



(*)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	Mechanics of Materials	2nd	6
V12G380V01403	Automation and Control Fundamentals	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				
Coordinator	Pérez Vázquez, María Consuelo			
Lecturers	Abreu Fernández, Carmen María Cortes Redin, María Begoña Díaz Fernández, Belén Figueroa Martínez, Raúl Iglesias Rodríguez, Fernando Pena Uris, Gloria María Pérez Vázquez, María Consuelo Riobó Coya, Cristina Ruibal Acuña, Mauricio			
E-mail	mcperez@uvigo.es			
Web	http://fatic.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		
It comprises the fundamental concepts of link, structure and microstructure of the distinct types of materials	B3	C9	D10
It comprises the relation go in to microstructure 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	
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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. Standards for materials analysis. Compressive and tensile deformation. Principles of fracture mechanisms. Toughness. Hardness. Main test methods. Fundamentals of thermal analysis. Fundamentals of non-destructive testing. 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: fundamentals and classification. Annealing, normalizing, quenching and tempering. Nonferrous 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
Master Session	31	55.8	86.8
Laboratory practises	18	18	36
Autonomous troubleshooting and / or exercises	0	12	12
Multiple choice tests	0.5	0.5	1
Short answer tests	1	0.95	1.95
Troubleshooting and / or exercises	1.25	3	4.25
Jobs and projects	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
Master Session	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 practises	Application to practical level of the theory in the field of the knowledge of Science and Technology of materials
Autonomous troubleshooting and / or exercises	The student has to be able to develop the capacity to resolve problems and/or exercises of autonomous form.

Personalized attention

Methodologies	Description
Master Session	The professor, in his schedule of tutorials, will clear the doubts that can have the student.
Laboratory practises	The professor, in his schedule of tutorials, will clear the doubts that can have the student.
Tests	Description
Troubleshooting and / or exercises	The professor, in his schedule of tutorials, will clear the doubts that can have the student.
Jobs and projects	The professor, in his schedule of tutorials, will clear the doubts that can have the student.

Assessment

Description	Qualification	Training and Learning Results
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Laboratory practises	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
Troubleshooting and / or exercises	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
Jobs and projects	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

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

The three first constitute the basic Bibliography basic of the subject. The remaining consider complementary Bibliography.

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

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				
Coordinator	Sieres Atienza, Jaime Santos Navarro, José Manuel			
Lecturers	Dopazo Sánchez, José Alberto Giraldez Leirado, Alejandro López Arana, Alba López Suárez, José Manuel Román Espiñeira, Miguel Ángel Santos Navarro, José Manuel Sieres Atienza, Jaime Vidal López, Antonio José			
E-mail	jsieres@uvigo.es 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.
D1	CT1 Analysis and synthesis
D2	CT2 Problems resolution.
D6	CT6 Application of computer science in the field of study.
D7	CT7 Ability to organize and plan.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
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 and understand the Laws of Thermodynamics, the modes of heat transfer and the relations to calculate heat transfer rates	B4 B5 B6 B7	C7	D1 D2 D7 D9 D10 D16 D17 D20
Know and understand the basic notions of the physics involved in the different modes of heat transfer	B5 B6 B7 B11	C7	D1 D2 D7 D9 D10 D16 D17 D20
Identify the relevant heat transfer mechanisms involved in any heat transfer engineering application	B4 B6 B7 B11	C7	D1 D2 D7 D9 D10 D16 D17 D20
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	D1 D2 D6 D7 D9 D16 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
Master Session	32.5	65	97.5
Laboratory practises	6	0	6
Autonomous troubleshooting and / or exercises	0	18.5	18.5
Troubleshooting and / or exercises	12	12	24
Troubleshooting and / or exercises	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
Master Session	Lecturer's introduction of the contents of the matter object of study
Laboratory practises	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 troubleshooting and / or exercises	Troubleshooting and / or exercises related to the subject that the student take place by consulting the literature
Troubleshooting and / or exercises	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
Master Session	Students' questions or doubts about any of the course contents will be solved during the instructor's office hours
Laboratory practises	Students' questions or doubts about any of the course contents will be solved during the instructor's office hours
Troubleshooting and / or exercises	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		
Troubleshooting and / or exercises	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	D1 D2 D6 D7 D9 D10 D16 D20
Other	The corresponding note to the Continuous Evaluation will be based on written tests of short answer Throughout the semester several tests will be performed	20	B6	C7	D1 D2 D7 D9 D10 D16

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 (EX) 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 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 the Teaching 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, such as: calculator (non- programmable), tables and diagrams of properties of substances. Any kind of form or similar complementary document will not be allowed during these tests.

For the continuous evaluation tests and the final exam, it is recommended 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 different 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 assessment. 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

$$CF = 0.2 \cdot EC + 0.8 \cdot EF$$

Second call: the final qualification is calculated as

$$CF = \max(N1, N2), \text{ where}$$

$$N1 = 0.2 \cdot EC + 0.8 \cdot EF$$

$$N2 = EF$$

A score system from 0 to 10 points will be used (RD 1125/2003 de 5 de septiembre, BOE de 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 with 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 Commitment:

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 assessments 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.

Responsible teacher for the different groups:

Group M1(English): Jaime Sieres Atienza

Sources of information

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

Çengel Yunus A., Boles Michael A., **Thermodynamics : an engineering approach**, 2011,

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

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

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

Moran M.J. y Shapiro H.N., **Fundamentos de Termodinámica Técnica**, 1993,
Merle C. Porter y Craig W. Somerton, **Termodinámica para ingenieros**, 2004,
Incropera F.P. y DeWitt D.P, **Introduction to Heat Transfer**, 2002,
Wark, K. y Richards, D.E., **Termodinámica**, 2010,
Kreith J. y Bohn M.S, **Principios de Transferencia de Calor**, 2001,
Mills A.F., **Transferencia de calor**,

Basic Bibliography:

Thermodynamics : an engineering approach.

