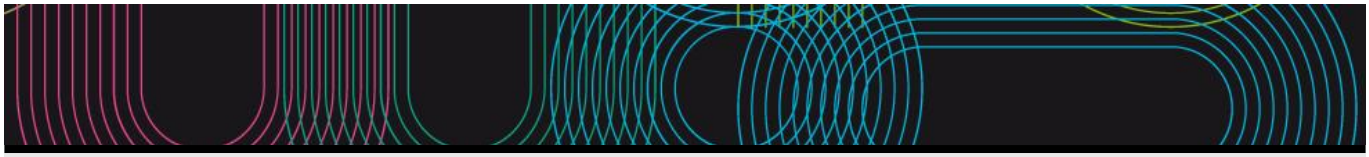

(*)Escola de Enxeñaría Industrial

Information
For additional information about the centre and its degres visit the centre's website https://eei.uvigo.es/

Grado en Ingeniería Mecánica

Subjects

Year 2nd

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

IDENTIFYING DATA				
Materials science and technology				
Subject	Materials science and technology			
Code	V12G380V01301			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Figueroa Martínez, Raúl Abreu Fernández, Carmen María			
Lecturers	Abreu Fernández, Carmen María Álvarez Dacosta, Pedro Cortes Redin, María Begoña Feijoó Vázquez, Iria Figueroa Martínez, Raúl Guitián Saco, María Beatriz Iglesias Rodríguez, Fernando Pena Uris, Gloria María Riobó Coya, Cristina Vázquez Castro, Alfonso			
E-mail	cabreu@uvigo.es raulfm@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	The aim of this subject is to introduce the main concepts of materials technology as well as to study applications of the most common materials			

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

Learning outcomes	Competences		
It comprises the fundamental concepts of link, structure and microestructure of the distinct types of materials	CG3	CE9	CT10
It comprises the relation go in to microestructure of the material in his mechanical behaviour, electrical, thermal and magnetic	CG3	CE9	
It comprises the mechanical behaviour of the metallic materials, ceramic, plastics and compound	CG4 CG6		
It knows how they can modify the properties by means of mechanical processes and thermal treatments	CG4	CE9	CT9
It knows the basic technicians of structural characterisation of the materials	CG3 CG6	CE9	
It purchases skills in the handle of the diagrams and charts			CT1 CT5
It purchases skill in the realisation of essays	CG6	CE9	CT10
It analyses the results obtained and extracts conclusions of the same			CT1 CT9
It is able to apply norms of essays of materials	CG6		CT1 CT9

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

Planning	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Lecturing	31	56	87
Laboratory practical	18	18	36
Autonomous problem solving	0	12	12
Mentored work	0.5	7.95	8.45
Problem and/or exercise solving	1	0	1
Presentation	0.25	0	0.25
Report of practices, practicum and external practices	0	2	2
Self-assessment	0	0.3	0.3
Objective questions exam	2	0	2
*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	A presentation of the course is made: contents, organization, methodologies to be used, schedule and evaluation system. Emphasis is placed on student participation and the personalized tutoring system.
Lecturing	During the academic course, the teacher exposes the main contents of the course, encouraging the active participation of the students. Exercises and type problems are solved, and hands on science methodology will be also applied.
Laboratory practical	Activities for the practical application of the knowledge acquired in the theoretical sessions. They are performed in the laboratory with specialized equipment and in accordance with applicable standards
Autonomous problem solving	Throughout the course, students will be offered different set of problems and questions that they will have to solve by themselves, demonstrating the capacity for learning and developing autonomous work.
Mentored work	The teacher will propose various assignments to be carried out in small groups. Throughout its development the teacher will guide and orient the students. Finally, the work must be presented in a public session in front of the teacher and all the classmates.

Personalized assistance	
Methodologies	**Description**
Lecturing	The teacher will guide and resolve any doubts that the student may have in relation to the contents explained in the lectures.
Laboratory practical	The laboratory teacher will guide the students in the development of the practical classes, clarifying their doubts and guiding them to achieve the best understanding of the practical classes

Mentored work	During the development of the tasks proposed to be done in small groups, the students will have the guidance and help of the teacher

Tests	Description
Problem and/or exercise solving	The students will have the support of the teacher to solve the doubts that can arise in the resolution of the numerical problems proposed in class, as well as those that are offered for their autonomous work.
Report of practices, practicum and external practices	The laboratory teacher will guide the students in the resolution of the questions formulated in the practical classes and will help in the doubts that may arise in the writing of the practical reports.
Self-assessment	The teacher will design the self-assessment tests that the student must take throughout the course, and will guide the students in their completion, solving the technical questions that may arise

Assessment

	Description	Qualification	Evaluated Competencess		
Laboratory practical	The attendance and active participation of the student in the practical sessions will be valued	0.5	CG3 CG6	CE9	CT1 CT9 CT10
Problem and/or exercise solving	The knowledges acquired in the practical sessions will be evaluated by means of test questions and problems	16	CG4 CG6	CE9	CT1 CT9 CT10
Presentation	The work carried out in small groups will be evaluated through their public defense. The search for information, the structuring of the work and the clarity of the presentation will be especially taken into account.	8	CG4 CG6	CE9	CT1 CT5 CT10
Report of practices, practicum and external practices	The student must present a report of the practical sessions which will include the results obtained in the mechanical tests as well as the answers to the questions asked.	1.5	CG6	CE9	CT9
Self-assessment	Resolution of proposed online questionnaires, which will consist of true and false questions and multiple choice questions	4	CG3	CE9	CT9 CT10
Objective questions exam	Student learning in this course will be evaluated by means of a written exam, which will consist of short answer questions, test questions and problems similar to those posed during the course.	70	CG3 CG4	CE9	CT1 CT5 CT9 CT10

Other comments on the Evaluation

Continuous assessment: The continuous assessment activities will be carried out during the teaching period and correspond to 30% of the grade.

Final Exam: counts for 70% of the course grade. The exam will be taken on the official date set by the EEI direction.

Requirements to pass the course:

It is necessary to achieve a minimum score of 40% in the final exam, that is 2.8 / 7.

If this minimum is not reached, the course will be considered as not passed and, although the sum of the exam grade and the continuous evaluation is higher than 5, the maximum grade that will be included in the academic records will be 4.5 points.

Renouncing continuous assessment: Students that do not follow the continuous assessment activities, after receiving authorization from the EEI direction, will be evaluated through a final exam on the contents of all the course, covering both lecture and labo contents, counting for 100% of the grade. A minimum mark of 5 (50%) will be required to pass the course.

July exam (2nd Edition): In the July edition, the continuous assessment marks will be also considered (only marks obtained in the current academic year). The characteristics of the exam will be the same as the first edition, and will be taken on the official date set by the EEI direction. Further in the July edition, the student can choose to be evaluated through a final exam on the contents of all the course, covering both lecture and labo contents, counting for 100% of the grade. A minimum mark of 5 (50%) will be required to pass the course. The student must notify the teacher of their choice well in advance.

