo. 9. Máquina de corrente continua. Constitución e principio de funcionamento.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	22	44	66
Resolución de problemas	10	10	20
Prácticas de laboratorio	20	10	30
Resolución de problemas de forma autónoma	0	20	20
Exame de preguntas de desenvolvemento	4	0	4
Informe de prácticas	0	10	10
*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 de aula os contidos da materia.
Resolución de problemas	Exporanse e resolverán problemas e exercicios tipo nas clases de aula como guía para o alumnado.
Prácticas de laboratorio	Realizaranse no laboratorio montaxes prácticas correspondentes aos contidos vistos na aula, ou ben se tratarán aspectos complementarios non tratados nas clases teóricas.
Resolución de problemas de forma autónoma	É moi aconsellable que o alumno trate de resolver pola súa conta exercicios e cuestións da materia propostos polo profesorado.

Atención personalizada	
Methodologies	**Description**
Resolución de problemas	O profesor atenderá persoalmente as dúbidas e consultas dos alumnos.
Prácticas de laboratorio	O profesor atenderá persoalmente as dúbidas e consultas dos alumnos.

Avaliación

	Description	Qualification	Training and Learning Results
Lección maxistral	Avaliarase o nivel de seguimento por parte do alumnado dos contidos da materia. A este efecto desenvolveranse durante o curso polo menos dúas probas curtas a realizar descontando o tempo do dedicado ás clases de aula. Tentarase no posible realizar as probas dentro do horario habitual de clase, con todo o profesor/a pode considerar conveniente realizar a proba noutro horario, previamente anunciado, sempre que non coincida con clases teoría/prácticas do mesmo curso e titulación, e que conte con permiso da Dirección do Centro. Cada proba constará dun conxunto de pequenos exercicios para os cales cada alumno/a proporá unha resposta, se é correcta conta como un acerto e se é errónea ou se deixa en branco non puntúa, cada proba valórase entre 0 e 10 puntos. A avaliación das probas curtas é a media aritmética das puntuacións obtidas, está comprendida entre 0 e 10. A primeira desas probas comprende ata o tema 6 incluído e a segunda ata o tema 10 incluído O alumnado coas probas curtas aprobadas e cun valor medio igual ou superior a 6,5 puntos sobre 10 pode, se o desexa, deixar de realizar os exercicios 1 e 2 do exame xeral, nese caso a cualificación deses exercicios será a correspondente ás das probas curtas. En caso de decidir realizar os exercicios liberados a nota a considerar será a mellor delas. NOTA: o indicado en o párrafo anterior refírese en exclusiva a as probas curtas realizadas durante o período de clases pero non é de aplicación en ningún outro caso.	25	B3 C10 D1 D2 D10 D16
Exame de preguntas de desenvolvemento	Realizarase un exame xeral (que poden incluír tanto cuestións teóricas como exercicios de aplicación) con dúas seccións de tres preguntas cada unha, a primeira sección corresponde aos contidos de teoría de circuítos e a segunda aos de máquinas eléctricas, Cada sección avaliarase entre 0 e 10 puntos esixíndose un mínimo de 3 puntos en cada unha delas para poder aprobar a materia.	65	B3 C10 D1 D2 D6 D10 D14 D16
Informe de prácticas	Valorarase positivamente a realización das prácticas e a resolución dun cuestionario referido á montaxe, resultados obtidos e interpretación dos mesmos. A realización de cada práctica e resolución do cuestionario valorarase entre 0 e 10 puntos A avaliación do conxunto de prácticas é a media aritmética das puntuacións obtidas, está comprendida entre 0 e 10.	10	B3 C10 D1 D2 D6 D10 D14 D16 D17

Other comments on the Evaluation

A nota numérica final obtense pola media ponderada dos ítems anteriores: Nota = 0,25xPruebas curtas + 0,1xPrácticas + 0,65xExamen Se como resultado da aplicación da media ponderada anterior a nota final é superior a 4,5 puntos pero non se cumpre a condición de alcanzar un mínimo de 3 puntos en cada parte do final, a nota máxima será de 4,5 puntos. Tanto a realización do test, como a asistencia ás prácticas e entrega dos cuestionarios das mesmas, son actividades de avaliación continua, valorándose a primeira con ata 2,5 puntos e a segunda con ata 1 punto na cualificación final. O profesorado desta materia considera xustificado que o alumnado poida presentarse a un exame final tendo opcións de aspirar á máxima cualificación posible, por tanto aqueles alumnos que desexen mellorar a cualificación correspondente á avaliación continua poderán presentarse a un exame adicional a continuación do exame xeral, no que se incluirán preguntas relativas aos contidos da docencia tanto de aula como de laboratorio, avaliable entre 0 e 10 puntos, e que poderá supor ata un 35% da cualificación final co mesmo reparto que se outorga na avaliación continua, nese exame adicional pódese recuperar unha das partes ou ambas. En caso de realizalo a cualificación que se terá en conta para valorar as actividades de avaliación continua será a do exame adicional. O alumno que desexe renunciar ás actividades correspondentes á avaliación continua dispón dun prazo para facelo, nese caso a cualificación máxima a que se pode aspirar co exame final é de 6,5 puntos sobre 10, con todo pode aumentar a súa cualificación realizando o exame adicional comentado no parágrafo anterior. Para a segunda oportunidade de Xuño - Xullo mantense a última cualificación na avaliación continua obtida durante o propio curso, é dicir, ou ben a obtida polas actividades regulares ou a do exame adicional se se realizou, sen prexuízo de que, do mesmo xeito que na primeira oportunidade de Decembro - Xaneiro, poida ser superada pola realización do exame adicional que se propoña a ese efecto. A cualificación que se terá en conta para valorar as actividades de avaliación continua será a da última nota alcanzada. A condición de Non Presentado se reserva en exclusiva ao alumnado do cal non consta ningunha cualificación durante o curso, é dicir, que non realizase ningunha proba curta nin práctica de laboratorio nin se presentou ao exame xeral. O feito de non presentarse ao exame final non supón a consideración de NP se xa se ten unha cualificación nas

actividades de avaliación continua durante o curso, neste caso a nota final é a que corresponde á avaliación continua. Cada nova matrícula na materia supón unha posta a cero das cualificacións nas actividades de avaliación continua obtida en cursos anteriores. O sistema de avaliación trata de incentivar o traballo continuado ao longo do curso rebaixando o peso do exame final na cualificación. En concreto se se cumpre a condición das probas curtas aprobadas e unha nota media nelas igual ou superior a 6,5 puntos o peso que toman ditas probas na cualificación final é superior ao 25% dado que ditas probas tamén contan na puntuación do exame final Compromiso ético Espérase que o alumno presente un comportamento ético adecuado. En caso de detectar un comportamento non ético (copia, plaxio, utilización de aparellos electrónicos non autorizados, por exemplo) considerarase que o alumno non reúne os requisitos necesarios para superar a materia. Neste caso a cualificación global no presente curso académico será de suspenso (0,0).

Bibliografía. Fontes de información

Basic Bibliography

Suárez Creo, J. Albo López E, **Apuntes F.Electrotecnia**,

Súarez Creo, J. , Albo López, E, **Ejercicios Resueltos de F. Electrotecnia**,

Complementary Bibliography

Jesús Fraile Mora, **Circuitos Eléctricos**, 2015,

V. M. Parra, A. Pérez, A. Pastor, J. Ortega, **TEORÍA DE CIRCUITOS**, 1985,

P. Sánchez Barrios y otros, **TEORIA DE CIRCUITOS. Problemas y pruebas objetivas**,

Suarez Creo J. y Miranda Blanco B.N., **MÁQUINAS ELÉCTRICAS. FUNCIONAMIENTO EN RÉGIMEN PERMANENTE**, 4º Ed. 2006,

Jesús Fraile Mora, **Máquinas eléctricas**, 2015,

Jesús Fraile Mora, **Problemas resueltos de máquinas eléctricas**, 2015,

Müller-Schwarz, **FUNDAMENTOS DE LA ELECTROTECNIA**,

Enrique Ras, **TEORÍA DE CIRCUITOS: FUNDAMENTOS**,

REGLAMENTO ELECTROTECNICO DE BAJA TENSIÓN.,

Recomendacións

Subjects that continue the syllabus

Tecnoloxía eléctrica/V12G340V01804
Compoñentes eléctricos en vehículos/V12G340V01902
Oficina técnica/V12G340V01307

Subjects that it is recommended to have taken before

Física: Física I/V12G340V01102
Física: Física II/V12G340V01202
Matemáticas: Álxebra e estatística/V12G340V01103
Matemáticas: Cálculo I/V12G340V01104

Other comments

É moi recomendable que os alumnos teñan coñecementos suficientes da álxebra dos números complexos e cursar as materias de Física de primeiro curso.
Para matricularse nesta materia é conveniente superar ou ben estar matriculado de todas as materias dos cursos inferiores ao curso en que está situado esta materia.
a información necesaria para o alumnado estará dispoñible na plataforma TEMA

IDENTIFYING DATA				
Fundamentos de sistemas e tecnoloxías de fabricación				
Subject	Fundamentos de sistemas e tecnoloxías de fabricación			
Code	V12G380V01305			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	1c
Teaching language	Castelán			
Department	Deseño na enxeñaría			
Coordinator	Diéguez Quintas, José Luís Fernandez Ulloa, Antonio Prado Cerqueira, María Teresa			
Lecturers	Areal Alonso, Juan José Ares Gómez, José Enrique Diéguez Quintas, José Luís Fernandez Ulloa, Antonio Hernández Martín, Primo Prado Cerqueira, María Teresa Rodríguez Paz, Rafael			
E-mail	tprado@uvigo.es jdieguez@uvigo.es afulloa@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Os obxectivos docentes de Fundamentos de Sistemas e Tecnoloxías de Fabricación, nos seus aspectos fundamentais e descritivos, céntranse 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 ata as de utilización dos instrumentos, as ferramentas, *utillajes, equipos, máquinas ferramenta e sistemas necesarios para a súa realización, de acordo coas normas e especificacións establecidas, e aplicando criterios de optimización. Para alcanzar os obxectivos mencionados impartirase a seguinte temática docente: - Fundamentos de *metrología *dimensional. Medida de lonxitude, ángulos, formas e elementos de máquinas. - Estudo, análise e avaliación das tolerancias *dimensionales. Cadea de tolerancias. Optimización das tolerancias. Sistemas de axustes e tolerancias. - Procesos de conformado de materiais mediante arranque de material, operacións, *maquinas, equipos e *utillaje - Procesos de conformado mediante deformación plástica, operacións, *maquinas, equipos e *utillaje - Procesos de conformado por moldeo, operacións, *maquinas, equipos e *utillaje - Procesos de conformado non convencionais, operacións, *maquinas, equipos e *utillaje. - Conformado de *polímeros, e outros materiais non metálicos, operacións, *maquinas, equipos e *utillaje - Procesos de unión e ensamblaxe, operacións, *maquinas, equipos e *utillaje - Fundamentos da programación de *maquinas con *CNC, utilizadas na fabricación mecánica.			