Authors: Çengel, Yunus y Boles, Michael - Ed. McGraw-Hill

Heat and mass transfer: a practical approach

Authors: Çengel Y.A., y Ghajar A.J.Ed. McGraw-Hill

Complementary Bibliography:

Introduction to Thermodynamics and Heat Transfer.

Authors: Çengel, Yunus - Ed. McGraw-Hill

Termodinámica.

Authors: Çengel, Yunus y Boles, Michael - Ed. McGraw-Hill

Transferencia de Calor y Masa. fundamentos y aplicaciones

Authors: Çengel Y.A., y Ghajar A.J.Ed. McGraw-Hill

Fundamentos de Termodinámica Técnica

Authors: Moran M.J. y Shapiro H.N. - Ed. Reverté

Termodinámica

Authors: Wark, K. y Richards, D.E.. - Ed. McGraw-Hill

Termodinámica para ingenieros

Authors: Merle C. Porter y Craig W. Somerton. - Ed. McGraw-Hill

Principios de Transmisión de Calor

Authors: Kreith J. y Bohn M.S - Ed. Paraninfo

Transmisión de Calor

Authors: Mills A.F. - Ed. Irwin

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics II/V12G340V01202

Mathematics: Calculus I/V12G340V01104

Mathematics: Calculus II 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 Suárez Creo, Juan Manuel			
Lecturers	Albo López, María Elena Míguez García, Edelmiro Suárez Creo, Juan Manuel			
E-mail	jsuarez@uvigo.es ealbo@uvigo.es			
Web	http://http://fatic.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.
D19	CT19 Relacións persoais.

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
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 D19

Contidos

Topic	
TEMA 1. INTRODUCCIÓN.	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 CIRCUÍTO.	Elementos reais. Fontes, resistencia, bobina e *condensador.
TEMA 4. ASOCIACIÓN DE ELEMENTOS.	Asociación serie e paralelo, estrela e triángulo
TEMA 5. FORMAS DE ONDA.	Valores característicos das funcións *senoidales. Concepto de *fasor
TEMA 6. *TEOREMAS.	Substitución, *superposición, *Thevenin e *Norton.
TEMA 7. *METODOS SISTEMÁTICOS DE ANÁLISES.	Nós e mallas
TEMA 8. *REGIMEN *ESTACIONARIO *SENOIDAL.	Comportamento dos elementos en corrente alterna. Combinacións de elementos.
TEMA 9. POTENCIA E ENERXÍA EN *REGIMEN *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, *índice horario.
TEMA 12. *MAQUINAS *ASÍNCRONAS.	Constitución. Xeración do campo *giratorio.
TEMA 13. *MAQUINAS *ASÍNCRONAS.	Circuíto equivalente
TEMA 14. *MAQUINAS *ASÍNCRONAS.	Curvas características
TEMA 15. *MAQUINAS *ASÍNCRONAS.	Manobras.
TEMA 16. *MAQUINAS DE ALTERNA *MONOFÁSICAS	Constitución. Principio de funcionamento. Aplicacións.
TEMA 17. *MAQUINAS *SÍNCRONAS.	Constitución. Funcionamento en baleiro e en carga. *Sincronización.
TEMA 18. MÁQUINAS DE CORRENTE CONTINUA.	Constitución. Xeneralidades. Curvas características.
PRACTICAS	1. Descrición do laboratorio. Medidas en circuitos eléctricos. 2. O *contactor. *Automatismos básicos. Descrición do sistema de protección do laboratorio. 3. Formas de onda. Utilización do *osciloscopio. Desfasamentos entre tensión e intensidade en resistencias, bobinas e *condensadores. 4. Caracterización de elementos. 5. Circuitos básicos. Asociación serie e paralelo. 6. Potencia e cargas *monofásicas. 7. Sistema *trifásico equilibrado. Comparación de valores de liña e fase. Circuíto *monofásico equivalente. 8. Potencia e cargas *trifásicas. Equivalente estrela-triángulo. 9. Transformadores. Constitución e funcionamento dos transformadores *monofásicos e *trifásicos. *Índice horario. 10. Máquinas *asíncronas. Constitución e principio de funcionamento. 11. Máquina *asíncrona en carga 12. Manobras en máquinas *asíncronas. Arranque estrela-triángulo. 13. Máquina de corrente continua. Constitución e principio de funcionamento.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Sesión maxistral	22	44	66
Resolución de problemas e/ou exercicios	10	10	20
Prácticas de laboratorio	20	10	30
Resolución de problemas e/ou exercicios de forma autónoma	0	20	20
Probas de resposta longa, de desenvolvemento	4	0	4
Informes/memorias 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
Sesión maxistral	O profesor exporá nas clases de grupos grandes os contidos da materia.
Resolución de problemas e/ou exercicios	Exporanse e resolverán problemas e exercicios tipo nas clases de grupos grandes 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 e/ou exercicios 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 e/ou exercicios	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		
Sesión maxistral	Avaliarase o nivel de seguimento por parte do alumnado dos contidos da materia. A este efecto desenvolveranse durante o curso polo menos tres 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 puntuá, cada proba valórase entre 0 e 10 puntos. A avaliación do conxunto de test é a media *aritmética das puntuacións obtidas, está comprendida entre 0 e 10	15	B3	C10	D1 D2 D10 D16
Probas de resposta longa, de desenvolvemento	Realizarase un exame xeral con dúas seccións, unha correspondente aos contidos de teoría de circuitos e a outra correspondente aos de máquinas eléctricas, que poden incluír tanto cuestións teóricas como exercicios de aplicación. Cada sección avaliarase entre 0 e 10 puntos esixíndose un mínimo de 3 puntos en cada unha delas para poder aprobar a materia	70	B3	C10	D1 D2 D6 D10 D14 D16
Informes/memorias 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	15	B3	C10	D1 D2 D6 D10 D14 D16 D17 D19