Extraordinary Call: The extraordinary call exam contents will cover the entire course, including both lecture and labo contents, counting for 100% o the grade. A minimum mark of 5 (50%) will be required to pass the course.

Ethical commitment: Students are expected to carry out their work in accordance with an appropriate ethical behaviour. If the professor detects a behaviour that constitutes academic dishonesty (cheating, plagiarism, use of unauthorized electronic devices, for example) the student will be deemed not to meet all the criteria to pass the course, and will be informed that the final grade of this course will be FAIL (0.0). The use of any electronic device will not be allowed during the evaluation tests, unless expressly authorized. Introducing an unauthorized electronic device into the exam room will be considered reason enough for not passing the course in the present academic year, and the final grade will be: FAIL (0.0).

Attention: If there is any mismatch between the contents of the 3 language versions of this teaching guide, those included in the Spanish version will be considered valid.

Sources of information

Basic Bibliography

Callister, William, **Ciencia e ingeniería de los materiales**, 978-84-291-7251-5, 2ª, Reverté, 2016

Askeland, Donald R, **Ciencia e ingeniería de materiales**, 978-607-481-620-4, 6ª, Cengage Learning, 2012

Shackelford, James F, **Introducción a la ciencia de materiales para ingenieros**, 9788483226599, 7ª, Pearson Educación, 2010

Complementary Bibliography

Smith, William F, **Fundamentos de la ciencia e ingeniería de materiales**, 978-607-15-1152-2, 5ª, McGraw-Hill, 2010

AENOR, **Standard tests**,

Montes J.M., Cuevas F.G., Cintas J., **Ciencia e ingeniería de los materiales / J.M. Montes, F.G. Cuevas, J. Cintas**, 978-84-283-3017-6, 1ª, Paraninfo, 2014

Recommendations

Subjects that continue the syllabus

Materials engineering/V12G380V01504

Subjects that are recommended to be taken simultaneously

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

Subjects that it is recommended to have taken before

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

Contingency plan

Description

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

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained
All the lecture-based sessions will be maintained, moving them totally or partially to an online version, through the Online Campus (Campus Remoto) of the UVigo.
* Teaching methodologies modified
Laboratory sessions will be modified to adapt the group size to that set by the University or the EEI as safe. Sessions will be organized to ensure the safety distance. All the activities that can be performed in non face-to-face mode will be deployed on online platforms.
* Non-face-to-face student attention (tutoring)
Non-face-to-face tutorial services will be held through the virtual offices on the Online Campus, although the attention of the students may be carried out also by other ways (email, videoconference, Moovi forums, ...), always after previous agreement with the teacher.

* Modifications (if applicable) of the contents of the course
According to the moment when the University decision of starting non-face-to face or mix teaching is made, some reduction of the lab contents will need to be done, following the defined organization. Students will be informed of the changes through Moovi platform.
* Additional bibliography to facilitate self-learning
If student access to academic libraries is limited, additional documentation will be provided.

* Other modifications

=== ADAPTATION OF THE COURSE ASSESSMENT ===

* Tests already carried out
The marks obtained in the continuous assessment tests already performed will maintain their weight in the final grade without changes, as defined in the teaching guide.

* Pending tests that are maintained
- Those continuous assessment tests or exams that have not yet been done will also maintain their contribution in the final grade, as defined in the teaching guide. Exams will be held face-to-face if possible and will be adapted to take place fully online, if the applied contingency measures make it necessary.
* Tests that are modified
- Final exam: The final exam weight (70% of the course grade) can be modified depending on the date when the non face-to-face teaching is stablished. It can be reduced to a minimum contribution of 40% of the course grade.
- Students will be informed through Moovi of the change in the reweighting of the final exam, as well as the new tests that will be proposed to increase the weight of the continuous assessment.
- The final exam will be held face-to-face if possible but, if not, it will be adapted to be performed online.
* New tests
- In case of reducing the weight of the final exam mark in the course grade, new online tests and/or exercises will be proposed covering different items of the course syllabus and performed online using Moovi platform. The sum of the marks for the new tests and the final exam will contribute 70% to the course grade.
- Students will receive sufficient information in advance of the new tests and the grading procedure through Moovi platform.

IDENTIFYING DATA				
Thermodynamics and heat transfer				
Subject	Thermodynamics and heat transfer			
Code	V12G380V01302			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Sieres Atienza, Jaime Santos Navarro, José Manuel			
Lecturers	Pequeño Aboy, Horacio 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	
CG4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
CG5	CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
CG6	CG6 Capacity for handling specifications, regulations and mandatory standards.
CG7	CG7 Ability to analyze and assess the social and environmental impact of the technical solutions.
CG11	CG11 Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Industrial Technical Engineer.
CE7	CE7 Knowledge of applied thermodynamics and heat transfer. Basic principles and their application to solving engineering problems.
CT2	CT2 Problems resolution.
CT7	CT7 Ability to organize and plan.
CT9	CT9 Apply knowledge.
CT10	CT10 Self learning and work.
CT17	CT17 Working as a team.

Learning outcomes	Competences		
Know and understand the Laws of Thermodynamics, the modes of heat transfer and the relations to calculate heat transfer rates	CG4 CG5 CG6 CG7	CE7	CT2 CT7 CT9 CT10 CT17
Know and understand the basic notions of the physics involved in the different modes of heat transfer	CG5 CG6 CG7 CG11	CE7	CT2 CT7 CT9 CT10 CT17
Identify the relevant heat transfer mechanisms involved in any heat transfer engineering application	CG4 CG6 CG7 CG11	CE7	CT2 CT7 CT9 CT10 CT17

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	CG4 CG5 CG6 CG7 CG11	CE7	CT2 CT7 CT9 CT17

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	65	97.5
Laboratory practical	6	0	6
Autonomous problem solving	0	18.5	18.5
Problem solving	12	12	24
Problem and/or exercise solving	0	3	3
Objective questions exam	1	0	1
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Lectures introduction of the contents of the matter object of study
Laboratory practical	Real processes experimentations in the laboratory which complement the contents covered in the course.
Autonomous problem solving	Troubleshooting and / or exercises related to the subject that the student take place by consulting the literature
Problem solving	Troubleshooting and / or exercises related to the subject that the student take place in the classroom and/or laboratory. Examples of simple application of the contents studied as well as practical examples will be solved. The methodology will be focused on explaining how to solve the problems rather than on the determining the final numerical solution.