Competencias	
Code	
B3	CG3 Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.
C15	CE15 Coñecementos básicos dos sistemas de produción e fabricación.
D2	CT2 Resolución de problemas.
D8	CT8 Toma de decisións.
D9	CT9 Aplicar coñecementos.
D10	CT10 Aprendizaxe e traballo autónomos.
D17	CT17 Traballo en equipo.
D20	CT20 Capacidade para comunicarse con persoas non expertas na materia.

Resultados de aprendizaxe	
Expected results from this subject	Training and Learning Results

 Coñecer as ecuacións de curvas e superficies máis utilizadas no plano e no espazo. Manexar a integración en dúas e tres variables nestes recintos como ferramenta de cálculo de áreas e volumes.

Coñecer a base tecnolóxica e aspectos básicos dos procesos de fabricación		C15	D2 D9 D10 D20
Comprender os aspectos básicos dos sistemas de fabricación	B3	C15	D2 D10
Adquirir habilidades para a selección de procesos de fabricación e elaboración da planificación de fabricación		C15	D2 D8 D17
Desenvolver habilidades para a fabricación de conxuntos e elementos en contornas *CAD/*CAM	B3	C15	D2 D8 D9 D17 D20

Contidos

Topic	
UNIDADE DIDÁCTICA 1. INTRODUCIÓN Ás TECNOLOXÍAS E SISTEMAS DE FABRICACIÓN.	Lección 1. INTRODUCIÓN Á ENXEÑARÍA DE *FABRICACION. O ciclo produtivo. Clasificación de industrias. Tecnoloxías de fabricación.
UNIDADE DIDÁCTICA 2. *METROTECNIA.	Lección 2. PRINCIPIOS DE *METROLOGÍA *DIMENSIONAL. Introdución. Definicións e conceptos. O Sistema Internacional de Unidades. Magnitudes físicas que abarca a *Metrología *Dimensional. Elementos que interveñen na medición. Clasificacións dos métodos de medida. Patróns. A cadea de *trazabilidad. *Calibración. Incerteza. Cadea de *calibración e transmisión da incerteza. Relación entre tolerancia e incerteza. Expresión da incerteza de medida en *calibración. Lección 3. INSTRUMENTOS E MÉTODOS DE MEDIDA. Introdución. Patróns. Instrumentos de verificación. Patróns *interferométricos. Principios de *interferometría. Instrumentos de medida directa. Métodos e instrumentos de medida indirecta. Lección 4. MEDICIÓN POR COORDENADAS. MEDICIÓN POR IMAXE. CALIDADE SUPERFICIAL. Máquinas de medición por coordenadas. Concepto. Principios das *MMC. Clasificación das máquinas. Principais compoñentes das *MMC. Proceso a seguir para o desenvolvemento dunha medida. Sistemas de medición por imaxe. Calidade Superficial. Métodos de medida da rugosidade. Parámetros de rugosidade.

UNIDADE DIDÁCTICA 3. PROCESOS DE CONFORMADO POR ARRANQUE DE MATERIAL	Lección 5. INTRODUCIÓN Ao CONFORMADO POR ARRANQUE DE MATERIAL. Introdución. Movementos no proceso de arranque de material. Factores a ter en conta na elección da ferramenta. Xeometría de ferramenta. Materiais de ferramenta. Mecanismo de formación da labra. Tipos de labras. Potencia e forzas de corte. Desgaste de ferramenta. Criterios de desgaste de ferramenta. Determinación da vida da ferramenta. Fluídos de corte. Lección 6. *TORNEADO: OPERACIÓNS, *MAQUINAS E *UTILLAJE. Introdución. Principais operacións en torno. A máquina-ferramenta: o torno. Partes principais do torno. Montaxe ou *sujeción de pezas. Ferramentas típicas do torno. *Tornos especiais. Lección 7. *FRESADO: OPERACIÓNS, MÁQUINAS E *UTILLAJE. Introdución. Descrición e clasificación das operacións de *fresado. Partes e tipos principais de *fresadoras. Tipos de fresas. Montaxe da ferramenta. *Sujeción de pezas. Diferentes configuracións de *fresadoras. *Fresadoras especiais. Lección 8. MECANIZADO DE BURACOS E CON MOVEMENTO PRINCIPAL *RECTILÍNEO: OPERACIÓNS, MÁQUINAS E *UTILLAJE. Introdución ás operacións de mecanizado de buracos. *Taladradoras. *Mandrinadoras. Características xerais dos procesos de mecanizado con movemento principal *rectilíneo. *Limadora. *Mortajadora. *Cepilladora. *Brochadora. Serras. Lección 9. CONFORMADO CON *ABRASIVOS: OPERACIÓNS, MÁQUINAS E *UTILLAJE. Introdución ás operacións de mecanizado de buracos. Muelas *abrasivas. Operación de rectificado. Tipos de *rectificadoras. *Honeado. *Lapeado. Pulido. *Bruñido. *Superacabado Lección 10. PROCESOS DE MECANIZADO NON CONVENCIONAIS. Introdución. O mecanizado por *electroerosión ou *electro-descarga. Mecanizado *electroquímico. Mecanizado por láser. Mecanizado por chorro de auga. Corte por arco de plasma. Mecanizado por ultrasóns. *Fresado químico.
UNIDADE DIDÁCTICA 4. AUTOMATIZACIÓN E XESTIÓN DOS PROCESOS DE FABRICACIÓN.	Lección 11. CONTROL NUMÉRICO DE MÁQUINAS FERRAMENTA. Introdución. Vantaxes da aplicación do *CN nas máquinas ferramenta. Información necesaria para a creación dun programa de *CN. Programación manual de *MHCN. Tipos de linguaxe de *CN. Estrutura dun programa en código *ISO. Caracteres empregados. Funcións preparatorias (*G__). Funcións auxiliares (*M__). Interpretación das principais funcións. Exemplos. Programación automática en control numérico.

UNIDADE DIDÁCTICA 5. PROCESOS DE CONFORMADO DE MATERIAIS EN ESTADO LÍQUIDO E *GRANULAR.	Lección 12. ASPECTOS XERAIS DO CONFORMADO POR *FUNDICIÓN DE METAIS. Introdución. Etapas no conformado por *fundición. Nomenclatura das principais partes do *molde. Materiais empregados no conformado por *fundición. Fluxo do fluído no sistema de alimentación. *Solidificación dos metais. Contracción dos metais. O *rechupe. Procedemento de cálculo do sistema distribución de coada. Consideracións sobre deseño e defectos en pezas fundidas. Lección 13. PROCESOS DE FABRICACIÓN POR *FUNDICIÓN. Clasificación dos procesos de *fundición. Moldeo en area. Moldeo en casca. Moldeo en *yeso. Moldeo en cerámica. Moldeo ao CO2. Moldeo á cera perdida *Fundición en *molde cheo. Moldeo *Mercast. Moldeo en *molde permanente. *Fundición inxectada. *Fundición *centrifugada. Fornos empregados en *fundición. Lección 14. *METALURGIA DE POS (*PULVIMETALURGIA). Introdución. Fabricación dos pos metálicos. Características e propiedades dos pos metálicos. *Dosificación e mestura de pos metálicos. *Compactación. *Sinterizado. Fornos de *sinterización. *Sinterizado por descarga *disruptiva. *Presinterizado. Operacións posteriores. Consideracións de deseño. Produtos *obtenibles por *sinterización. Lección 15. CONFORMADO DE PLÁSTICOS. Introdución. Clasificación materiais *poliméricos. Propiedades físicas de *polímeros. Clasificación dos procesos. Moldeo por *extrusión. Moldeo por inxección. Moldeo por *compresión. Moldeo por transferencia. Moldeo *rotacional. *Termoconformado.
UNIDADE DIDÁCTICA 6. PROCESOS DE CONFORMADO POR UNIÓN.	Lección 16. PROCESOS DE SOLDADURA. Introdución aos procesos de soldadura. Soldadura con arco eléctrico. Soldadura por resistencia. Soldadura con osíxeno e gas combustible .Soldadura con temperatura de fusión de metal de achegue menor que a dos metais a unir. Lección 17. PROCESOS DE UNIÓN E MONTAXE SEN SOLDADURA. Procesos de unión mediante adhesivos. Resistencia á adhesión. Condicións para o pegado. Deseño de unións Tipos de adhesivos segundo orixe e composición. Procesos de unión mecánica. Unións mecánicas *desmontables e permanentes.
UNIDADE DIDÁCTICA 7. PROCESOS DE CONFORMADO POR DEFORMACIÓN PLÁSTICA DE METAIS.	Lección 18. ASPECTOS XERAIS DO CONFORMADO POR DEFORMACIÓN PLÁSTICA. Introdución. Curvas de esforzo-deformación. Expresións da deformación. Constancia do volume. Modelos aproximados da curva esforzo real-deformación natural. Estado de deformación plana. Procesos primarios e secundarios. Procesos de traballo en quente e en frío. Condicións e control do proceso. Lección 19. PROCESOS DE *LAMINACIÓN E FORXA. *Laminación: fundamentos; temperatura de *laminación; equipos para a *laminación en quente; características, calidade e tolerancias dos produtos *laminados en quente; *laminación en frío. Forxa: libre; en matriz de impresión; en prensa; por recalcado; *encabezamiento en frío; por *laminación; en frío. Lección 20. *EXTRUSIÓN, *EMBUTICIÓN E AFÍNS. *Extrusión. Estirado de barras e tubos. *Trefilado. Redución de sección. *Embutición. *Repujado en torno. Pezas realizables por *repujado: consideracións de deseño. Conformación por estirado. Conformación con *almohadillas de caucho e con líquido a presión. Conformación a gran potencia. Lección 21. CONFORMADO DE CHAPA METÁLICA. *Curvado ou dobrado de chapas. *Curvado con rodetes. Conformado con rodetes. Endereitado. *Engatillado. Operacións de corte de chapa.