Other comments on the Evaluation

A nota numérica final obtense pola media ponderada dos
*ítems anteriores: $\text{Nota} = 0,15 \times \text{xPruebas curtas} + 0,15 \times \text{xPrácticas} + 0,7 \times \text{xExamen}$ 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 punto Tanto a realización do test, como a asistencia ás prácticas e entrega dos cuestionarios das mesmas, forman parte do proceso de avaliación continua do alumno, valorándose cada unha destas actividades ata 1,5 puntos sobre 10 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 incluírán preguntas relativas aos contidos da docencia tanto de aula como de laboratorio, avaliable entre 0 e 10 puntos, e que poderá supor ata un 30% da cualificación final co mesmo repartición que se outorga na avaliación continua, nese exame 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 7 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. 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. Nese caso a cualificación global no presente curso académico será de suspenso (0,0) Notas de interese sobre a materia: a) É moi recomendable que os alumnos teñan coñecementos suficientes da álgebra dos números complexos e cursar as materias de Física de primeiro curso. *b) Para matricularse nesta materia é necesario superar ou ben estar matriculado de todas as materias dos cursos inferiores ao curso en que está situado esta materia.

Bibliografía. Fontes de información

V. M. Parra, A. Pérez, A. Pastor, J. Ortega, **TEORÍA DE CIRCUITOS**, 1985,
 Suarez Creo J. y Miranda Blanco B.N., **MÁQUINAS ELÉCTRICAS. FUNCIONAMIENTO EN RÉGIMEN PERMANENTE**, 4º Ed. 2006,
 C. Garrido, J. Cidrás, **EJERCICIOS RESUELTOS DE CIRCUITOS ELÉCTRICOS. VOLUMEN 1 Y 2**,
 P. Sánchez Barrios y otros, **TEORIA DE CIRCUITOS. Problemas y pruebas objetivas**,
 Müller-Schwarz, **FUNDAMENTOS DE LA ELECTROTECNIA**,
 Enrique Ras, **TEORÍA DE CIRCUITOS: FUNDAMENTOS**,
REGLAMENTO ELECTROTECNICO DE BAJA TENSIÓN.,
 Jesús Fraile Mora, **Máquinas eléctricas**, 2015,
 Jesús Fraile Mora, **Problemas resueltos de máquinas eléctricas**, 2015,

Segundo se vaia avanzando no desenvolvemento da asignatura irase incorporando documentación escrita dos distintos temas na plataforma TEMA

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: Álgebra e estatística/V12G340V01103
 Matemáticas: Cálculo I/V12G340V01104

Other comments

É moi recomendable que os alumnos teñan coñecementos suficientes da álgebra dos números complexos e cursar as materias de Física de primeiro curso. Para matricularse nesta materia é necesario superar ou ben estar matriculado de todas as materias dos cursos inferiores ao curso en que está situado esta materia.

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	Ares Gómez, José Enrique Diéguez Quintas, José Luís			
Lecturers	Areal Alonso, Juan José Ares Gómez, José Enrique Diéguez Quintas, José Luís Fenollera Bolívar, María Inmaculada Hernández Martín, Primo Pérez García, José Antonio Rodríguez Paz, Rafael			
E-mail	enrares@uvigo.es jdieguez@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, *utillaxes, 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 *dimensionais. Cadea de tolerancias. Optimización das tolerancias. Sistemas de axustes e tolerancias. - Procesos de conformado de materiais mediante arranque de material, operacións, *maquinas, equipos e *utillaxe - Procesos de conformado mediante deformación plástica, operacións, *maquinas, equipos e *utillaxe - Procesos de conformado por moldeo, operacións, *maquinas, equipos e *utillaxe - Procesos de conformado non convencionais, operacións, *maquinas, equipos e *utillaxe. - Conformado de *polímeros, e outros materiais non metálicos, operacións, *maquinas, equipos e *utillaxe - Procesos de unión e ensamblaxe, operacións, *maquinas, equipos e *utillaxe - 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.			
D1	CT1 Análise e síntese.			
D2	CT2 Resolución de problemas.			
D3	CT3 Comunicación oral e escrita de coñecementos na lingua propia.			
D8	CT8 Toma de decisións.			
D9	CT9 Aplicar coñecementos.			
D10	CT10 Aprendizaxe e traballo autónomos.			
D16	CT16 Razoamento crítico.			
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		

(*)		C15	D2 D3 D9 D10 D16 D20
Nova	B3	C15	D2 D10
Nova		C15	D1 D2 D3 D8 D17
Nova	B3	C15	D2 D8 D9 D16 D17 D20

Contidos

Topic	
UNIDADE DIDÁCTICA 1. INTRODUCCIÓN ÁS TECNOLOXÍAS E SISTEMAS DE FABRICACIÓN.	Lección 1. INTRODUCCIÓN 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. Clasificación dos métodos de medida. Patróns. A cadea de *trazabilidade. *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. INTRODUCCIÓN 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. Flúidos 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
UNIDADE DIDÁCTICA 4. AUTOMATIZACIÓN E XESTIÓN DOS PROCESOS DE FABRICACIÓN.	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. 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.

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
Sesión maxistral	32.5	0	32.5
Prácticas de laboratorio	18	0	18
Probas de tipo test	0	2	2
Probas prácticas, de execución de tarefas reais e/ou simuladas.	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
Sesión 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
Sesión maxistral	
Prácticas de laboratorio	
Tests	Description
Probas de tipo test	
Probas prácticas, de execución de tarefas reais e/ou simuladas.	