Personalized assistance	
Methodologies	**Description**
Lecturing	Students questions or doubts about any of the course contents will be solved during the instructors office hours
Laboratory practical	Students questions or doubts about any of the course contents will be solved during the instructors office hours
Problem solving	Students questions or doubts about any of the course contents will be solved during the instructors office hours

Assessment

	Description	Qualification	Evaluated Competencess		
Problem and/or exercise solving	Final written exam where students should solve lengthy response problems or exercies or theoertical questions about the course content. The exam durration and conditions will be established by the course teachers. Students should develop, relate, justify and present their knowledge and results including appropriate explanations. This exam will be take place in the dates fixed by the educational organisation of the centre Learning outcomes: know, understand and apply the principles and foundations of applied thermodynamics and heat transfer, including appropriate explanations to proposed solutions.	80	CG4 CG5 CG6 CG7	CE7	CT2 CT7 CT9 CT10
Objective questions exam	Throughout the semester several tests will be performed. The corresponding note will be based on short-answer written essays or tests. This note will correspond with the denomination of Continuous Evaluation	20	CG6	CE7	CT2 CT7 CT9 CT10

Other comments on the Evaluation

There are two evaluation modes that can be followed un order to passed this subject:

A) *Continuous Evaluation Mode* .

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

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 Subject Guide, 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 are not allowed to use any kind of equation sheet or complementary document, neiter a calculatior.

These tests may be carried out during any of the course session hours (during classroom, problems or laboratory sessions) without previous notice.

The points achieved by continuous assessment will be valid in the first and the second calls/editions of the course.

B) *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/editions (same day and time) by a specific assesment.

This specific assessment will take into account all contents (theory, problems and laboratory practices) of the course, and will account for 100% of the maximum score. It will take place as follows:

1.- Written exam (EF), with a weight of 80% of the final qualification, identical to the final exam 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. No supporting material will be allowed such as any kind of equation sheet, complementary document,or even a calculator. Any evidence about this specific test will be considered as assessable and it will imply that the student is not eligible for repeating this specific test.

The following qualification criteria apply to the two evaluation modes.

Qualification criteria:

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

In the solutions proposed in the final exam, the students will have to justify or argue all the results that propose. The procedure used by the students during the solution of the differernt problems will also be taken into account.

None of the results obtained by the student will be "understood" by default.

The First Call/Edition: the final qualification is calculated as

CF =0.2·EC+0.8·EF

The Second Call/Ediciton: the final qualification is calculated as

CF =maximum(N1, N2), where

N1 = 0.2·EC + 0.8·EF

N2 = EF

The points obtained for the Continuous Evaluation (EC) during the first call (by any of the two evaulation modes) will also apply for the second call.

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

'FINAL DE CARRERA' EXTRAORDINARY EXAM:

They will be able to have a format of distinct examination to the detailed previously. It will consist of a wirtten exam, where students should solve problems and/or answer theoretical questions about the most relevant contents of the course. It will allow students to obtain 100% of the maximum final qualification, being a minimum of 50% required in order to pass the course.

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

Ethical Comminmnet:

It might have a different format to the formerly detailed one.

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

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

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

Sources of information
Basic Bibliography
Çengel, Yunus y Boles, Michael, **Termodinámica**, 7ª Edición, McGraw-Hill, 2012
Çengel Yunus A., Boles Michael A., **Thermodynamics : an engineering approach**, 7th ed, McGraw-Hill, 2011
Çengel Y.A., y Ghajar A.J., **Transferencia de Calor y Masa. fundamentos y aplicaciones**, 4ª edición, McGraw-Hill, 2011
Çengel, Yunus A., **Heat and mass transfer: a practical approach**, 4th ed, McGraw-Hill, 2011
Complementary Bibliography
Çengel Y.A., **Introduction to Thermodynamics and Heat Transfer**, McGraw-Hill, 2008
Moran M.J. y Shapiro H.N., **Fundamentos de Termodinámica Técnica**, 2ª edición - castellano, Ed. Reverté, 2004
Merle C. Porter y Craig W. Somerton, **Termodinámica para ingenieros**, McGraw-Hill/Interamericana de España, 2004
Incropera F.P. y DeWitt D.P, **Introduction to Heat Transfer**, 2002
Wark, K. y Richards, D.E., **Termodinámica**, McGraw-Hill, 2010
Kreith J. y Bohn M.S, **Principios de Transferencia de Calor**, 2001,
Mills A.F., **Transferencia de calor**, 1995

Recommendations

Subjects that it is recommended to have taken before

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

Other comments

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

Given the limitation of time for the "Thermodynamic and 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.

Contingency plan

Description

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

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching Methodologies maintained
UNCHANGED

* Teaching Methodologies modified
If the classroom attendance is suspended, the teaching methodologies (master class, seminars, problem classes, supervised work, presentations, etc.) will be carried out through the virtual means that the University of Vigo makes available to teachers to such an effect.

* Non-attendance mechanisms for student attention (tutoring):
The attention to the students in tutorials will be carried out at fixed and published time of the tutorials but through an "appointment" managed by email. In this way the tutoring will be carried out through the virtual means that the University of Vigo proposes and enables the teaching staff for this purpose, see virtual office of the teacher in Campus Remoto

* Modifications (if they proceed) of the contents to give
UNCHANGED

* Additional bibliography to facilitate self-learning:
None

* Other modifications:
None

=== ADAPTATION OF THE EVALUATION ===

In case to exist a situation of sanitary alarm and by part of the competent authority (sanitary administrations and the own institution of Rectorado) decree the no classroom attendance, is possible that splits of the educational contents evaluate by means of other tasks that will have a weight of 20%, what does that the evaluation of the course remain with the following percentages:

Tests "Objective questions exam" -> 20%

Tests "Problem and/or exercise solving" -> 60%

"Additional Tasks" -> 20%

IDENTIFYING DATA				
Fundamentos de electrotecnia				
Subject	Fundamentos de electrotecnia			
Code	V12G380V01303			
Study programme	Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2	1c
Teaching language	Castelán			
Department	Enxeñaría eléctrica			
Coordinator	Albo López, María Elena			
Lecturers	Albo López, María Elena Parajo Calvo, Bernardo José Sueiro Domínguez, José Antonio			
E-mail	ealbo@uvigo.es			
Web	http://moovi.uvigo.gal/			
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	
CG3	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.
CE10	CE10 Coñecemento e utilización dos principios de teoría de circuítos e máquinas eléctricas.
CT1	CT1 Análise e síntese.
CT2	CT2 Resolución de problemas.
CT6	CT6 Aplicación da informática no ámbito de estudo.
CT10	CT10 Aprendizaxe e traballo autónomos.
CT14	CT14 Creatividade.
CT16	CT16 Razoamento crítico.
CT17	CT17 Traballo en equipo.