PROGRAMA DE PRÁCTICAS	Práctica 1.- Utilización dos aparellos convencionais de *metrología. Medición de pezas utilizando pé de rei normal e de profundidades e *micrómetro de exteriores e interiores. Emprego de reloxo *comparador. Comprobación de superficies planas. Uso de calibres pasa/non pasa, regras, escuadras e calas patrón. Medición e comprobación de roscas. Realización de medicións *métricas e en unidades inglesas. Práctica 2.-Medicións indirectas. Comprobación dun cono utilizando rodetes e un pé de rei, medición dunha cola de *milano utilizando rodetes, medición dos ángulos dunha dobre cola de *milano e medicións utilizando unha regra de seos. Medicións directas con *goniómetro. Práctica 3.- Máquina de medición por coordenadas. Establecer un sistema de coordenadas. Comprobar medidas en peza, utilizando unha máquina de medir por coordenadas. Verificar tolerancias forma e posición. Práctica 4.- Fabricación con máquinas ferramentas convencionais. Fabricación dunha peza empregando o torno, a *fresadora e o trade convencionais, definindo as operacións básicas e realizándoas sobre a máquina. Práctica 5.- Selección de condicións de corte asistida por computador. Realización de follas de proceso de tres pezas utilizando programa de planificación de procesos asistida por ordenador Práctica 6, 7 e 8.- Iniciación ao control numérico aplicadas ao torno e á *fresadora. Realización dun programa en *CNC utilizando un simulador, coas ordes principais e máis sinxelas; realizando ao final diversas pezas tanto no torno como na *fresadora da aula taller. Práctica 9.- Soldadura. Coñecemento de diferentes equipos de soldadura eléctrica. *Soldeo de diferentes materiais empregado as técnicas de eléctrodo revestido, *TIG e *MIG.

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	32.5	0	32.5
Prácticas de laboratorio	18	0	18
Exame de preguntas obxectivas	0	2	2
Práctica de laboratorio	0	50	50
Outras	0	47.5	47.5

*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	As clases teóricas realizaranse combinando as explicacións de lousa co emprego de vídeos e presentacións de computador. A finalidade destas é complementar o contido dos apuntamentos, interpretando os conceptos nestes expostos mediante a mostra de exemplos e a realización de exercicios.
Prácticas de laboratorio	As clases prácticas de laboratorio realizaranse en 9 sesións de 2 horas, salvo os alumnos do curso ponte que realizarán as prácticas nas 6 sesións que contempla o seu horario particular, en grupos de 20 alumnos máximo, e empregando os recursos dispoñibles de instrumentos e máquinas, combinándose coas simulacións por computador.

Atención personalizada

Methodologies	**Description**
Lección maxistral	
Prácticas de laboratorio	
Tests	**Description**
Exame de preguntas obxectivas	
Práctica de laboratorio	

Avaliación

	Description	Qualification	Training and Learning Results
Exame de preguntas obxectivas	PROBA TIPO A (para todos os alumnos -60% nota final-) O carácter desta proba é escrita e presencial, é obrigatoria para todos os alumnos, con ou sen avaliación continua. Estará composta esta proba por 20 preguntas tipo test sobre os contidos teóricos e prácticos. A valoración de próbaa tipo test realizarase nunha escala de 6 puntos, o que representa o 60% da nota total, sendo necesario obter polo menos 2 puntos, para que xunto coas probas prácticas póidase obter polo menos 5 puntos e superar a materia A nota deste test obterase sumando 0,3 puntos por cada cuestión correctamente contestada e restaranse 0,1 puntos se a cuestión é resolta de forma incorrecta. As cuestións en branco non puntúan.	60	B3 C15 D8 D9 D10
Práctica de laboratorio	PROBA TIPO *B (avaliación continua -30% nota final-): Dous probas tipo test a realizar no horario de clase, consistentes en 5 preguntas sobre a materia impartida ata o momento, cada pregunta correcta valerá 0,3 puntos e as incorrectas restarán 0,1 puntos. As cuestións en branco non puntúan. Cada proba será por tanto o 15% da nota final. PROBA TIPO *C (avaliación continua -10% nota final-): Unha proba escrita ou traballo a propor polo profesor ao longo do cuadrimestre. Esta proba valorarase cun máximo de 1 punto, o 10% da nota final. Estas notas sumaranse á cualificación de próbaa tipo test, para poder obter polo menos 5 puntos e superar a materia. PROBA TIPO (renuncia á avaliación continua -40% nota final-): Resolución de varios problemas prácticos, cuxo valor será o 40% da nota final, ou sexa como máximo 4 puntos, sendo necesario obter un mínimo de 1 punto nesta segunda proba para que a cualificación póidase sumar á de próbaa tipo test, e se iguala ou supera 5 puntos, aprobar a materia. Esta proba tipo D, realizarana os alumnos aos que se lles concedeu a renuncia á avaliación continua, e realizarase o mesmo día que se realice próbaa test obrigatoria, despois de que este finalizase.	40	C15 D2 D8 D9 D10 D17 D20

Other comments on the Evaluation

<*p>APROBADO</*p><*p>Alumnos cualificados mediante avaliación continua:</*p><*p>Para superar esta materia é necesario polo menos obter 5 puntos sumando a puntuación de próbalas tipos □A□, □*B□ e □*C□. </*p><*p>Todos os alumnos en principio deberán seguir o procedemento de avaliación continua, salvo aqueles que expresamente renuncien no prazo e forma que marque a escola. </*p><*p>&*nbsp;Alumnos cualificados con renuncia concedida á avaliación continua:</*p><*p>Para superar esta materia é necesario polo menos obter 5 puntos sumando a puntuación de próbalas tipos □A□ e □D□.</*p><*p>ASISTENCIA A CLASES PRÁCTICAS</*p><*p>A asistencia a clases prácticas non é obrigatoria, pero será sempre materia de exame o nelas impartido.</*p><*p>CONVOCATORIA DE 2º EDICIÓN</*p><*p>Alumnos con avaliación continua, cualificación na convocatoria de 2º edición: </*p><*p>&*nbsp;Esta segunda edición da convocatoria ordinaria cualificarase da seguinte maneira: </*p><*p>- Mediante a realización da proba obrigatoria tipo □A□ </*p><*p>- Consérvanse as cualificacións das dúas probas tipo □*B□ nesta 2ª oportunidade, pero poderase, se se desexa, mellorar esta cualificación, mediante a repetición destas probas tipo □*B□ ao finalizar próbaa tipo □A□.</*p><*p>- Manterase a puntuación alcanzada en próbaa tipo □*C□ por valor máximo de 1 punto, pero poderase mellorar esta nota se se desexa mediante unha proba escrita ou traballo a propor polo profesor, a entregar antes do día da convocatoria desta segunda edición.</*p><*p>Para superar esta materia é necesario polo menos obter 5 puntos sumando o tres anteriores probas. </*p><*p>As notas das probas de avaliación continua, correspondentes ao 40% da cualificación final, non se conservará dun curso para outro. </*p><*p>Alumnos sen avaliación continua, cualificación na convocatoria de 2º edición: </*p><*p>Os alumnos que non realicen avaliación continua, debido a que o centro lles aceptou a renuncia, sempre deberán realizar en todas as convocatorias próbaa tipo □A□ (por valor de 6 puntos) e próbaa tipo □D□ (por valor de 4 puntos), nos termos especificados nos anteriores apartados. </*p><*p>Para superar esta materia é necesario polo menos obter 5 puntos sumando as dúas anteriores probas. </*p><*p>CONVOCATORIA EXTRAORDINARIA: </*p><*p>Esta proba será igual para todos os alumnos e consistirá nunha próbaa tipo □A□ (por valor de 6 puntos) e próbaa tipo □D□ (por valor de 4 puntos), nos termos especificados nos anteriores apartados. </*p><*p>Para superar esta materia é necesario polo menos obter 5 puntos sumando as dúas anteriores probas. </*p><*p>COMPROMISO ÉTICO:</*p><*p>Espérase que o alumno presente un comportamento ético adecuado, libre de fraude. En caso de detectar un comportamento non ético (copia, plaxio, utilización de aparellos electrónicos non autorizados, por exemplo) considerarase que o alumno non reúne os requisitos necesarios para superar a materia. Neste caso a cualificación global no presente curso académico será de suspenso (0.0).</*p>

Bibliografía. Fontes de información

Basic Bibliography

Complementary Bibliography

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

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

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

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

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

Recomendacións

Subjects that are recommended to be taken simultaneously

Ciencia e tecnoloxía dos materiais/V12G350V01305

Other comments

Requisitos: Para matricularse de esta materia es necesario tener superado o bien estar matriculado de todas las materias de los cursos inferiores al curso al que está emplazada esta materia.

En caso de discrepancias, prevalecerá la versión en castellano de esta guía.:(Gateway Time-out:http://tradutorsw.uvigo.es/trad-docx/web/translate-string.php?wsdl)

IDENTIFYING DATA				
Mechanism and machine theory				
Subject	Mechanism and machine theory			
Code	V12G380V01306			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician English			
Department	Mechanical Engineering, Heat Engines & Machines, and Fluids			
Coordinator	Fernández Vilán, Ángel Manuel Segade Robleda, Abraham			
Lecturers	Fernández Vilán, Ángel Manuel López Campos, José Ángel Segade Robleda, Abraham			
E-mail	asegade@uvigo.es avilan@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject is intended to provide the students with basic knowledge about Mechanism and Machine Theory as well as his applications in the field of Mechanical engineering. It also covers and provides the students with the most important concepts related with Mechanism and Machine Theory. The students will know and apply kinematic and dynamic analysis methods for mechanical systems both with graphical and analytical methods and also through effective use of simulation software. Furthermore, this subject serves as an introduction of some aspects about machinery design; a topic that will be cover thoroughly in future subjects of the Degree.			