Avaliación

Description	Qualification	Training and Learning Results
Probas de tipo test 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 pódase 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 D1 D3 D8 D9 D10 D16
Probas prácticas, de execución de tarefas reais e/ou simuladas. 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 pódase 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 D16 D17 D20

Other comments on the Evaluation

APROBADO Alumnos cualificados mediante avaliación continua: Para superar esta materia é necesario polo menos obter 5 puntos sumando a puntuación de próbalas tipos [A], [B] e [C]. 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.

&nb Alumnos cualificados con renuncia concedida á avaliación continua: Para superar esta materia é necesario polo menos obter 5 puntos sumando a puntuación de próbalas tipos [A] e [D].

ASISTENCIA A CLASES PRÁCTICAS asistencia a clases prácticas non é obrigatoria, pero será sempre materia de exame o nelas impartido.

CONVOCATORIA DE 2ª EDICIÓN Alumnos con avaliación continua, cualificación na convocatoria de 2ª edición: &nb Esta segunda edición da convocatoria ordinaria cualificarase da seguinte maneira: - Mediante a realización da proba obrigatoria tipo [A] - 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].- 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. Para superar esta materia é necesario polo menos obter 5 puntos sumando o tres anteriores probas. As notas das probas de avaliación continua, correspondentes ao 40% da cualificación final, non se conservará dun curso para outro.

Alumnos sen avaliación continua, cualificación na convocatoria de 2ª edición: 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. Para superar esta materia é necesario polo menos obter 5 puntos sumando as dúas anteriores probas.

CONVOCATORIA EXTRAORDINARIA: 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. Para superar esta materia é necesario polo menos obter 5 puntos sumando as dúas anteriores probas.

COMPROMISO ÉTICO: 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).

Bibliografía. Fontes de información

Dieguez, J.L.; Pereira, A.; Ares, J.E.; **Fundamentos de fabricación mecánica**,
 Alting, L., **Procesos para ingeniería de manufactura**,
 De Garmo; Black; Kohser, **Materiales y procesos de fabricación**,

Recomendacións**Subjects that continue the syllabus**

Enxeñaría de fabricación e calidade dimensional/V12G380V01604

Materiais e tecnoloxías en fabricación mecánica/V12G380V01912

Selección de materiais e fabricación de medios de produción/V12G380V01932

Tecnoloxías avanzadas de fabricación/V12G380V01935

Subjects that are recommended to be taken simultaneously

Ciencia e tecnoloxía dos materiais/V12G380V01301

Other comments

Requisitos: Para matricularse desta materia é necesario ter superado ou ben estar matriculado de todas as materias dos cursos inferiores ao curso ao que está emprazada esta materia.

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

IDENTIFYING DATA				
Teoría de máquinas e mecanismos				
Subject	Teoría de máquinas e mecanismos			
Code	V12G380V01306			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	1c
Teaching language	Castelán			
Department	Dpto. Externo Enxeñaría mecánica, máquinas e motores térmicos e fluídos			
Coordinator	Fernández Vilán, Ángel Manuel Segade Robleda, Abraham			
Lecturers	Castro Ramos, Miguel Cereijo Fernández, Santiago Fernández Vilán, Ángel Manuel Segade Robleda, Abraham Yáñez Alfonso, Pablo			
E-mail	asegade@uvigo.es avilan@uvigo.es			
Web	http://fatic.uvigo.es			
General description	Esta materia proporcionará ao alumno coñecementos dos fundamentos básicos da Teoría de Máquinas e Mecanismos e a súa aplicación no campo da enxeñaría Mecánica. Achegaralle coñecementos sobre os conceptos máis importantes relacionados coa teoría máquinas e mecanismos. Coñecerá e aplicará as técnicas de análises *cinemático e dinámico para sistemas mecánicos, tanto gráficas e analítica, como mediante a utilización eficaz de software de simulación. Así mesmo servirá de introdución a aspectos sobre maquinaria que abordará en materias de cursos posteriores da Titulación.			

Competencias

Code			
B3	CG3 Coñecemento en materias básicas e tecnolóxicas que os capacite para a aprendizaxe de novos métodos e teorías, e os dote de versatilidade para adaptarse a novas situacións.		
B4	CG4 Capacidade para resolver problemas con iniciativa, toma de decisións, creatividade, razoamento crítico e capacidade para comunicar e transmitir coñecementos, habilidades e destrezas no campo da enxeñaría industrial na especialidade de Mecánica.		
C13	CE13 Coñecemento dos principios de teoría de máquinas e mecanismos.		
D2	CT2 Resolución de problemas.		
D3	CT3 Comunicación oral e escrita de coñecementos na lingua propia.		
D6	CT6 Aplicación da informática no ámbito de estudo.		
D9	CT9 Aplicar coñecementos.		
D10	CT10 Aprendizaxe e traballo autónomos.		
D16	CT16 Razoamento crítico.		
D17	CT17 Traballo en equipo.		

Resultados de aprendizaxe

Expected results from this subject	Training and Learning Results		
□ Coñecer os fundamentos básicos da Teoría de Máquinas e Mecanismos e a súa aplicación na Enxeñaría Mecánica para resolver os problemas relacionados coa devandita materia no campo da Enxeñaría Industrial.	B3	C13	D2
□ Coñecer, comprender, aplicar e practicar os conceptos relacionados coa Teoría de Máquina e Mecanismos	B4		D3
□ Coñecer e aplicar as técnicas análises *cinemático e dinámico de sistemas mecánicos.			D6
□ Coñecer e utilizar eficazmente software de análise de mecanismos.			D9
			D10
			D16
			D17

Contidos

Topic

Introdución á Teoría de máquinas e mecanismos.	Introdución. Definición de máquina, mecanismo e cadea cinemática. Membros e pares cinemáticos. Clasificación. Esquematización, modelización e simboloxía. Mobilidade. Graos de liberdade. Síntese de mecanismos.
Análise xeométrica de mecanismos.	Introdución. Métodos de cálculo da posición. Ecuacións de peche de circuíto.
Análise cinemática de mecanismos.	Fundamentos. Métodos gráficos. Métodos analíticos. Métodos matriciais.
Análise estática de mecanismos.	Fundamentos. Redución de forzas. Método dos traballos/potencias virtuais.
Análise dinámica de mecanismos.	Fundamentos. Dinámica xeral de máquinas. Traballo e potencia en máquinas. Dinámica do equilibrado.
Mecanismos de leva.	Fundamentos xerais. Levas Planas. Síntese de levas.
Mecanismos de transmisión.	Fundamentos. Mecanismo de engrenaxes. Outros mecanismos.