Resultados de aprendizaxe			
Learning outcomes		Competences	
Comprender os aspectos básicos do funcionamento dos circuítos e as máquinas eléctricas.	CG3	CE10	
Coñecer o proceso experimental utilizado cando se traballa con circuítos eléctricos e máquinas eléctricas			CT1 CT2
Coñecer as técnicas actuais dispoñibles para a análise de circuítos eléctricos		CE10	CT6
Coñecer as técnicas de medida de circuítos eléctricos			CT6 CT10
Adquirir habilidades sobre o proceso de análise de circuítos eléctricos			CT1 CT2 CT10 CT14 CT16 CT17

Contidos	
Topic	
INTRODUCIÓN.	Carga, corrente, potencial eléctrico, enerxía e potencia eléctrica, lei de Ohm, lei de Joule, leis de Kirchoff. Elementos Ideais. Asociación serie, paralelo de elementos ideais
ELEMENTOS REAIS.	Elementos Pasivos Reais (Resistencia, Bobina, Condensador)
FONTES E TEOREMAS FUNDAMENTAIS.	Modelos de Fontes Reais. Conversión de Fontes Reais. Teoremas Fundamentais: Linealidade, Substitución, Superposición, Thévenin e Norton.
MÉTODOS SISTEMÁTICOS DE ANÁLISES.	Nós e mallas

REGIMEN ESTACIONARIO SENOIDAL	Formas de onda e parámetros asociados, fasores, impedancias/admitancias. Asociación de impedancias/admitancias. Comportamento dos elementos no R.E.S
POTENCIA E ENERXÍA EN R.E.S	Potencias: complexa, activa, reactiva, aparente. Teorema de Boucherot. Factor de Potencia. Compensación de Potencia Reactiva
SISTEMAS TRIFÁSICOS EQUILIBRADOS	Valores de liña e fase. Redución ao monofásico equivalente. Potencia. Medida de Potencia Activa e Reactiva
TRANSFORMADORES MONOFÁSICOS E TRIFÁSICOS.	Constitución, circuíto equivalente, índice horario.
MÁQUINAS ASÍNCRONAS	Constitución. Xeración do campo xiratorio. Circuíto Equivalente. Curvas Características. Manobras
MAQUINAS DE ALTERNA MONOFÁSICAS	Constitución. Principio de funcionamento. Aplicacións.
MAQUINAS SÍNCRONAS.	Constitución. Funcionamento en baleiro e en carga. Sincronización.
MÁQUINAS DE CORRENTE CONTINUA.	Constitución. Circuítos Equivalentes. Curvas características
PRÁCTICAS	INTRODUCIÓN E SEGURIDADE 1. Descrición do laboratorio. Seguridade eléctrica 2. Equipos de medida (polímetro, pinza amperimétrica, vatímetro dixital, osciloscopio dixital, analizador de rede) e de xeración (fonte DC, fonte AC, fonte trifásica) utilizados no laboratorio. Métodos para realizar as medidas de tensión, intensidade, potencia con efectividade e seguridade. BLOQUE TEORÍA DE CIRCUÍTOS 3. Asociacións de elementos. Equivalencia estrela-triángulo. 4. Elementos Reais: resistencia, bobina núcleo aire, bobina núcleo ferro, condensador, transformador. 5. Circuíto RLC serie e paralelo. Media de tensións, intensidades, potencias. Determinación de Impedancia/Admitancia Equivalente. 6. Compensación de Reactiva en Circuítos RL serie e paralelo. 7. Sistema trifásico equilibrado. Concepto de valores de liña e fase. Medida de Potencias en cargas trifásicas. BLOQUE MÁQUINAS ELÉCTRICAS 8. Ensaios na máquina asíncrona trifásica. Determinación do circuíto equivalente 9. Máquinas de corrente continua. Constitución e principio de funcionamento. Aplicacións

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	22	44	66
Resolución de problemas	10	10	20
Prácticas de laboratorio	20	10	30
Resolución de problemas de forma autónoma	0	20	20
Exame de preguntas de desenvolvemento	4	0	4
Informe de prácticas, prácticum e prácticas externas	0	10	10
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente

	Description
Lección maxistral	O profesor exporá nas clases de aula os contidos da materia.
Resolución de problemas	Exporanse e resolverán problemas e exercicios tipo nas clases de aula como guía para o alumnado.
Prácticas de laboratorio	Realizaranse no laboratorio montaxes prácticas correspondentes aos contidos vistos na aula, ou ben se tratarán aspectos complementarios non tratados nas clases teóricas.
Resolución de problemas de forma autónoma	É moi aconsellable que o alumno trate de resolver pola súa conta exercicios e cuestións da materia propostos polo profesorado.

Atención personalizada

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

Avaliación					
	Description	Qualification	Evaluated Competencess		
Lección maxistral	Avaliarase o nivel de seguimento por parte do alumnado dos contidos da materia. A este efecto desenvolveranse durante o curso polo menos dúas probas curtas a realizar descontando o tempo do dedicado ás clases de aula. Cada proba constará dun conxunto de pequenos exercicios para os cales cada alumno/a proporá unha resposta, si é correcta (e o exercicio está resolto/xustificado) conta como un acerto e si é errónea ou se deixa en branco non puntúa, cada proba valórase entre 0 e 10 puntos. A avaliación das probas curtas é a media aritmética das puntuacións obtidas, está comprendida entre 0 e 10. A primeira desas probas comprende até Métodos Sistemáticos de Análises e a segunda inclúe R.E.S. en sistemas monofásicos e trifásicos. En caso de realizarse algunha outra proba, o profesor/a determinará os contidos a avaliar.	30	CG3	CE10	CT1 CT2 CT10 CT16
Exame de preguntas de desenvolvemento	O exame constará de dous problemas, un deles da parte de Teoría de Circuítos e outro da parte de Máquinas Eléctricas. Cada sección avaliarase entre 0 e 10 puntos esixíndose un mínimo de 3 puntos en cada unha delas para poder aprobar a materia.	60	CG3	CE10	CT1 CT2 CT6 CT10 CT14 CT16
Informe de prácticas, prácticum e prácticas externas	Valorarase a realización das prácticas e a resolución dun cuestionario referido á montaxe, resultados obtidos e interpretación dos mesmos. A non asistencia á práctica leva asociada a cualificación de cero puntos na práctica, independentemente que o estudante entregue o correspondente cuestionario/informe.	10	CG3	CE10	CT1 CT2 CT6 CT10 CT14 CT16 CT17

Other comments on the Evaluation

A nota numérica final obtense pola media ponderada dos elementos anteriores:

Nota = 0,3 * Probas curtas + 0,1 * Prácticas + 0,6 * Exame

Se pola 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 exame final, a nota máxima será de 4,5 puntos. .

AVALIACIÓN CONTINUA:

Tanto a realización das probas, como a asistencia ás prácticas e entrega dos cuestionarios dos mesmos, son actividades de avaliación continua, avaliando a primeira con ata 3 puntos ea segunda con ata 1 punto na nota final.