Competencies	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
C13	CE13 Knowledge of the principles of the theory of machines and mechanisms.
D2	CT2 Problems resolution.
D6	CT6 Application of computer science in the field of study.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
D16	CT16 Critical thinking.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
To know the fundamentals of Mechanism and Machines Theory, and the application of these concepts concerning to the field of Mechanical engineering to solve problems related with this subject in the Industrial Engineering field.	B3 B4	C13	D2 D6 D9 D10 D16
To know, comprehend, apply, and practice the concepts related to Mechanism and Machines Theory.	B3 B4	C13	D2 D6 D9 D10 D16
To know and apply kinematic and dynamic analyses techniques to mechanical systems.	B3 B4	C13	D2 D6 D9 D10 D16
Efficiently know and utilize software for analysis of mechanisms.	B3 B4	C13	D2 D6 D9 D10 D16

Contents	
Topic	
Introduction to mechanism and machine theory	Introduction Definition of Machine, Mechanism and Kinematic Chain Link/part and linkage/joint Classification Kinematic Diagram, modeling, and symbology (nomenclature) Mobility Degrees of freedom Synthesis of mechanisms
Geometrical analysis of mechanisms.	Introduction Calculation methods of placement Loop closure equations
Kinematic analysis of mechanisms	Fundamentals Graphical methods Analytical methods Matrix methods
Static analysis of mechanisms	Fundamentals Force reduction (Graphical Methods) Work/Power Virtual Methods
Dynamic analysis of mechanisms	Fundamentals Machine general dynamics Machine Work and Power Balanced Dynamics of rotors
Cam mechanisms	Fundamentals Flat cams Cam synthesis
Power transmission mechanisms	Fundamentals Gears Mechanism Other mechanisms

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	23	19.5	42.5
Problem solving	9.5	30	39.5
Laboratory practices	18	47	65
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	Master class where the theoretical concepts are explain
Problem solving	Problem solving using the theoretical concepts presented in the Master Lesson
Laboratory practices	Practical tasks developed at the teaching laboratory or computer lab.

Personalized attention	
Methodologies	**Description**
Lecturing	Group or individual tutorials will be held during office hours to strengthen the acquired knowledge and to guide and assess the proposed works/papers .
Problem solving	Group or individual tutorials will be held during office hours to strengthen the acquired knowledge and to guide and assess the proposed works/papers.
Laboratory practices	Group or individual tutorials will be held during office hours to strengthen the acquired knowledge and to guide and assess the proposed works/papers.

Assessment					
	Description	Qualification	Training and Learning Results		
Laboratory practices	Attendance and participation as well as practices reports, papers, and tests will be rated. However, to be evaluated, students must attend a minimum of 7 practice sessions; otherwise, students won't be evaluated and will get 0 points. Learning outcomes: all will be graded	20	B3 B4	C13	D2 D6 D9 D10 D16

Essay questions exam	Final and mid-term tests will be focused on the contents taught at classes and laboratory sessions. Learning outcomes: all will be graded.	80	B3 B4	C13	D2 D9 D10 D16

Other comments on the Evaluation

Students must achieve a 5 or higher grade* to pass the subject, following these rules:

1. Students are required to attend and utilized the laboratory/Computer room. Practices reports, papers, and tests for each practice session as well as proposed works/papers from tutorials will be evaluated and graded with a maximum of 2 points of the final grade. This grade will be kept for the second term in the student□s evaluation records (July). To be evaluated, students must attend a minimum of 7 practice sessions; otherwise, students won□t be evaluated and will get 0 points.
2. For those students who have been officially granted the right to waive their continued evaluation, there will be a mandatory final test where they will be able to get a maximum grade of 2 points. However, an advanced request must be made to the professor to prepare the necessary materials for this test.
3. The final test will have a maximum grade of 8 points.

* Grades are calculated using a system of numerical qualification from 0 to 10 points conforming to the Spanish current legislation (RD 1125/2003, 5 September; BOE 18 September).

Ethical commitment: An adequate ethical behaviour of the student is expected at all times. In case an unethical behaviour is detected (copying, plagiarism, unauthorized use of electronic devices, and others); the student will be considered unfit to meet the necessary requirements to pass the subject. In this case, the overall qualification in the current academic year will be a Fail grade (0.0).
The use of any electronic devices during tests is completely forbidden unless is specified and authorized. The fact of introducing unauthorized electronic devices in the examination room will be considered reason enough to fail the subject in the current academic year and the overall qualification will be a Fail grade (0.0).
Tests Schedule: This information can be found along with any updates at the center (university) webpage.

Sources of information

Basic Bibliography

Munir Khamashta, **Problemas resueltos de cinemática de mecanismos planos**, UPC,

Munir Khamashta, **Problemas resueltos de dinámica de mecanismos planos**, UPC,

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

Complementary Bibliography

García Prada, J.C. Castejón, C., Rubio, H., **Problemas resueltos de Teoría de Máquinas y mecanismos**, THOMSON,

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

Shigley, J.E.; Uicker J.J. Jr., **Theory of Machines and Mechanisms**, McGraw-Hill,

Hernández A, **Cinemática de mecanismos: Análisis y diseño**, SÍNTESIS,

Lamadrid Martínez, A.; Corral Sáiz, A., **Cinemática y Dinámica de Máquinas**, E.T.S.I.I.T,

Mabie, Reinholtz, **Mechanisms and dynamics of machinery**, Limusa-wyley,

Nieto, j., **Síntesis de Mecanismos**, AC,

Erdman, A.G.; Sandor, G.N.,, **Mechanism Design: Analysis and Synthesis**, PRENTICE HALL,

Simon A.; Bataller A; Guerra .J.; Ortiz, A.; Cabrera, J.A., **Fundamentos de teoría de Máquinas**, BELLISCO,

Kozhevnikov SN, **Mecanismos**, Gustavo Gili,

Recommendations

Subjects that continue the syllabus

Machine design I/V12G380V01304
Automobiles and railways/V12G380V01941
Design of hydraulic machines and oleo-pneumatic systems/V12G380V01914
Machine design II/V12G380V01911
Computer-aided mechanical design/V12G380V01915
Transport engineering/V12G380V01945
Thermal engines and machines/V12G380V01913
Systems for data analysis, simulation and validation/V12G380V01933
Hybrid and electric automotive vehicles/V12G380V01944

Subjects that it is recommended to have taken before

Graphic expression: Graphic expression/V12G380V01101
Physics: Physics I/V12G380V01102
Mathematics: Algebra and statistics/V12G380V01103
Mathematics: Calculus I/V12G380V01104
Mathematics: Calculus II and differential equations/V12G380V01204

Other comments

Requirements: to enrol in this subject, it is mandatory to have passed or at least, to be enrolled of all first year subjects.
In case of discrepancies, the Spanish version of this guide prevails.

IDENTIFYING DATA				
Environmental technology				
Subject	Environmental technology			
Code	V12G380V01401			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician English			
Department	Chemical Engineering			
Coordinator	Álvarez da Costa, Estrella			
Lecturers	Álvarez da Costa, Estrella Cameselle Fernández, Claudio Moldes Menduíña, Ana Belén Moure Varela, Andrés Pazos Curras, Marta María Rincón Fontán, Mirian Yañez Diaz, Maria Remedios			
E-mail	ealvarez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Subject that belongs to the Block of Common Subjects of the Industrial Technologies. It is part of the curricula of all Degrees of Industrial Engineering. The main objective is to achieve a basic knowledge about the Treatment and management of solid wastes, wastewaters and pollutant emission to the atmosphere. It includes also the concepts of pollution prevention and sustainability.			

Competencies	
Code	
B7	CG7 Ability to analyze and assess the social and environmental impact of the technical solutions.
C16	CE16 Basic knowledge and application of environmental technologies and sustainability.
D1	CT1 Analysis and synthesis
D2	CT2 Problems resolution.
D3	CT3 Oral and written proficiency.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
D12	CT12 Research skills.
D17	CT17 Working as a team.
D19	CT19 Sustainability and environmental commitment. Equitable, responsible and efficient use of resources.

Learning outcomes		
Expected results from this subject	Training and Learning Results	
Basic knowledge and application of environmental technologies and sustainability	C16	D2 D3 D10 D19
Problem solving	C16	D2 D3 D10 D19
Oral and writing communication	C16	D2 D3 D10
Knowledge application to practical and real cases	C16	D2 D3 D10 D19

Analysis and synthesis	C16	D1 D2 D3 D9 D10 D12 D17 D19
Ability to analyze and determine the social and environmental impact of the technical solutions to environmental problems	B7	D1 D3 D9 D10 D17 D19

Contents	
Topic	
Lesson 1: Introduction to the environmental technology.	1. Material cycle economy. 2. Introduction to the best available techniques (BAT).
Lesson 2: Management of waste and effluents.	1. Generation of waste. Types and classification of wastes. 2. Codification of wastes. 3. Urban waste management. 4. Industrial waste management. Industrial waste treatment facilities. 5. Regulations
Lesson 3: Treatment of urban and industrial wastes.	1. Valorization. 2. Physico-chemical treatment. 3. Biological treatment. 4. Thermal treatment. 5. Landfilling. 6. Soil remediation technologies.
Lesson 4: Treatment of industrial and municipal wastewaters.	1. Characteristics of municipal and industrial wastewaters. 2. Wastewater treatment plant. 3. Sludge treatment. 4. Water treatment and reuse 5. Regulations
Lesson 5: Atmospheric pollution.	1. Types and origin of atmospheric pollutants. 2. Dispersion of pollutants in the atmosphere. 3. Effects of the atmospheric pollution. 4. Treatment of polluting gas emissions. 5. Regulations
Lesson 6: Sustainability and environmental impact assessment	1. Sustainable development 2. Life cycle analysis and economy. 3. Ecological footprint and carbon footprint. 4. Introduction to the environmental impact assessment
Practice 1: Codification of wastes	
Practice 2: Preparation of immobilized activated charcoal for use as an adsorbent.	
Practice 3: Contaminants removal by adsorption with immobilized activated charcoal.	
Practice 4: Pollutants removal by extraction with solvents.	
Practice 5: Coagulation-flocculation: Establishment of optimal working conditions.	
Practice 6: Simulation of certain stages of a EDAR	

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	26	52	78
Problem solving	11	22	33
Laboratory practices	12	12	24
Short answer tests	2	4	6
Practices report	0	6	6
Other	0	3	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
Problem solving	Solving exercises with the teacher's help and independently
Laboratory practices	Application of the knowledge acquired to the resolution of problems of environmental technology, using equipment and facilities available in the laboratory/computer room.