Planificación

	Class hours	Hours outside the classroom	Total hours
Sesión maxistral	23	19.5	42.5
Resolución de problemas e/ou exercicios	9.5	30	39.5
Prácticas de laboratorio	18	47	65
Probas de resposta longa, de desenvolvemento	3	0	3

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

Metodoloxía docente

	Description
Sesión maxistral	Clase maxistral na que se expoñen os contidos teóricos.
Resolución de problemas e/ou exercicios	Resolución de problemas utilizando os conceptos teóricos presentados en aula.
Prácticas de laboratorio	Realización de tarefas prácticas en laboratorio docente ou aula informática

Atención personalizada

Methodologies	Description
Sesión maxistral	Realizaranse titorías de grupo ou individuais en horario de titorías, que servirán para reforzar coñecementos adquiridos e para tutelar traballos propostos
Resolución de problemas e/ou exercicios	Realizaranse titorías de grupo ou individuais en horario de titorías, que servirán para reforzar coñecementos adquiridos e para tutelar traballos propostos
Prácticas de laboratorio	Realizaranse titorías de grupo ou individuais en horario de titorías, que servirán para reforzar coñecementos adquiridos e para tutelar traballos propostos

Avaliación

Description	Qualification	Training and Learning Results
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Prácticas de laboratorio	Valorarase a asistencia e a participación do alumno nas prácticas de laboratorio e as memorias de práctica	20	B3 B4	C13	D2 D3 D6 D9 D10 D16 D17
Probas de resposta longa, de desenvolvemento	Exame final/parciais enfocados aos contidos correspondentes impartidos durante as clases de aula e laboratorio	80	B3 B4	C13	D2 D3 D9 D10 D16

Other comments on the Evaluation

A materia aprobábase se se obtén unha cualificación (*) igual ou maior que un 5 como nota final, da seguinte forma: A asistencia con aproveitamento ao Laboratorio/Aula informática, a cualificación das memorias entregadas en cada práctica e os traballos tutelados, terán unha valoración máxima de 2 puntos da nota final, esta cualificación conservarase na segunda convocatoria. Para poder ser avaliado neste apartado, a asistencia a prácticas é obrigatoria. Para os alumnos que o soliciten no prazo establecido (renuncia a avaliación continua), existirá un exame final de Laboratorio/Traballos tutelados en ambas as convocatorias cunha valoración máxima de 2 puntos. O exame final terá unha valoración máxima de 8 puntos da nota final.

(*) Empregarase un sistema de cualificación numérica de 0 a 10 puntos segundo a lexislación vixente (RD 1125/2003 de 5 de setembro, BOE de 18 de setembro).

Profesor responsable de grupo:

Grupo M1: ANGEL MANUEL FERNANDEZ VILAN

Grupo M2: ANGEL MANUEL FERNANDEZ VILAN

Grupo M3: Abraham Segade Robleda

Grupo M4: Abraham Segade Robleda

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, e outros) 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). Non se permitirá a utilización de ningún dispositivo electrónico durante as probas de avaliación salvo autorización expresa. O feito de introducir un dispositivo electrónico non autorizado na aula do exame será considerado motivo de non superación da materia no presente curso académico e a cualificación global será de suspenso (0.0).

Bibliografía. Fontes de información

García Prada, J.C. Castejón, C., Rubio, H., **Problemas resueltos de Teoría de Máquinas y mecanismos**, THOMSON,
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,
Cardona, S. y Clos D., **Teoría de Máquinas.**, UPC,
Shigley, J.E.; Uicker J.J. Jr., **Teoría de Máquinas y Mecanismos**, 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, **Mecanismos y dinámica de maquinaria**, Limusa-wiley,
Nieto, j., **Síntesis de Mecanismos**, AC,
Erdman, A.G.; Sandor, G.N., **Diseño de Mecanismos Análisis y síntesis**, PRENTICE HALL,
Simon A.; Bataller A; Guerra J.; Ortiz, A.; Cabrera, J.A., **Fundamentos de teoría de Máquinas**, BELLISCO,
Kozhevnikov SN, **Mecanismos**, Gustavo Gili,

Recomendacións

Subjects that continue the syllabus

Diseño de máquinas I/V12G380V01304

Automóviles e ferrocarrís/V12G380V01941

Diseño de máquinas hidráulicas e sistemas oleopneumáticos/V12G380V01914

Diseño de máquinas II/V12G380V01911

Diseño mecánico asistido/V12G380V01915

Enxeñaría do transporte/V12G380V01945

Motores e máquinas térmicos/V12G380V01913
Sistema de análise, simulación e validación de datos/V12G380V01933
Vehículos automóbiles híbridos e eléctricos/V12G380V01944

Subjects that it is recommended to have taken before

Expresión gráfica: Expresión gráfica/V12G380V01101
Física: Física I/V12G380V01102
Matemáticas: Álgebra e estatística/V12G380V01103
Matemáticas: Cálculo I/V12G380V01104
Matemáticas: Cálculo II e ecuacións diferenciais/V12G380V01204

Other comments

Requisitos: Para matricularse nesta materia é necesario superar ou ben estar matriculado de todas as materias do primeiro curso.