Na facultade desta materia considérase xustificado que o alumno poida realizar un exame final con opcións para aspirar ao grao máis alto posible, para que os estudantes que desexen mellorar a cualificación correspondente á avaliación continua poidan facer un exame adicional despois do exame. xeral, que incluirá cuestións relacionadas cos contidos tanto da docencia de clase como de laboratorio, e que pode ser ata o 40% da cualificación final coa mesma distribución que se outorga na avaliación continua, nese exame adicional pode recuperar unha das partes ou ambas. En caso de facelo, a nota que se terá en conta para avaliar as actividades de avaliación continua será a nota máis alta obtida (durante o curso / exame adicional).

O alumno que desexe renunciar ás actividades correspondentes á avaliación continua ten un prazo para facelo fixado pola dirección da escola, nese caso a nota máxima que se pode esperar co exame final é de 6,0 puntos sobre 10, con todo, pode aumentar a súa cualificación realizando o exame adicional mencionado no parágrafo anterior.

Para a segunda oportunidade de xuño a xullo mantense a cualificación na avaliación continua obtida na primeira oportunidade, sen prexuízo de que, como na primeira oportunidade de decembro a xaneiro, pódese superar coa realización do exame adicional que é propoñer a tal efecto. A nota que se terá en conta para avaliar as actividades de avaliación continua será a nota máis alta obtida.

Cada nova matrícula na materia implica unha redución a cero das cualificacións nas actividades de avaliación continua obtidas nos cursos anteriores.

Compromiso ético:

Estudante deberá presentar un comportamento ético axeitado. En caso de detectar un comportamento non ético (copia, plaxio, uso de dispositivos electrónicos non autorizados, por exemplo) considerarase que o alumno non cumpre os requisitos necesarios para aprobar a materia. Dependendo do tipo de comportamento non ético detectado, poderíase concluír que o alumno non alcanzou as competencias B2, B3 e CT19.

Bibliografía. Fontes de información

Basic Bibliography

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

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

Complementary Bibliography

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

Gómez Expósito, Martínez Ramos y otros, **FUNDAMENTOS DE TEORÍA DE CIRCUITOS**, 2007,

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

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

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

Recomendacións

Subjects that continue the syllabus

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

Subjects that it is recommended to have taken before

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

Other comments

É moi recomendable que os alumnos teñan coñecementos suficientes da álxebra dos números complexos e coñecementos básicos de teoría de circuítos:

 En concreto, esta materia parte e apóiase dos contidos estudados en Física II, realizando un mero repaso no primeiro tema Introdución daqueles aspectos relacionados directamente coa Teoría Circuítos, primeiro bloque didáctico de Fundamentos de Electrotecnia. É por tanto recomendable, para o correcto seguimento da materia, ter aprobada Física II.
 Por outra banda, todo o cálculo en R.E.S., que abarca o 80% do curso, realízase aplicando operacións de números complexos (suma, resta, multiplicación, división, conxugado.), por tanto é fundamental dominar a álxebra de números complexos (Matemáticas I) para poder seguir adecuadamente esta materia.

Por todo iso, é conveniente superar as materias dos cursos inferiores ao curso en que está situado esta materia, especialmente Matemáticas I e Física II, antes de matricularse de Fundamentos de Electrotecnia.

Plan de Continxencias

Description

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

=== ADAPTACIÓN DAS METODOLOXÍAS ===
* Metodoloxías docentes que se manteñen
En caso de docencia virtual ou mixta, mantéñense as mesmas metodoloxías docentes que en docencia presencial utilizando os medios telemáticos que a Universidade pon a disposición do profesorado e do alumnado (Faitic, Campus Remoto e/oCampus Integra, programas informáticos, etc.)

* Metodoloxías docentes que se modifican
As prácticas de laboratorio substitúense por tarefas usando gravacións de prácticas reais ou programas informáticos de simulación eléctrica.

* Mecanismo non presencial de atención ao alumnado (tutorías)
As tutorías, en caso de docencia virtual ou mixta, desenvolveranse de forma telemática mediante o uso das ferramentas telemáticas dispoñibles (faitic, correo electrónico, Campus Remoto, Campus Integra, teléfono, etc.)

* Modificacións (si proceden) dos contidos a impartir
ningunha

* Bibliografía adicional para facilitar o auto-aprendizaxe
ningunha

* Outras modificacións
ningunha

=== ADAPTACIÓN DA AVALIACIÓN ===
* Probas xa realizadas
As probas presenciais realizadas manteñen o seu valor e peso na avaliación global

* Probas pendentes que se manteñen
As probas pendentes de realizarse mantéñense co seu valor e peso na avaliación global, realizándose a través das distintas ferramentas postas a disposición do profesorado e alumnado (faitic, correo electrónico, Campus Remoto,
Campus Integra, teléfono, etc.)

* Probas que se modifican
ningunha

* Novas probas
ningunha

* Información adicional
Mantéñense os criterios de avaliación adecuados á realización das probas, no caso de ser necesario e por indicación en Resolución Reitoral, usando os medios telemáticos postos a disposición do profesorado

IDENTIFYING DATA				
Fundamentals of manufacturing systems and technologies				
Subject	Fundamentals of manufacturing systems and technologies			
Code	V12G380V01305			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Diéguez Quintas, José Luís			
Lecturers	Areal Alonso, Juan José Ares Gómez, José Enrique Diéguez Quintas, José Luís Fenollera Bolíbar, María Inmaculada Pérez García, José Antonio			
E-mail	jdieguez@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	The educational aims of Foundations of Systems and Technologies of Manufacture, in his fundamental and descriptive appearances, centre in the study and the application of scientific knowledges and technicians related with the processes of manufacture of components and conjoint whose functional purpose is mechanical, as well as the evaluation of his dimensional precision and the one of the products to obtain, with a determinate quality. All this including from the phases of preparation until the ones of utilisation of the instruments, the tools, toolings, teams, machines tool and necessary systems for his realisation, in accordance with the norms and specifications established, and applying criteria of optimisation. To reach the aims mentioned will give the following thematic educational: - Foundations of dimensional metrology. Measure of length, angles, forms and elements of machines. - Study, analysis and evaluation of the dimensional tolerances. Chain of tolerances. Optimisation of the tolerances. Systems of adjust and tolerances. - Processes of conformed of materials by means of start of material, operations, scheme, teams and tooling - Processes of conformed by means of plastic deformation, operations, scheme, teams and tooling - Processes of conformed by *moldeo, operations, scheme, teams and tooling - Processes of conformed no conventional, operations, scheme, teams and tooling. - Conformed of polymers, and other no metallic materials, operations, scheme, teams and tooling - Processes of union and assembling, operations, scheme, teams and tooling - Foundations of the programming of scheme with *CNC, used in the mechanical manufacture.			