Personalized attention	
Methodologies	**Description**
Laboratory practices	
Lecturing	
Problem solving	

Assessment					
	Description	Qualification	Training and Learning Results		
Short answer tests	All exercises, seminars, practical cases and theoretical / practical tests that are made and delivered to the teacher throughout the course, related to the concepts and contents of the syllabus. Throughout a four-month time several tests are performed. Competences CG7 and CE16 will be assessed considering the students answers to the theoretical questions. Competences CT2, CT10 and CT12 will be assessed considering the students answers to the exercises. Competenci CT3 will be assessed base on the two parts of the exam: theory and exercises; considering the precision and clarity of the answers.	30	B7	C16	D2 D3 D10 D12
Practices report	Detailed report for each practices that includes the results and their discussion. The competences: CG7, CE16, CT1, CT3, CT9 and CT10, are assessed based on the quality of the written report elaborated by each student on his/her own. The following points will be evaluated in the report: text style and correctness, structure and presentation, analysis and discussion of the results, and conclusions. Competences CT12 and CT17 will be assessed based on the laboratory work. Lab practices will be carried out in pairs, and it is expected the student develop research skills in the field of environmental technology. The written report must be done in pairs.	10	B7	C16	D1 D3 D9 D10 D12 D17 D19
Other	"Final Exam" consisting of problems and theoretical questions related to the syllabus of the subject. CG7 and CE16 competences will be assessed in the exam of theory, based on student responses to the questions. CT2 and CT9 competences will be assessed in the exam of exercises, based on the resolution of various exercises of environmental technology, which require the use of applied knowledge related to the contents of the subject. CT1, CT3 and CT10 competences will be evaluated considering both theory and exercise exams. The exam resolution requires the student to use his/her capacity of analysis and synthesis.	60	B7	C16	D1 D2 D3 D9 D10

Other comments on the Evaluation

Evaluation:

A student who choose continuous assessment, to pass the course, must achieve a **MINIMUN SCORE** of **4.0 points** (out of 10) i***n each of the parts of the "final exam"*** . If a student reaches the minimum grade in both parts of the "final exam", to pass the subject must obtain a **final grade of ≥ 5.0.**

Students who "officially renounces continuous assessment", will make a "final exam" of theory and problems that will be worth 90% of the final grade, and a "exam of practices" that will be worth 10% of the final grade. In any case, to pass the

course, the student must achieve 50% of the maximum score in each of the constituent parts of the subject, ie, theory, problems and practices.

Second Call:

In the second call the same criteria apply.

In relation to the July exam, grades of the "short answer tests" and "practices" are maintained, and students only have to repeat the "final exam".

If, at the 1st call, a student suspended one of the parts of the "final exam" (theory or problems) and approves the other party with a grade ≥ 6, on the July exam, you only need to repeat the suspended part.

Ethical commitment:

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

The use of electronic devices during the assessment tests will be allowed. The fact of introducing into the examination room an unauthorized electronic device, will be reason not pass the course in the current academic year, and the final grade will FAIL (0.0 points)

Sources of information

Basic Bibliography

Mihelcic, J.R. and Zimmerman, J. B., **Environmental Engineering: Fundamentals, sustainability, design**, Wiley, 2014

Davis, M.L. and Masten S.J., **Principles of Environmental Engineering and Science**, McGraw-Hill, 2014

Metcalf & Eddy, **Ingeniería de aguas residuales : tratamiento, vertido y reutilización**, McGraw-Hill, 1998

Acosta, J.A. et al., **Introducción a la contaminación de suelos**, Mundi-prensa, 2017

Complementary Bibliography

Tchobanoglous, G., **Gestión integral de residuos sólidos**, McGraw-Hill, 1996

Nemerow, N. L., **Tratamiento de vertidos industriales y peligrosos**, Diaz de Santos, 1998

Baird, C y Cann M., **Química Ambiental**, Reverté, 2014

Kiely, G., **Ingeniería Ambiental: fundamentos, entornos, tecnología y sistemas de gestión**, McGraw-Hill, 2001

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

Albergaria, J.M. and Nouws H.P.A., **Soil remediation**, Taylor and Francis, 2016

Sharma, H. D., and Reddy, K. R., **Geoenvironmental engineering: site remediation, waste containment, and emerging waste management technologies**, John Wiley & Sons, 2004

Wark and Warner, **Contaminación del aire: origen y control**, Limusa, 1996

Jonker, G. y Harmsen, J., **Ingeniería para la sostenibilidad**, Reverté, 2014

Azapagic, A. and Perdan S., **Sustainable development in practice: Case studies for engineers and scientists**, Wiley, 2011

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/V12G360V01102
Physics: Physics 2/V12G360V01202
Chemistry: Chemistry/V12G380V01205

Other comments

To enroll in this subject is necessary to have passed or be enrolled in all subjects of previous courses to the course that is located this subject.

IDENTIFYING DATA				
Resistance of materials				
Subject	Resistance of materials			
Code	V12G380V01402			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician			
Department	Materials Engineering, Applied Mechanics and Construction			
Coordinator	Caamaño Martínez, José Carlos Riveiro Rodríguez, Belén			
Lecturers	Caamaño Martínez, José Carlos Cabaleiro Núñez, Manuel Conde Carnero, Borja Fernández Abalde, Félix Fuentes Fernández, Eugenio Ignacio Ponte Suárez, José Riveiro Rodríguez, Belén			
E-mail	jccaam@uvigo.es belenriveiro@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Introduction to linear elastic materials, and analysis of internal loadings, stress and strain relationships. Study of the fundamentals of mechanics of materials and particularization for shafts and beam structures.			

Competencies	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
C14	CE14 Knowledge and use of the principles of strength of materials.
D1	CT1 Analysis and synthesis
D2	CT2 Problems resolution.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
D16	CT16 Critical thinking.
D17	CT17 Working as a team.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
To know the differences between rigid solid and elastic solid. To know the stress and deformation states in a deformable solid and the relationship between them. Apply the acquired knowledge to the determination of the maximum values of stress at a point of a deformable solid. T know the basic principles governing the Mechanics of Materials. To know the relationships between the different stress resultants and the stresses. To apply the knowledge acquired to the determination of stress resultant diagrams. To apply the acquired knowledge about stresses applied to bar elements. To know the basics about deformations of bar elements. To apply the knowledge acquired to the dimensioning of bar elements.	B3 B4	C14	D1 D2 D9 D10 D16 D17
Phase equilibria. Evaporation, transport, mixing of waters, solubility of gases in the sea.			

Contents	
Topic	
1. Introduction	1.1 Introduction 1.2 Review of statics fundamentals and applied concepts for further progress in solid mechanics and stress analysis

2. Basic principles of elasticity and mechanics of materials.	2.0 Stress and strain. Linear elastic materials 2.1. Normal stress in an axially loaded prismatic bar. 2.2. Equilibrium of a deformable body. 2.3. Stress-Strain diagram of ductile materials. Hooke's Law. 2.4. Stress resultants. Diagrams.
3. Axial loads	3.1. Normal forces. 3.2. Elastic deformation of an axially loaded member. 3.3. Statically governed problems. 3.4. Statically indeterminate problems. 3.5. Thermal stress and assembly misfits.
4. Bending	4.1 Beams: definition and types. Loads on beams. 4.2 Internal shear forces and bending moments. 4.3 External load, shear force and bending moment relationships. 4.4 Shear and moment diagrams 4.5 Pure bending and non-uniform bending. Hypothesis and limitations. 4.6. Normal stresses in unsymmetric bending. 4.7 Symmetric bending. The flexure formula (Navier's Law). 4.8 Section modulus of a beam. Ideal beam cross-section. 4.9 Deflection of beams and shafts. Slope and deflection. Mohr's Theorems. 4.10 Hyperstatic bending.
5. Other forces: shear, buckling and torsion	5.1. Shear in joints. Definition. Shear force. Shear stress. Bolted and riveted joints. Shear joints. 5.2. Introduction to the concept of compressive buckling. 5.3. Intoduction to the concept of torsion in straight prisms.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	49	81.5
Laboratory practices	9	23	32
Problem based learning	9	24.5	33.5
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	Lecture where theoretical principles are presented using digital media, videos and blackboard.
Laboratory practices	Activities of application of the knowledge to concrete situations and of acquisition of basic skills and procedural skills related with the subject of study.
Problem based learning	Resolution of problems related to real case studies.

Personalized attention

Methodologies	Description
Laboratory practices	

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practices	A) it will evaluate the attendance and active participation in all the practicals of the semester, as well as the correct delivery (time and form) of all the documentation requested (reports, exercises, etc.). Practical sessions will be held in a fixed date, so it is not possible to attend the practical in a later date. Whether the student does not attend to a practical, he/she must demonstrate that the absence was due to unavoidable reasons (e.g. medical reasons). Practicals will marked with the value indicated, only when the student reaches the minimum mark in the written exam, which is 45%. (See following section: 'Other comments')	2.5	B3 C14 D1 B4 D2 D9 D10 D16 D17
Problem based learning	C) Written tests to evaluate the individual work delivered by the student. It will be compulsory the attendance to the 90% of the practicals to obtain the marks given in section C. The marks obtained in the sections A will proportionally affect to the marks of the section C. The section C will be marked with a maximum value of 12,5% of the total mark, only when the student reach the minimum mark in the written exam, which is 45%. (See following section: 'Other comments')	12.5	B3 C14 D1 B4 D2 D9 D10 D16

Essay questions exam	Written exam in the dates established by the School.	85	B3 B4	C14	D1 D2 D9 D10 D16

Other comments on the Evaluation

Students resigning continuum assessment (after School aproval) will be evaluated only through the written exam which will be graded with 100% of final mark.

Continuum assessment is composed of sections A and C. The maximum mark for continuum assessment (NEC) is 15%, which will be computed from the following equation: NEC (%) = 0,25·(A) + 1,25·(C)·(A) ; where A and C are granted 0-1.

Ethical commitment: it is expected an adequate ethical behavior of the student. In case of detecting unethical behaviour (copying, plagiarism, unauthorized use of electronic devices, etc.) shall be deemed that the student does not meet the requirements for passing the subject.

In this case, the overall rating in the current academic year will be Fail (0.0).

The use of any electronic device for the assessment tests is not allowed unless explicitly authorized. The fact of introducing unauthorized electronic device in the examination room will be considered reason for not passing the subject in the current academic year and will hold overall rating (0.0).