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

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				
Coordinator	Álvarez da Costa, Estrella			
Lecturers	Álvarez da Costa, Estrella Cameselle Fernández, Claudio Moldes Menduíña, Ana Belén Moldes Moreira, Diego Moure Varela, Andrés Orge Álvarez, Beatriz Prudencia Pérez Rial, Leticia			
E-mail	ealvarez@uvigo.es			
Web	http://fatic.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 in the own language.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
D12	CT12 Research skills.
D17	CT17 Working as a team.

Learning outcomes

Expected results from this subject	Training and Learning Results	
Basic knowledge and application of environmental technologies and sustainability	C16	D2 D3 D10
Problem solving	C16	D2 D3 D10
Oral and writing communication	C16	D2 D3 D10
Knowledge application to practical and real cases	C16	D2 D3 D10
Analysis and synthesis	C16	D1 D2 D3 D9 D10 D12 D17

Ability to analyze and determine the social and environmental impact of the technical solutions to B7 environmental problems

D1
D3
D9
D10
D17

Contents

Topic

Lesson 1: Introduction to the environmental technology.	1. Material cycle economy.
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
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
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.
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 best available techniques (BAT). 5. Introduction to the environmental impact assessment
Practice 1: Codification of wastes	
Practice 2: Water quality parameters.	
Practice 3: Removal of pollutants	
Practice 4: Wastewater treatment.	
Practice 5: Treatment of effluents and/or emissions.	
Practice 6: Simulation of certain stages of a EDAR	

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	26	52	78
Troubleshooting and / or exercises	11	22	33
Laboratory practises	12	12	24
Short answer tests	2	4	6
Reports / memories of practice	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
Master Session	Teaching in the classroom of the key concepts and procedures for learning the syllabus contents
Troubleshooting and / or exercises	Solving exercises with the teacher's help and independently
Laboratory practises	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 practises	
Master Session	

Assessment						
	Description	Qualification	Training and Learning Results			
Short answer tests	"Partial exam" consisting of theoretical questions and problems related to the syllabus of the subject. 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	
Reports / memories of practice	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	
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:

Students who choose continuous assessment, to pass the course, must exceed 40% of the maximum score in each of the parts of the "final exam".

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

- B1.- Mihelcic, J.R. and Zimmerman, J. B., **Environmental Engineering: Fundamentals, sustainability, design**, Wiley,
B2.- Davis, M.L. and Masten S.J., **Principles of Environmental Engineering and Science**, McGraw-Hill,
B3.- Metcalf & Eddy, **Ingeniería de aguas residuales : tratamiento, vertido y reutilización**, McGraw-Hill,
C1.- Tchobanoglous, G., **Gestión integral de residuos sólidos**, McGraw-Hill,
C2.- Nemerow, N. L., **Tratamiento de vertidos industriales y peligrosos**, Díaz de Santos,
C3.- Baird, C y Cann M., **Química Ambiental**, Reverté,
C4.- Kiely, G., **Ingeniería Ambiental: fundamentos, entornos, tecnología y sistemas de gestión**, McGraw-Hill,
C5.- Castells et al., **Reciclaje de residuos industriales: residuos sólidos urbanos y fangos de depuradora**, Díaz de Santos,
C6.- Wark and Warner, **Contaminación del aire: origen y control**, Limusa,
C7.- Jonker, G. y Harmsen, J., **Ingeniería para la sostenibilidad**, Reverté,
C8.- Azapagic, A. and Perdan S., **Sustainable development in practice: Case studies for engineers and scientists**, Wiley,

Books with references B1, B2, and B3 are considered as "Basic bibliography". Books with references C1 to C8 are considered as "Complementary bibliography".

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				
Mechanics of Materials				
Subject	Mechanics of Materials			
Code	V12G380V01402			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Caamaño Martínez, José Carlos			
Lecturers	Caamaño Martínez, José Carlos Conde Carnero, Borja Fernández Abalde, Félix Fuentes Fernández, Eugenio Ignacio Lorenzo Mateo, Jaime Alberto Ponte Suárez, José Riveiro Rodríguez, Belén Soilán Rodríguez, Mario			
E-mail	jccaam@uvigo.es			
Web	http://faiatic.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 body and elastic solid.	B3	C14	D1
To know the state of stress and deformation of a deformable solid and the relationship between them.	B4		D2 D9
To apply the knowledge acquired to the determination of the maximum values of the stress at a point of a deformable solid.			D10 D16
To know the basic principles governing the strength of materials.			D17
To know the relationships between the different stresses and strains they originate.			
To apply the knowledge acquired to the determination of internal loads.			
To apply the acquired knowledge on the calculation of stresses in bar elements.			
To know the basics of the deformation of rod elements.			
To apply the knowledge gained to sizing bar elements.			

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. Axial load	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. Elastic deformation of an axially loaded member. 2.5. Saint-Venant principle and superposition principle. 2.6. Statically governed problems. 2.7. Statically indeterminate problems. 2.8. Thermal stress and assembly misfits.
3. Bending	3.1 Beams: definition and types. Loads on beams. 3.2 Internal shear forces and bending moments. 3.3 External load, shear force and bending moment relationships. 3.4 Shear and moment diagrams 3.5 Pure bending and non-uniform bending. Hypothesis and limitations. 3.6 Normal stresses in unsymmetric bending. 3.7 Symmetric bending. The flexure formula (Navier's Law). 3.8 Section modulus of a beam. Ideal beam cross-section. 3.9 Deflection of beams and shafts. Rotation and displacement. Mohr's Theorems. 3.10 Hyperstatic bending.
4. Other forces: shear, buckling and torsion	4.1. Shear in joints. Definition. Shear force. Shear stress. Bolted and riveted joints. Shear joints. 4.2. Introduction to the concept of compressive buckling. 4.3. Introduction to the concept of torsion in straight prisms.