Competencies	
Code	
CG3	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.
CE15	CE15 Basic knowledge of production systems and manufacturing.
CT2	CT2 Problems resolution.
CT8	CT8 Decision making.
CT9	CT9 Apply knowledge.
CT10	CT10 Self learning and work.
CT17	CT17 Working as a team.
CT20	CT20 Ability to communicate with people not expert in the field.

Learning outcomes			
Learning outcomes		Competences	
(*)		CE15	CT2 CT9 CT10 CT20
New	CG3	CE15	CT2 CT10
New		CE15	CT2 CT8 CT17

New	CG3	CE15	CT2 CT8 CT9 CT17 CT20

Contents	
Topic	
DIDACTIC UNIT 1. INTRODUCTION To THE TECHNOLOGIES And SYSTEMS OF MANUFACTURE.	Lesson 1. INTRODUCTION To THE ENGINEERING OF *FABRICACION. The productive cycle. Classification of industries. Technologies of manufacture.
DIDACTIC UNIT 2. *METROTECNIA.	Lesson 2. PRINCIPLES OF DIMENSIONAL METROLOGY. Introduction. Definitions and concepts. The International System of Units. Physical magnitudes that covers the Dimensional Metrology. Elements that take part in the measurement. Classifications of the methods of measure. Patterns. The chain of *trazabilidad. *Calibración. Uncertainty. Chain of *calibración and transmission of the uncertainty. Relation between tolerance and uncertainty. Expression of the uncertainty of measure in *calibración. Lesson 3. INSTRUMENTS And METHODS OF MEASURE. Introduction. Patterns. Instruments of verification. Patterns *interferométricos. Principles of *interferometría. Instruments of direct measure. Methods and instruments of indirect measure. Lesson 4. MEASUREMENT BY COORDINATES. MEASUREMENT BY IMAGE. SUPERFICIAL QUALITY. Machines of measurement by coordinates. Concept. Principles of the MMC. Classification of the machines. Main components of the MMC. Process to be followed for the development of a measure. Systems of measurement by image. Superficial quality. Methods of measure of the *rugosidad. Parameters of *rugosidad.
DIDACTIC UNIT 3. PROCESSES OF CONFORMED BY START OF MATERIAL	Lesson 5. INTRODUCTION To THE CONFORMED BY START OF MATERIAL. Introduction. Movements in the process of start of material. Factors to take into account in the election of the tool. Geometry of tool. Materials of tool. Mechanism of training of the shaving. Types of shavings. Power and strengths of court. Wear of tool. Criteria of wear of tool. Determination of the life of the tool. Flowed of court. Lesson 6. TURNING: OPERATIONS, SCHEME And TOOLING. Introduction. Main operations in lathe. The machine-tool: the lathe. Main parts of the lathe. Setting or subjection of pieces. Typical tools of the lathe. Special lathes. Lesson 7. MILLED: OPERATIONS, MACHINES And TOOLING. Introduction. Description and classification of the operations of milled. Parts and main types of *fresadoras. Types of strawberries. Setting of the tool. Subjection of pieces. Different configurations of *fresadoras. *Fresadoras Special. Lesson 8. MECHANISED OF HOLES And WITH RECTILINEAR MAIN MOVEMENT: OPERATIONS, MACHINES And TOOLING. Introduction to the operations of mechanised of holes. Punches. *Mandrinadoras. General characteristics of the processes of mechanised with rectilinear main movement. *Limadora. *Mortajadora. *Cepilladora. *Brochadora. Saws. Lesson 9. CONFORMED WITH ABRASIVE: OPERATIONS, MACHINES And TOOLING. Introduction to the operations of mechanised of holes. You grind abrasive. Operation of rectified. Types of *rectificadoras. *Honeado. *Lapeado. Polishing. Burnished. *Superacabado Lesson 10. PROCESSES OF MECHANISED NO CONVENTIONAL. Introduction. The mechanised by electroerosion or *electro-download. Mechanised electrochemical. Mechanised by laser. Mechanised by *chorro of water. Court by arch of plasma. Mechanised by ultrasounds. Milled chemist.

DIDACTIC UNIT 4. AUTOMATION And MANAGEMENT OF THE PROCESSES OF MANUFACTURE.	Lesson 11. NUMERICAL CONTROL OF MACHINES TOOL. Introduction. Advantages of the application of the *CN in the machines tool. Necessary information for the creation of a program of *CN. Manual programming of *MHCN. Types of language of *CN. Structure of a program in code ISO. Characters employed. Preparatory functions (G__). Auxiliary functions (M__). Interpretation of the main functions. Examples. Automatic programming in numerical control.
DIDACTIC UNIT 5. PROCESSES OF CONFORMED OF MATERIALS IN LIQUID STATE And GRANULATE.	Lesson 12. GENERAL APPEARANCES OF THE CONFORMED BY FOUNDRY OF METALS. Introduction. Stages in the conformed by foundry. Nomenclature of the main parts of the mould. Materials employed in the conformed by foundry. Flow of the fluid in the system of feeding. Solidification of the metals. Contraction of the metals. The *rechupe. Procedure of calculation of the system distribution of *colada. Considerations on design and defects in pieces melted. Lesson 13. PROCESSES OF MANUFACTURE BY FOUNDRY. Classification of the processes of foundry. *Moldeo In sand. *Moldeo In shell. *Moldeo In plaster. *Moldeo In ceramics. *Moldeo To the CO2. *Moldeo To the stray wax Foundry in full mould. *Moldeo *Mercast. *Moldeo In permanent mould. Foundry injected. Foundry *centrifugada. Ovens employed in foundry. Lesson 14. METALLURGY OF DUSTS (*PULVIMETALURGIA). Introduction. Manufacture of the metallic dusts. Characteristics and properties of the metallic dusts. Dosage and mix of metallic dusts. *Compactación. *Sinterizado. Ovens of sintering. *Sinterizado By download *disruptiva. *Presinterizado. Back operations. Considerations of design. Products *obtenibles by sintering. Lesson 15. CONFORMED OF PLASTICS. Introduction. Polymeric material classification. Physical properties of polymers. Classification of the processes. *Moldeo By extrusion. *Moldeo By injection. *Moldeo By compression. *Moldeo By transfer. *Moldeo Rotational. *Termoconformado.
DIDACTIC UNIT 6. PROCESSES OF CONFORMED BY UNION.	Lesson 16. PROCESSES OF WELDING. Introduction to the processes of welding. Welding with electrical arch. Welding by resistance. Welding with oxygen and gas fuel .Welding with temperature of fusion of metal of lower contribution that the one of the metals to join. Lesson 17. PROCESSES OF UNION And SETTING WITHOUT WELDING. Processes of union by means of adhesive. Resistance to the adhesion. Conditions for the hit. Design of unions Types of adhesive according to origin and composition. Processes of mechanical union. Removable mechanical unions and permanent.