Sources of information

Basic Bibliography

Hibbeler, R., **Mechanics of Materials**,

Manuel Vázquez, **Resistencia de materiales**,

Complementary Bibliography

Ortiz Berrocal, L., **Resistencia de materiales**, Ed. McGraw-Hill,

González Taboada, J.A., **Tensiones y deformaciones en materiales elásticos**, Ed. Autor,

González Taboada, J.A., **Fundamentos y problemas de tensiones y deformaciones en materiales elásticos**, Ed. Autor,

Recommendations

Other comments

Requirements: To register for this module the student must have passed or be registered for all the modules of the previous year.

IDENTIFYING DATA				
Fundamentals of automation				
Subject	Fundamentals of automation			
Code	V12G380V01403			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish English			
Department	Systems Engineering and Automatisms			
Coordinator	Espada Seoane, Angel Manuel			
Lecturers	Armesto Quiroga, José Ignacio Espada Seoane, Angel Manuel Fernández Silva, María López Fernández, Joaquín Rajoy González, José Antonio			
E-mail	aespada@uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this matter present the basic concepts of the systems of industrial automation and of the methods of control, considering like central elements of the same the programmable programmable logic controller and the industrial controller, respectively.			

Competencies	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
C12	CE12 Know the fundamentals of automation and control methods.
D2	CT2 Problems resolution.
D3	CT3 Oral and written proficiency.
D6	CT6 Application of computer science in the field of study.
D9	CT9 Apply knowledge.
D16	CT16 Critical thinking.
D17	CT17 Working as a team.
D20	CT20 Ability to communicate with people not expert in the field.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Know the geological terminology.			
Purchase a global and realistic vision of the current scope of industrial automation systems.	B3	C12	D17 D20
Know which are the constitutive elements of an industrial automation system, its sizing and as they work.	B3	C12	D2 D6 D20
Knowledge applied on the programmable logic controllers, its programming and its application to industrial automation systems.	B3	C12	D2 D6 D9 D16 D17
General knowledge on the continuous control of dynamic systems, of the main tools of simulation of continuous systems and of the main devices of process control with greater interest to industrial level.	B3	C12	D3 D6 D17 D20
General concepts of the technicians of industrial controllers tuning.	B3	C12	D2 D9 D16

Contents
Topic

1. Introducción to industrial automation and elements of automation.	1.1 Introducción to automation of tasks. 1.2 Types of control. 1.3 The programmable logic controller. 1.4 Diagrama of blocks. Elements of the PLC. 1.5 Cycle of operation of the PLC. Time of cycle. 1.6 Ways of operation.
2. Languages and programming technics of programmable logic controllers.	2.1 Binary, octal, hexadecimal, BCD systems. Real numbers. 2.2 Access and adressing to periphery. 2.3 Instructions, variables and operating. 2.4 Forms of representation of a program. 2.5 Types of modules of program. 2.6 linear Programming and estructurada. 2.7 Variables binarias. Entrances, exits and memory. 2.8 Binary combinations. 2.9 Operations of allocation. 2.10 Timers and counters. 2.11 Operations aritméticas.
3. Tools for sequential systems modelling.	3.1 Basic principles. Modelling technics. 3.2 Modelling by means of Petri Networks. 3.2.1 Definition of stages and transitions. Rules of evolution. 3.2.2 Conditional election between several alternatives. 3.2.3 Simultaneous sequences. Concurrence. Resource shared. 3.3 Implementation of Petri Networks. 3.3.1 Direct implementation. 3.3.2 Normalised implementation (Grafcet). 3.4 Examples.
4. Control systems introduction.	4.1 Systems of regulation in open loop and closed loop. 4.2 Control typical loop. Nomenclature and definitions.
5. Representation, modelling and simulation of continuous dynamic systems.	5.1 Physical systems and mathematical models. 5.2.1 Mechanical systems. 5.2.2 Electrical systems. 5.2.3 Others. 5.3 Modelling in state space. 5.4 Modelling in transfer function. Laplace transform. Properties. Examples. 5.5 Blocks diagrams.
6. Analysis of continous dynamical systems.	6.1 Stability. 6.2 Transient response. 6.2.1 First order systems. Differential equation and transfer function. Examples. 6.2.2 Second order systems. Differential equation and transfer function. Examples. 6.2.3 Effect of the addition of poles and zeros. 6.3 Systems reduction. 6.4 Steady-state response. 6.4.1 Steady-state errors. 6.4.2 Input signals and system type. 6.4.3 Error constants.
7. PID controller. Parameters tunning of industrial controllers.	7.1 Basic control actions. Proportional effects, integral and derivative. 7.2 PID controller. 7.3 Empirical methods of tuning of industrial controllers. 7.3.1 Open loop tuning: Ziegler-Nichols and others. 7.3.2 Closed loop tuning: Ziegler-Nichols and others. 7.4 Controllers design state space. Pole assigment.
P1. Introduction to STEP7.	Introduction to the program STEP7, that allows to create and modify programs for the Siemens PLC S7-300 and S7-400.
P2. Programming in STEP7.	Modelling of simple automation system and implementation in STEP7 using binary operations.
P3. Implementation of PN in STEP7.	Petri Networks modelling of simple automation system and introduction to the implementation of the same in STEP7.
P4. PN Modelling and implementation in STEP7.	Petri Networks modelling of complex automation system and implementation of the same in STEP7.
P5. GRAFCET modelling and implementation with S7-Graph.	Petri Networks normalised modelling and implementation with S7-Graph.
P6. Control systems analysis with MATLAB.	Introduction to the control systems instructions of the program MATLAB.
P7. Introduction to SIMULINK.	Introduction to SIMULINK program, an extension of MATLAB for dynamic systems simulation.

P8. Modelling and transient response in SIMULINK.	Modelling and simulation of control systems with SIMULINK.
P9. Empirical tuning of an industrial controller.	Parameters tuning of a PID controller by the methods studied and implementation of the control calculated in an industrial controller.

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practices	18	30	48
Problem solving	0	15	15
Lecturing	32.5	32.5	65
Essay questions exam	3	19	22
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Laboratory practices	Different activities aimed to apply the concepts learned during the lectures.
Problem solving	The professor is going to solve in class some problems and exercises. The students need to solve similar exercises on their own to obtain the capabilities needed.
Lecturing	Include the professor lectures about the contents of the subject.

Personalized attention	
Methodologies	**Description**
Lecturing	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed).
Laboratory practices	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed).
Problem solving	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed).
Tests	**Description**
Essay questions exam	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed).

Assessment					
	Description	Qualification	Training and Learning Results		
Laboratory practices	It will evaluate each practice of laboratory between 0 and 10 points, in function of the fulfillment of the aims fixed in the billed of the same and of the previous preparation and the attitude of the students. Each practical will be able to have distinct weight in the total note.	20	B3	C12	D3 D6 D9 D16 D17 D20
Essay questions exam	Final examination of the contents of the matter, that will be able to include problems and exercises, with a punctuation between 0 and 10 points.	80	B3	C12	D2 D3 D16

Other comments on the Evaluation

- Continous Assesment of student work practices along established laboratory sessions will be held in the semester, with the assistance to them mandatory. In the case of not overcome, a review of practices will take place in the second call.
- The assesment of the practices for students who officially renounces Continuous Assesment will be carried out in a review of practices in the two calls.
- It may demand previous requirements to the realisation of each practice in the laboratory, so that they limit the maximum qualification to obtain.
- It must pass both tests (script and practices) to pass the matter, give the total score at the rate indicated above. In case of no longer than two or one test, scaling may be applied to partial notes that the total does not exceed 4.5.
- In the final exam may establish a minimum score on a set of issues to overcome.
- In the second call of the the same course, students should examine the tests (script and/or practices) not passed in the first one, with the same criteria of that.

- According to the Rule of Continuous Assesment, the subject students to Continuous Assesment that present to some activity evaluable collected in the Teaching Guide of the matter, will be considered like "presented".
- Ethical commitment: student is expected to present an adequate ethical behavior. If you detect unethical behavior (copying, plagiarism, unauthorized use of electronic devices, and another ones), it follows that the student does not meet the requirements for passing the subject. In this case the global qualification in the present academic course will be of suspense (0.0).

Sources of information

Basic Bibliography

E.MANDADO, J.MARCOS, C. FERNANDEZ, J.I.ARMESTO, **Autómatas Programables y Sistemas de Automatización**, 1ª, Marcombo, 2009

MANUEL SILVA, **Las Redes de Petri en la Automática y la Informática**, 1ª, AC, 1985

R. C. DORF, R. H. BISHOP, **Sistemas de Control Moderno**, 10ª, Prentice Hall, 2005

Complementary Bibliography

PORRAS A., MONTANERO A., **Autómatas programables : fundamento, manejo, instalación y prácticas**, McGraw-Hill, 2003

ROMERA J.P., LORITE J.A., MONTORO S., **Automatización : problemas resueltos con autómatas programables**, 4ª, Paraninfo, 2002

BARRIENTOS, ANTONIO, **Control de sistemas continuos: Problemas resueltos**, 1ª, McGraw-Hill, 1997

OGATA, KATSUIKO, **Ingeniería de Control Moderna**, 5ª, Pearson, 2010

Recommendations

Subjects that continue the syllabus

Product design and communication, and automation of plant elements/V12G380V01931

Subjects that are recommended to be taken simultaneously

Electronic technology/V12G380V01404

Subjects that it is recommended to have taken before

Computer science: Computing for engineering/V12G380V01203
Mathematics: Calculus II and differential equations/V12G380V01204
Fundamentals of electrical engineering/V12G380V01303

Other comments

- Requirements: To enrol in this subject is necessary to had surpassed or well be enrolled of all the subjects of the inferior courses to the course in the that is summoned this subject.