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	32.5	49	81.5
Laboratory practises	16	13	29
Troubleshooting and / or exercises	1	17.5	18.5
Autonomous troubleshooting and / or exercises	1	17	18
Long answer tests and development	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
Master Session	Lecture where theoretical principles are presented using digital media, videos and blackboard.
Laboratory practises	Activities of application of the knowledge to concrete situations and of acquisition of basic skills and procedural skills related with the subject of study.
Troubleshooting and / or exercises	Resolution of problems related to real case studies.
Autonomous troubleshooting and / or exercises	Autonomous resolution of problems that must be delivered as coursework

Personalized attention	
Methodologies	Description
Laboratory practises	
Autonomous troubleshooting and / or exercises	
Master Session	

Assessment	
Description	Qualification Training and Learning Results

Laboratory practises	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 be 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 D2 D9 D10 D16 D17
Troubleshooting and / or exercises	C) Written tests to evaluate the individual work delivered by the student in the previous sections (A and B). It will be compulsory the attendance to the 90% of the practicals and the on-time delivery of all the lists of problems explained in section B, to obtain the marks given in section C. The marks obtained in the sections A and B will proportionally affect to the marks of the section C. The section C will be marked with a maximum value of 10% of the total mark, only when the student obtain the minimum mark in the written exam, which is 45%. (See following section: 'Other comments')	10	B3 C14 D1 B4 D2 D9 D10 D16
Autonomous troubleshooting and / or exercises	B) Lists of problems to solve individually by students will be published in the platform FAITIC-TEMA along the course. Each list of problems will have a deadline. All this coursework needs to be delivered to the corresponding lecturer in time and form, so they can be counted for marking. Any defect of form (out of term, absence of name, etc.) will invalidate the exercises and they will not be marked. When all the coursework are correctly submitted, they will be marked with the value indicated. These marks will be added to the marks obtained in the written exam, once the student reaches the minimum mark in this exam, which is 45%. (See following section: 'Other comments')	2.5	B3 C14 D1 B4 D2 D9 D10 D16
Long answer tests and development	Written exam in the dates established by the School.	85	B3 C14 D1 D2 D9 D10 D16

Other comments on the Evaluation

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

Continuum assessment is composed of sections A, B, C. The maximum mark for continuum assessment (NEC) is 15%, which will be computed from the following equation: $NEC (\%) = (2'5 \cdot A) + (2'5 \cdot B) + (C) \cdot A \cdot B$; where A,B: 0-1 and $C_{\text{máx}} = 10\%$ of final mark.

Assessment section:

Ethical commitment: it is expected an adequate ethical behaviour 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

Manuel Vázquez, **Resistencia de materiales**,
Hibbeler, R., **Mecánica de materiales**,

English version of main Bibliography:

Hibbeler, R.; 'Mechanics of materials'. Ed Prentice Hall.

Other books:

Ortiz Berrocal, L. 'Resistencia de materiales'. Ed. McGraw-Hill. TOR 620 ORT res; IND T11 391

González Taboada, J.A. 'Tensiones y deformaciones en materiales elásticos'. Ed. Autor. TOR 620 GON ten; IND T11 18

González Taboada, J.A. 'Fundamentos y problemas de tensiones y deformaciones en materiales elásticos'. Ed. Autor. IND T11

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				
Automation and Control Fundamentals				
Subject	Automation and Control Fundamentals			
Code	V12G380V01403			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish English			
Department				
Coordinator	Espada Seoane, Angel Manuel López Fernández, Joaquín			
Lecturers	Espada Seoane, Angel Manuel Fernández Silva, María López Fernández, Joaquín Rajoy González, José Antonio			
E-mail	joaquin@uvigo.es aespada@uvigo.es			
Web	http://fatic.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 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 in the own language.
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		
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. Introduction the industrial automation.	1.1 Introduction to automation of tasks. 1.2 Types of control. 1.3 The programmable logic controller. 1.4 Diagram of blocks. Elements of the programmable logic controller. 1.5 Cycle of operation of the programmable logic controller. Time of cycle. 1.6 Ways of operation.
2. Introduction the programming of programmable logic controllers.	2.1 Binary, octal, hexadecimal and BCD systems. Real numbers. 2.2 Addressing and access to periphery. 2.3 Instructions, variables and operands. 2.4 Forms of representation of a program. 2.5 Types of modules of program. 2.6 Linear and structured programming.
3. Programming of programmable logic controllers with I/O.	3.1 Binary variables. Inputs, outputs and memory. 3.2 Binary combinations. 3.3 Operations of allocation. 3.4 Creation of a simple program. 3.5 Timers and counters. 3.6 Arithmetical operations. 3.7 Examples.
4. Modelling of systems for the programming of programmable logic controllers .	4.1 Basic principles. Modelling technics. 4.2 Modelling by means of Petri Networks. 4.2.1 Definition of stages and transitions. Rules of evolution. 4.2.2 Conditional election between several alternatives. 4.2.3 Simultaneous sequences. Concurrency. Resource shared. 4.3 Implementation of Petri Networks. 4.3.1 Direct implementation. 4.3.2 Normalised implementation (Grafcet). 4.4 Examples.
5. Basic concepts of automatic control. Representation and modelling of continuous systems.	5.1 Systems of regulation in open loop and closed loop. 5.2 Control typical loop. Nomenclature and definitions. 5.3 Physical systems and mathematical models. 5.3.1 Mechanical systems. 5.3.2 Electrical systems. 5.3.3 Others. 5.4 Modelling in state space. 5.5 Modelling in transfer function. Laplace transform. Properties. Examples. 5.6 Blocks diagrams.
6. Analysis of dynamic 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. Controllers and parameters tuning.	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 assignment.
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 practises	18	30	48
Troubleshooting and / or exercises	0	15	15
Master Session	32.5	32.5	65
Long answer tests and development	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 practises	Different activities aimed to apply the concepts learned during the lectures.
Troubleshooting and / or exercises	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.
Master Session	Include the professor lectures about the contents of the subject.