DIDACTIC UNIT 7. PROCESSES OF CONFORMED BY PLASTIC DEFORMATION OF METALS.	Lesson 18. GENERAL APPEARANCES OF THE CONFORMED BY PLASTIC DEFORMATION. Introduction. Curves of effort-deformation. Expressions of the deformation. Proof of the volume. Approximate models of the curve encourage real-natural deformation. State of flat deformation. Primary and secondary processes. Processes of work in hot and in cold. Conditions and control of the process. Lesson 19. PROCESSES OF *LAMINACIÓN And FORGES. *Laminación: Foundations; temperature of *laminación; teams for the *laminación in hot; characteristics, quality and tolerances of the products *laminados in hot; *laminación in cold. It forges: free; in matrix of impression; in press; by *recalcado; header in cold; by *laminación; in cold. Lesson 20. EXTRUSION, *EMBUTICIÓN And AFFINE. Extrusion. Pulled of bars and tubes. *Trefilado. Reduction of section. *Embutición. *Repujado In lathe. Attainable pieces by *repujado: considerations of design. Forming by pulled. Forming with pads of rubber and with liquid to pressure. Forming to big power. Lesson 21. CONFORMED OF METALLIC SHEET. *Curvado Or bent of sheets. *Curvado With rollers. Conformed with rollers. *Enderezado. *Engatillado. Operations of cut of sheet.
PROGRAM OF PRACTICES	Practice 1.- Utilisation of the conventional devices of metrology. Measurement of pieces using foot of normal king and of depths and micrometer of outsides and inner. Employment of clock comparator. *Comprobación Of flat surfaces. Use of calibrate raisin/does not happen, rules, squares and *calas pattern. Measurement and *comprobación of threads. Realisation of metric measurements and in English units. Practice 2.-Indirect measurements. *Comprobación Of a cone using rollers and a foot of king, measurement of a tail of *milano using rollers, measurement of the angles of a double tail of *milano and measurements using a rule of breasts. Direct measurements with goniometer. Practice 3.- Machine of measurement by coordinates. Establish a system of coordinates. Check measures in piece, using a machine to measure by coordinates. Verify tolerances forms and position. Practice 4.- Manufacture with machines conventional tools. Manufacture of a piece employing the lathe, the *fresadora and the *taladro conventional, defining the basic operations and realising them on the machine. Practice 5.- Selection of conditions of computer-aided court. Realisation of leaves of process of three pieces using program of planning of Practical computer-aided processes 6, 7 and 8.- Initiation to the numerical control applied to the lathe and to the *fresadora. Realisation of a program in *CNC using a simulator, with the main orders and simpler; realising at the end diverse pieces so much in the lathe as in the *fresadora of the classroom workshop. Practice 9.- Welding. Knowledge of different teams of electrical welding. *Soldeo Of different materials employed the technicians of electrode *revestido, *TIG and *MIG.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	0	32.5
Laboratory practical	18	0	18
Objective questions exam	0	2	2
Laboratory practice	0	50	50

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

Methodologies

Description

Lecturing	The theoretical classes will realise combining the explanations of blackboard with the employment of videos and presentations of computer. The purpose of these is to complement the content of aim them, interpreting the concepts in these exposed by means of the sample of examples and the realisation of exercises.
Laboratory practical	The practical classes of laboratory will realise in 9 sessions of 2 hours, except the students of the course bridge that will realise the practices in the 6 sessions that contemplates his particular schedule, in groups of 20 maximum students, and employing the available resources of instruments and machines, combining with the simulations by computer.

Personalized assistance

Methodologies	Description
Lecturing	
Laboratory practical	

Tests	Description
Objective questions exam	
Laboratory practice	

Assessment

	Description	Qualification	Evaluated Competencess
Objective questions exam	It TESTS TYPE To (for all the students -60% final note-) The character of this proof is written and face-to-face, is compulsory for all the students, with or without continuous evaluation. It will be composed this proof by 20 ask type test on the theoretical and practical contents. The assessment of tests it type test will realise in a scale of 6 points, what represents 60% of the total note, being necessary to obtain at least 2 points, so that together with the practical proofs can obtain at least 5 points and surpass the matter The note of this test will obtain adding 0,3 points by each properly answered question and will subtract 0,1 points if the question is resolved of wrong form. The questions in white do not mark.	60	CG3 CE15 CT8 CT9 CT10
Laboratory practice	It TESTS TYPE *B (continuous evaluation -30% final note-): Two test type test to realise in the schedule of class, consistent in 5 questions on the matter given until the moment, each correct question will cost 0,3 points and the wrong will subtract 0,1 points. The questions in white do not mark. Each proof will be therefore 15% of the final note. It TESTS TYPE C (continuous evaluation -10% final note-): A proof written or work to propose by the professor along the *cuatrimestre. This proof will value with a maximum of 1 point, 10% of the final note. These notes will add to the qualification of tests it type test, to be able to obtain at least 5 points and surpass the matter. It TESTS TYPE (renunciation to the continuous evaluation -40% final note-): Resolution of several practical problems, whose value will be 40% of the final note, or was at most 4 points, being necessary to obtain a minimum of 1 point in this second proof so that the qualification can add to the one of tests it type test, and if it equalises or surpasses 5 points, approve the matter. This tests type D, will realise it the students to which have conceded them the renunciation to the continuous evaluation, and will realise the same day that realise tests it compulsory test, after this have finalised.	40	CE15 CT2 CT8 CT9 CT10 CT17 CT20

Other comments on the Evaluation

<*p>APPROVED</*p><*p>Students described by means of continuous evaluation:</*p><*p>To surpass this matter is necessary at least obtain 5 points adding the punctuation of test them types □To□, □*B□ and □C□. </*p><*p>All the students in principle will have to follow the procedure of continuous evaluation, except those that on purpose renounce in the term and form that mark the school. </*p><*p>&*nbsp;Students described with renunciation conceded to the continuous evaluation:</*p><*p>To surpass this matter is necessary at least obtain 5 points adding the punctuation of test them types □To□ and □D□.</*p><*p>ASSISTANCE To PRACTICAL CLASSES</*p><*p>The assistance to practical classes is not compulsory, but will be always matter of examination the in them given.</*p><*p>ANNOUNCEMENT OF 2º EDITION</*p><*p>Students with continuous evaluation, qualification in the announcement of 2º edition: </*p><*p>&*nbsp;This second edition of the ordinary announcement will describe as the following way: </*p><*p>- By means of the realisation of the compulsory proof type □To□ </*p><*p>- conserve the qualifications of the two test type □*B□ in this 2ª opportunity, but will be able to , if it wishes , improve this qualification, by means of the repetition of these