IDENTIFYING DATA				
Electronic technology				
Subject	Electronic technology			
Code	V12G380V01404			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician			
Department	Electronics Technology			
Coordinator	Verdugo Mates, Rafael			
Lecturers	Doval Gandoy, Jesús López Sánchez, Óscar Martínez-Peñalver Freire, Carlos Nogueiras Meléndez, Andres Augusto Sánchez Real, Francisco Javier Verdugo Mates, Rafael			
E-mail	rverdugo@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	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
C11	CE11 Knowledge of the fundamentals of electronics.
D2	CT2 Problems resolution.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
D17	CT17 Working as a team.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Know the operation of the electronic devices.	B3	C11	D2 D9 D10 D17
Know the electronic systems of conditioning and acquisition of data.		C11	D10
Identify the different types of industrial sensors.			D10
Know the digital electronic systems basic.		C11	D2 D9 D17
Know the electronic circuits for the communication of information.	B3		D10

Contents	
Topic	
Introduction	- Control and supervision of industrial systems by means of electronics - Some representative cases
Electronic devices, circuits and systems	- Electronics components and devices - Active and passive electronic devices - Analog and digital electronic circuits - Electronic systems

Diodes and rectification	- The diode - Operation modes and characteristics - Diodes types - Operation Models - Analysis of circuits with diodes - Rectifier circuits - Filtering for rectifier circuits - Thyristors
Transistors	- The Bipolar Junction Transistor (BJT.) Operation principles and characteristic curves - Work zones - Quiescent point design - The transistor operating as a switch - The transistor operating as an amplifier - Field Effect Transistors (FET).
Amplification	- Amplification concept - Feedback concept - The Operational Amplifier (OA) - Basic circuits with OA - The Instrumentation Amplifier
Digital Electronics I	- Numbering Systems - Boolean Algebra - Combinatorial logic functions. Analysis, synthesis and reduction
Digital electronics II	- Flip-flops - Sequential logic circuits - Programmable Systems - Microprocessors - Memories
Electronic Sensors	- Sensors - Types of sensors as function of the measuring magnitude - Some sensors of special interest in industry applications - Electrical model of some common sensors - Study of some examples of coupling sensors and CAD system
Analog - Digital Converters	- The Analog and Digital Signals. - The Analog to Digital Converter (ADC) - Sampling, quantification and digitization - More important ADC characteristics: number of bits, sampling speed, conversion range and cost
Industrial Communications	- Introduction to Industrial Communications - Industrial data buses.
Power Electronics	- Circuits for Power Conversion - Rectifiers - Lineal and Switched Power Sources

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	25	0	25
Problem solving	8	0	8
Previous studies	0	49	49
Autonomous problem solving	0	46	46
Laboratory practices	18	0	18
Objective questions exam	1	0	1
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	These sessions will be held in the rooms and dates fixed by the direction of the school. They will consist in an oral explanation by the professor 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.
Problem solving	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.

Previous studies	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.
Autonomous problem solving	Self study and review of the theoretical sessions for knowledge consolidation: The student must study, in a systematic time schedule, after each lecture session, in order to dissipate any doubts. Any doubts or unsolved questions will have to be expose to the professor as soon as possible in order to enhance the feedback of the learning process.
Laboratory practices	Laboratory sessions will be held in the time schedule established by the school's head teacher. Students will work in groups of two students each. The sessions will be supervised by a professor, who will control the assistance and will also evaluate the harnessing of it. During the laboratory sessionsthe students will make activities of the following kinds: - Assembling electronics circuits - Use of electronic instrumentation - Measure of physical variables on circuits - Do calculations related to the circuit and/or the measurements - Collect data and represent it (diagrams, charts, tables) At the end of each laboratory session each group will deliver the corresponding score sheets.

Personalized attention

Methodologies	Description
Laboratory practices	Tutoring Sessions: During the established schedule of each professor, students will be able to speak freely about course issues with the professor. Also the will receive orientation and academic support, if needed. Email: The students also will be able to request orientation and support by means of email to the professors of the course. This way of attention is advisable for indications and short doubts of punctual type.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practices	Assessment of the laboratory sessions: The laboratory sessions will be evaluated in a continuous way, on each session. The applied criteria are: - A minimum attendance of 80% - Punctuality - Previous task preparation of the sessions - Make the most of the session The practical sessions will be held in groups of two students. The documents of the practices will be available prior to the sessions. The students will fill report, that will be delivered when the session ends. This report serves to justify both the attendance and how they have done the work asked for.	20	C11 D9 D10 D17
Objective questions exam	Evaluation of Blocks of Topics: This part is intended to emphasize the self learning process and provide feedback to the students. It's main aim is to provide honest and objective information about the learning process. These individual exams will be held by electronics means, if possible. It can consists on a wide set of test questions, short answers and analytical numerical problems.	20	B3 C11 D2 D9 D10
Essay questions exam	Individual Exam: It will consist on an individual written exam near the end of the semester, in the dates established by the head teachers. The exam will be a combination of any of the following types of exercises: - Test Questions - Short Answer Questions - Analysis Problems - Practical Cases	60	B3 C11 D2 D9 D10

Other comments on the Evaluation

Evaluation:

All the students will be evaluated of continuous way by means of the following procedure:

Along the semester the students will realise several partial proofs and will obtain a note by each proof. The note of partial (NP) will obtain of the average of the notes of the proofs.

Also the long of the semester the students will do practices of laboratory and will obtain a note by each practice. The sessions without assistance will be marked with a zero. The note of laboratory (NL) will obtain of the average of the notes of the practices, with the following exceptions:

a) If the assistance to the sessions of practices is inferior to 80% the total note of the same (NL) will be zero.

b) If the average of the notes obtained in the partial proofs (*NP) is inferior to 3,33, the note of laboratory (NL) will be zero.

Also along the semester partial exams will be made. Each partial exam will have a grade. The grade of these exams (NP) is the average of the grades in each one.

The qualification of continuous evaluation (CC) procedure will be calculated with this formula:

CC = 0,8 x NP + 0,2 x NL

The students can opt to that qualification CC becomes the qualification in records (CA), without need to take any additional exam, as long as they fulfil all the following requirements:

a) The average grade of the partial exams (NP) must be great or equal than 6,25 points.

b) The grade obtained in all the partial exams must be at least 3,75 points.

c) Obtain a laboratory grade (NL) great or equal to 7 points.

A final exam (EF) will be held in scheduled dates in June and July.

The grades in records (CA) for those students that do not want to or can not opt to the note of continuous qualification method will be obtained with arrangement to the following formula:

CA = 0,2 x NP + 0,2 x NL + 0,6 x EF

For the present academic year, grades NL and NP obtained in the previous two academic courses are still valid with the following exceptions:

- Those students that want to use the previous NL grade with less than 7 points can not apply for the continuous evaluation procedure, and must pass the final exam (EF)

- Those student that want to use the previous NP grade can not apply for the continuous evaluation procedure, and must pass the final exam (EF)

Those students granted with an exemption from the school direction not to take part on the continuous evaluation process, will be evaluated at the same day and time established by the school direction board, in the following way:

- A two part test

1- A written exam identical to the final examination, with a weight of 70% on the final grade and lasting a maximum of two hours.

2- A specific laboratory test, with a weight of 30% on the final grade and lasting a maximum of two hours. This take will take place immediately after the written exam in the laboratories of the same school.

In the final year examination, students will take a written exam that will weigh 70% on the final grade. The remaining 30%

will be obtained from the qualification of a laboratory test.

To pass the course, in any of the previous cases, it is necessary to achieve a final grade equal or higher than 5 points.

Recommendations:

It is very important that the students keep updated the profile in the FAITIC platform. All communications related with this course will be made through this platform. All individual communications will be made through the email listed in this platform.

The students can solve doubts related with the laboratory previous activities in the personal attention hours (tutoring time), or by any other contact procedure available in FAITIC.

The students must meet the deadlines for all the activities.

All the achieved results must be justified, in any of the exams or activities. None of the achieved results will be taken for good if no explanation is given about the method used to find them. The selected method for solving a problem is considered when grading the solution.

When writing the solutions and answers in reports and tests, avoid spelling mistakes and unreadable symbols.

Exams lacking some of the sheets will not be graded.

Use of cell phones, notes or books is forbidden during exams.

Competencies Acquisition and Its Influence on Assesments

In this subject all the different activitiesare designed to assess the students in the competencies, and the acquisition ofthe competencies defines the final mark. Here follows a description of how thecompetencies and activities are related.
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.
The acquisition of this competency is providedby the contents of the topics of the subject. All activities ofself-assessment, the laboratory sessions and the different test are elaborated to evaluate the knowledge of the technical subjects.
CE11 Knowledge of the fundamentals ofelectronics.
This competency is warrant to be acquired along all the lectures, the laboratory sessions, the self-assessment activities andt he tests.
CT2 Problems resolution.
The students will exercise this competency by means of the following activities: self-assessment activities, bulletin of problems and previous theoretical solution of experiments to be made at the laboratory. This competency is also acquired along all thetest (for each block and the individual one), as they mainly are composed by problems to be solved.
CT9 Apply Knowledge
This competency is mainly acquired during the laboratory sessions, where the theoretical knowledge from problems, designs and simulations should match the assembly of circuits and real measures. Laboratory sessions are evaluated one by one, scoring an average of marks, if there is a minimum number of attended sessions with a minimum score.
CT10 Self learning and work
The self learning process is fundamental to achieve the score to approve the subject. In order to motivate students in the task of acquiring the theoretical knowledgeneed, self-assessment test (on line), lectures based on the remote learningplatform (faitic) and bulletins of problems have been created. Theself-assessment test also provide feedback to the professors about the main difficulties found by students. On thelaboratory sessions, the previous preparation is an explicit method of evaluation. In order to made this preparation, each of the laboratory sessions has its specific documentation and tutorials.
CT17 Working as a team
The students exercise this competency at the laboratory sessions, by making teamsof two people. Cooperation in most of the sessions is needed to perform the assembly of circuits, make the measurements and take notes. The professor in charge of the laboratory session verifies the previous work and how each session is going along, watching that both members cooperate to achieve the best possible result. Scores for students can be different if the professor detects that one of the team member is not cooperating.