Personalized attention

Methodologies	Description
Master Session	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 practises	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).
Troubleshooting and / or exercises	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
Long answer tests and development	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 practises	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
Long answer tests and development	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

- Continuous Assessment 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 Assessment 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 Assessment, the subject students to Continuous Assessment 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

E.MANDADO, J.MARCOS, C. FERNANDEZ, J.I.ARMESTO, "Autómatas Programables y Sistemas de Automatización", 2009,
 MANUEL SILVA, [Las Redes de Petri en la Automática y la Informática],
 R. C. DORF, R. H. BISHOP, "Sistemas de control moderno", 2005,

Complementary:

- "Autómatas Programables. Fundamento. Manejo. Instalación y Práctica", PORRAS, A., MONTERO, A.P., Ed. McGraw-Hill, 1990.
- "Automatización. Problemas resueltos con autómatas programables", J. Pedro Romera, J. Antonio Lorite, Sebastián Montoro. Ed. Paraninfo
- [Guía usuario Step7] SIEMENS
- [Diagrama de funciones (FUP) para S7-300 y S7-400] SIEMENS
- [SIMATIC S7-GRAPH para S7-300/400] SIEMENS
- "Control de sistemas continuos. Problemas resueltos", Barrientos, Ed. Mcgraw-Hill.
- "Modern control engineering", Ogata, K., Ed. Prentice-hall.
- "Retroalimentación y sistemas de control", DISTEFANO, J.J., STUBBERUD, A.R., WILLIAMS, I.J., Ed. McGraw-Hill.

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

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 English			
Department				
Coordinator	Verdugo Mates, Rafael			
Lecturers	Cao Paz, Ana María Fernández Molanes, Roberto 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://fatic.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 structure of systems based in microprocessors	B3		D10
Know the structure of the electronic converters of power.		C11	D2
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
Master Session	25	0	25
Troubleshooting and / or exercises	8	0	8
Previous studies / activities	0	49	49
Autonomous troubleshooting and / or exercises	0	46	46
Laboratory practises	18	0	18
Other	1	0	1
Other	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
Master Session	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.
Troubleshooting and / or exercises	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 / activities	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 rely 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 tasks 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 troubleshooting and / or exercises	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 exposed to the professor as soon as possible in order to enhance the feedback of the learning process.
Laboratory practises	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 session the 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 practises	Tutoring Sessions: During the established schedule of each professor, students will be able to speak freely about course issues with the professor. Also they 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 practises	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
Other	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 consist on a wide set of test questions, short answers and analytical numerical problems.	20	B3	C11	D2
Other	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:

$$CC = 0,8 \times NP + 0,2 \times NL$$

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:

$$CA = 0,2 \times NP + 0,2 \times NL + 0,6 \times EF$$

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.

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.

Sources of information

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

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

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

Malik N. R., **Electronic Circuits. Analysis, simulation, and design**,

Wait, J.; Huelsman, L.; Korn, G., **INTRODUCCION AL AMPLIFICADOR OPERACIONAL**, 2ª,

Pleite Guerra, J.; Vergaz Benito, R.; Ruíz de Marcos; J. M., **Electrónica analógica para ingenieros.**,

Lago Ferreira, A.; Nogueiras Meléndez, A. A., **Dispositivos y Circuitos Electrónicos Analógicos: Aplicación práctica en laboratorio**,

All the books indicated consider basic bibliography, does not indicate complementary bibliography.

The student also has in faitic of specific material and of links to other sources of available complementary information in the network.

Recommendations

Subjects that are recommended to be taken simultaneously

Automation and Control Fundamentals/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				
Coordinator	Paz Penín, María Concepción López Veloso, Marcos Meis Fernández, Marcos			
Lecturers	Concheiro Castiñeira, Miguel Conde Fontenla, Marcos López Veloso, Marcos Martín Ortega, Elena Beatriz Meis Fernández, Marcos Molares Rodríguez, Alejandro Paz Penín, María Concepción Román Espiñeira, Ignacio Javier			
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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 as 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 C8 D2 B5 D9 D10
CG4 Capacity to: solve problems with initiative and creativity, take decisions, develop critical reasoning and capacity to communicate and transmit knowledge and skills in the field of the industrial engineering.	B4 C8 D2 B5 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. B4 B5 C8 D2 D9 D10

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

CT2 Resolution of problems. B4 B5 C8 D2 D9 D10

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 networks 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 measurmens in a venturi device. Minor losses measurments in a holed-plate. Friction coefficients measurements. Losses in elbows, bend, tees and valves

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	32.5	60.5	93
Troubleshooting and / or exercises	14	27	41
Laboratory practises	4	0	4
Long answer tests and development	3	0	3
Troubleshooting and / or exercises	0	6	6

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

Methodologies

	Description
Master Session	They explain the foundations of each subject needed to solve practical problems. It includes mainly lectures but can also include: Readings bibliographic Review Solution of problems Conferences Oral Presentations
Troubleshooting and / or exercises	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 practises	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
Master Session	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 practises	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		
Long answer tests and development	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
Troubleshooting and / or exercises	Resolution of problems and/or exercises proposed, being able to include: - a number of weekly deliveries (no face-to-face) - face-to-face resolutions in the classes schedule	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 of the present academic course will be failed (0.0).

Sources of information

Frank M White, **Mecánica de Fluidos/Fluid Mechanics**, VI,
Philip M. Gerhart, Richard J Gross, , Jonh I. Hochstein, **FUNDAMENTOS DE MECÁNICA DE FLUIDOS**, II,
Antonio Crespo, **Mecánica de fluidos**,
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