Sources of information

Basic Bibliography

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

Boylestad, R. L.; Nashelsky, L., **ELECTRÓNICA: TEORIA DE CIRCUITOS Y DISPOSITIVOS ELECTRONICOS**, 10ª,

Rashid, M.H., **CIRCUITOS MICROELECTRONICOS: ANALISIS Y DISEÑO**, 2ª,

TOCCI, RONALD J., NEAL S. WIDMER , GREGORY L. MOSS, **Sistemas digitales. Principios y aplicaciones**, 10ª,
Lago Ferreiro, A.; Nogueiras Meléndez, A. A., **Dispositivos y Circuitos Electrónicos Analógicos: Aplicación práctica en laboratorio**,

Complementary Bibliography

Malik N. R., **Electronic Circuits. Analysis, simulation, and design**,
Wait, J.; Huelsman, L.; Korn, G., **INTRODUCCION AL AMPLIFICADOR OPERACIONAL**, 4ª,
Pleite Guerra, J.; Vergaz Benito, R.; Ruíz de Marcos; J. M., **Electrónica analógica para ingenieros.**,

Recommendations

Subjects that are recommended to be taken simultaneously

Fundamentals of automation/V12G380V01403

Subjects that it is recommended to have taken before

Physics: Physics I/V12G380V01102
Physics: Physics II/V12G380V01202
Mathematics: Algebra and statistics/V12G380V01103
Mathematics: Calculus I/V12G380V01104
Mathematics: Calculus II and differential equations/V12G380V01204
Fundamentals of electrical engineering/V12G380V01303

IDENTIFYING DATA				
Fluid mechanics				
Subject	Fluid mechanics			
Code	V12G380V01405			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language				
Department	Mechanical Engineering, Heat Engines & Machines, and Fluids			
Coordinator	Meis Fernández, Marcos			
Lecturers	Carrera Pérez, Gabriel López Veloso, Marcos Meis Fernández, Marcos Molares Rodríguez, Alejandro Román Espiñeira, Ignacio Javier			
E-mail	mmeis@uvigo.es			
Web				
General description	This syllabus presents information the Fluid mechanics course that belongs to the 2nd year of the degree in Mechanical Engineering, 2013-2014, in accordance to the marked guidelines by the European Space of Upper Education. This is a first course in fluid mechanics, focusing on the topics that are relevant to Mechanical Engineering applications. The course is intended to acquire essential knowledge needed to analyze devices with fluid as a working material, such us hydraulic machinery, lubrication devices, heating and cooling systems, pipes systems, pneumatic systems, aero and hydrodynamics devices, windturbines, etc. It includes stress and strain rate descriptions, fluid statics, use of differential and finite control volume analysis with continuity, momentum, and energy equations, Bernoulli and Euler equations, incompressible viscous flow using Navier-Stokes equations, dimensional analysis, laminar and turbulent pipe flow.			

Competencies	
Code	
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
B5	CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
C8	CE8 Knowledge of the basic principles of fluid mechanics and their application to solving problems in the field of engineering. Calculation of pipes, channels and fluid systems.
D2	CT2 Problems resolution.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
CG5 Knowledge for the realisation of measurements, calculations, assessments, evaluations, studies, reports, plans of works and other analogous works.	B4 B5	C8	D2 D9 D10
CG4 Capacity to: solve problems with initiative and creativity, take decisions, develope critical reasoning and capacity to communicate and transmit knowledge and skills in the field of the industrial engineering.	B4 B5	C8	D2 D9 D10
RI2 Knowledge of the basic principles of the fluid mechanics and his application to the resolution of problems in the field of the engineering. Intended learning outcomes are, understanding of the basics of flow behaviour in engineering systems, awareness of the physical laws that govern fluid motion and development of analytical skills for simple flow systems, e.g. calculation of pipes, channels and fluid systems	B4 B5	C8	D2 D9 D10
CT2 Resolution of problems.	B4 B5	C8	D2 D9 D10
- To know and describe the different types of intermolecular forces.			

Contents

Topic	
1. Introduction	1.1 Fundamental Concepts: 1.1.1 Stress tensor. Newton Law 1.2 The Fluid as a Continuum 1.3 Viscosity:1.3.1 Newtonian Fluids and non Newtonian fluids 1.4 Characteristics of the flows: 1.4.1 Different types of flows: 1.4.1.1 Geometrical conditions, 1.4.1.2 Kinematic conditions, 1.4.1.3 Mechanical conditions, 1.4.1.4 Compressibility 1.5 Stresses on a fluid: 1.5.1 Tensorial and vectorial magnitudes, 1.5.1.2 Volumetric Forces, 1.5.2.2 Surface Forces, 1.5.2.3 The stress tensor, 1.5.2.4 Concept of pressure
2. Basic Physical Laws of Fluid Mechanics	2.1 Velocity field 2.2 Streamlines and pathlines 2.3 Systems and Control volumes 2.4 Integrals extended to Fluid volumes. The Reynolds Transport Theorem 2.5 Conservation of Mass. Integral and Differential Equation 2.6 The Linear Momentum Equation. Integral and Differential Equation. 2.7 Navier-Poisson Law 2.8 The Energy Equation. Integral and Differential Equation. Frictionless Flow: The Bernoulli Equation
3. Dimensional Analysis. Similarity concepts	3.1 Introduction 3.2 The Pi Theorem 3.3 Applications 3.4 Fundamental Nondimensional Numbers in Fluid Mechanics: 3.4.1 Physical meaning of the nondimensional numbers 3.5 Similarity in Fluid dynamics: 3.5.1 Partial Similarity, 3.5.2 Scaling effect
4. Laminar viscous flow	4.1 Introduction 4.2. Fully developed flow: 4.2.1 Hagen-Poiseuille Flow, 4.2.2 Viscous flow in circular ducts, 4.2.3 Flow in Noncircular Ducts 4.3 Entrance region effect 4.4 Losses in Pipe Systems: 4.4.1 Friction coefficient 4.5 Stability of laminar flow
5. Turbulent Flow in ducts	5.1 Introduction 5.2 Pipe-head Loss in turbulent regime: 5.2.1 Nikuradse chart, 5.2.2 Moody chart, 5.2.3 Empirical Formulas for flow in circular ducts. Hydraulic diameter
6. Minor Losses in Pipe Systems	6.1 Introduction 6.2 Minor Losses: 6.2.1 Loss at the entrance of a pipe, 6.2.2 Loss at the exit of a pipe, 6.2.3 Loss at contractions, 6.2.4 Loss at expansions, 6.2.5 Loss at elbows, 6.2.6 Losses at bends, elbows, tees and valves
7. Pipe systems	7.1 Pipes in series 7.2 Pipes in parallel 7.3 The three-reservoir pipe junction problem 7.4 Pipings netwoks 7.5 Nonsteady effects in duct flows: 7.5.1 Emptying time of a tank, 7.5.2 Setting of the steady flow in a pipe, 7.5.3 Water hammer
8. Open-Channel Flow	8.1 Introduction 8.2 Uniform Flow: 8.2.1 Pipes used like channels 8.3 Non uniform flow: 8.3.1 The hydarulic jump, 8.3.2 Fast transitions, 8.3.3 Flow over a gate, 8.3.4 Flow under a gate, 8.3.5 Section of control
LABORATORY	1. Measurements of head and minor losses in a pipe system. Minor losses measuremens in a venturi device. Minor losses measurents in a holed-plate. Friction coefficients measurements. Losses in elbows, bend, tees and valves

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	60.5	93
Problem solving	14	33	47
Laboratory practices	4	0	4
Essay questions exam	3	0	3
Problem solving	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	They explain the foundations of each subject needed to solve practical problems. It includes mainly lectures baut can also includes: Readings bibliographic Review Solution of problems Conferences Oral Presentations
Problem solving	They will apply the concepts tackled in the lectures. It includes activities such as: Readings Seminars Solution of problems Team working Study of practical cases
Laboratory practices	Fundamentally, they will consist on activities of experimentation, although they also can include: Practical cases Simulation Solution of problems Team working

Personalized attention

Methodologies	Description
Lecturing	Personalized attention will be given to the students during class (throughout the possible questions that could arise) and during the specific timetable of the teacher for tutorships. Updated information of the tutorships timetables will be given to the students
Laboratory practices	Personalized attention will be given to the students during class (throughout the possible questions that could arise) and during the specific timetable of the teacher for tutorships. Updated information of the tutorships timetables will be given to the students

Assessment

	Description	Qualification	Training and Learning Results		
Essay questions exam	Proof written that it will be able to consist of: theoretical questions practical questions resolution of exercises/problems fear to develop	80	B4 B5	C8	D2 D9 D10
Problem solving	(*)Resolución de problemas e/ou exercicios propostos, que poderán incluír: - un número de entregas semanais (non presencial) - resolucións presenciais en horario de prácticas como reforzo de temas - Informe as actividades realizadas nas sesións de laboratorio, resultados da experimentación, etc.	20	B4 B5	C8	D2 D9 D10

Other comments on the Evaluation

Continuous evaluation: it represents 20% of the note. Except official indication from the center direction of the renunciation of the student to the continuous evaluation, the student follows the course in this modality.

Marks of the continuous evaluation will not be kept for the next year
Final examination: it represents the 80 % of the note of the course
If the student attends all the continuous exams and lab classes during the course but does not attend the final examination of May, the student will be considered as no presented to the course;
July final exam: The final examination represents 80% of the note, being the remaining 20% evaluated with the marks obtained from the continuous evaluation ;
Ethical Commitment: In case of noticing a non ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices, and others) it will be considered that the student does not gather the necessary requirements to pass the course. In this case, the global qualification iof the present academic course will be failed (0.0).

Sources of information

Basic Bibliography

Frank M White, **Mecánica de Fluidos/Fluid Mechanics**, VI,

Antonio Crespo, **Mecánica de fluidos**,

Complementary Bibliography

Philip M. Gerhart, Richard J Gross, , Jonh I. Hochstein, **FUNDAMENTOS DE MECANICA DE FLUIDOS**, II,

Yunus A. Çengel, John M. Cimbala, **Mecánica de fluidos : fundamentos y aplicaciones**,

Elena Martín Ortega, Concepción Paz Penín, **Prácticas de laboratorio de mecánica de fluidos**,

A. Liñán Martínez, M. Rodríguez Fernández, F.J. Higuera Antón, **Mecánica de fluidos**,

Victor L. Streeter, E. Benjamin Wylie, Keith W. Bedford, **Mecánica de fluidos/Fluid Mechanics**, IX,

Robert W. Fox, Alan T. McDonald, **Introducción a la mecánica de fluidos**,

Robert L. Mott, **Mecánica de fluidos**, VI,

Merle C. Potter, David C. Wiggert ; con Miki Hondzo, Tom I.P. Shih, **Mecánica de fluidos/Mechanics of Fluids**, III,

Pijush K. Kundu , Ira M. Cohen, **Fluid Mechanics**, 4th Edition,

G. M. Homsy et al., **Multi-media Fluid Mechanics**,

Recommendations

Subjects that are recommended to be taken simultaneously

Thermodynamics and heat transfer/V12G380V01302

Subjects that it is recommended to have taken before

Physics: Physics I/V12G380V01102
Physics: Physics II/V12G380V01202
Mathematics: Algebra and statistics/V12G380V01103
Mathematics: Calculus I/V12G380V01104
Mathematics: Calculus II and differential equations/V12G380V01204