test type □*B□ when finalising tests it type □To□.</*p><*p>- Will keep the punctuation reached in tests it type □C□ by maximum value of 1 point, but will be able to improve this note if it wishes by means of a proof written or work to propose by the professor, to deliver before the day of the announcement of this second edition.</*p><*p>To surpass this matter is necessary at least obtain 5 points adding the three previous proofs. </*p><*p>The notes of the proofs of continuous evaluation, corresponding to 40% of the final qualification, will not conserve of a course for another. </*p><*p>Students without continuous evaluation, qualification in the announcement of 2º edition: </*p><*p>The students that do not realise continuous evaluation, due to the fact that the centre has accepted them the renunciation, always will have to realise in all the announcements tests it type □To□ (by value of 6 points) and tests it type □D□ (by value of 4 points), in the terms specified in the previous sections. </*p><*p>To surpass this matter is necessary at least obtain 5 points adding the two previous proofs. </*p><*p>EXTRAORDINARY ANNOUNCEMENT: </*p><*p>This proof will be equal for all the students and will consist in one tests it type □To□ (by value of 6 points) and tests it type □D□ (by value of 4 points), in the terms specified in the previous sections. </*p><*p>To surpass this matter is necessary at least obtain 5 points adding the two previous proofs. </*p><*p>ETHICAL COMMITMENT:</*p><*p>expects that the present student a suitable ethical behaviour, free of fraud. 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).</*p>

Sources of information

Basic Bibliography

Complementary Bibliography

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

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

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

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

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

Recommendations

Subjects that continue the syllabus

Manufacturing engineering and dimensional quality/V12G380V01604

Subjects that are recommended to be taken simultaneously

Materials science and technology/V12G350V01305

Other comments

Requirements: To enrol of this matter is necessary to have surpassed or be enrolled of all the matters of the inferior courses to the course to the that is *emplazada this matter.

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

Contingency plan

Description

The contents and the results of learning will not owe to be modified for power guarantee the collected in the memories of the qualifications. It owes to treated to adjust the materials, tutorships and the teaching methodologies to treat to achieve these results. It treats of an aspect of big importance stop the overrun of the processes of the one who are subjected the different qualifications. And say, the plan of contingency owes to based in a development of the subject, adapting the methodologies and the materials, in the research of the fulfilment of the resulted of learning of all the students.

The teaching methodologies will impart , to be necessary, to the telematic means that put the disposal of the teaching staff, in addition to the documentation facilitated through FAITIC and other platforms, email, etc.

When it was not possible to presential sesions, in the measure of the possible, will prevail the contained theorists by telematic means as well as those contents of practices of resolution of problems, classroom of computing, and others, that can be virtuals or developed pole students of way guided, tried keep the presential stop the experimental practices of laboratory, always that the groups fulfil with the rule established in the moment by the authorities in sanitary subject and of security. In the case of no power be imparted of form presential, those contents no virtuals will impart or by others (autonomous work guided, etc.) Enabling achieve equally the competitions associated it they. The titorships will be able to developed indistinctly of form presential (always that it was possible to guarantee the sanitary measures) or telematic (and email and others) respecting or adapting the schedules of titorships due. it will do a adecuation methodological to the students of risk, facilitating him additional specific information, to accredit that can not have access to the contained imparted of conventional form.

Additional information envelope to evaluation: they will keep those proofs that already come realizing of telematic form and, in the measure of the possible, will keep the proofs presentials to the normative valid medic. The proofs will develop of form presential except Resolution Reitoral that indicate that they owe do of form non-presential, realizing gave way through the distinct tools put the disposal of the teaching staff. Those proofs no-don of telematic form by others (deliveries of autonomous work guided, etc.)

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

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

Learning outcomes	Competences		
To know the fundamentals of Mechanism and Machines Theory, and the application of these concepts concerning to the field of Mechanical engineering to solve problems related with this subject in the Industrial Engineering field.	CG3 CG4	CE13	CT2 CT6 CT9 CT10 CT16
To know, comprehend, apply, and practice the concepts related to Mechanism and Machines Theory.	CG3 CG4	CE13	CT2 CT6 CT9 CT10 CT16
To know and apply kinematic and dynamic analyses techniques to mechanical systems.	CG3 CG4	CE13	CT2 CT6 CT9 CT10 CT16
Efficiently know and utilize software for analysis of mechanisms.	CG3 CG4	CE13	CT2 CT6 CT9 CT10 CT16

Contents

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	23	19.5	42.5
Problem solving	9.5	30	39.5
Laboratory practical	18	47	65
Essay questions exam	3	0	3
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Master class where the theoretical concepts are explain
Problem solving	Problem solving using the theoretical concepts presented in the Master Lesson
Laboratory practical	Practical tasks developed at the teaching laboratory or computer lab.

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

Assessment					
	Description	Qualification	Evaluated Competencess		
Laboratory practical	Attendance and participation as well as practices reports, papers, and tests will be rated. However, to be evaluated, students must attend a minimum of 7 practice sessions; otherwise, students won't be evaluated and will get 0 points. Learning outcomes: all will be graded	20	CG3 CG4	CE13	CT2 CT6 CT9 CT10 CT16

Essay questions exam	Final and mid-term tests will be focused on the contents taught at classes and laboratory sessions. Learning outcomes: all will be graded.	80	CG3 CG4	CE13	CT2 CT9 CT10 CT16

Other comments on the Evaluation

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

- Laboratory Practical.
  - Students are required to attend and utilized the laboratory/Computer room. Practices reports, papers, and tests for each practice session as well as proposed works/papers from tutorials will be evaluated and graded with a maximum of 2 points of the final grade. This grade will be kept for the second term in the student's evaluation records (July). To be evaluated, students must attend a minimum of 7 practice sessions; otherwise, students won't be evaluated and will get 0 points.
  - For those students who have been officially granted the right to waive their continued evaluation, there will be a mandatory final test where they will be able to get a maximum grade of 2 points. However, an advanced request must be made to the professor to prepare the necessary materials for this test.
- Essay questions exam. It will have a maximum grade of 8 points.

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

Ethical commitment: An adequate ethical behaviour of the student is expected at all times. In case an unethical behaviour is detected (copying, plagiarism, unauthorized use of electronic devices, and others); the student will be considered unfit to meet the necessary requirements to pass the subject. In this case, the overall qualification in the current academic year will be a Fail grade (0.0).

The use of any electronic devices during tests is completely forbidden unless is specified and authorized. The fact of introducing unauthorized electronic devices in the examination room will be considered reason enough to fail the subject in the current academic year and the overall qualification will be a Fail grade (0.0).

Tests Schedule: This information can be found along with any updates at the center (university) webpage.

Sources of information

Basic Bibliography

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

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

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

Complementary Bibliography

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

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

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

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

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

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

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

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

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

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

Recommendations

Subjects that continue the syllabus

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

Subjects that it is recommended to have taken before

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

Other comments

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

Contingency plan

Description

In the event that attendance to classes become legally entirely or partially limited, the measures set on place will be:

1. To guarantee the necessary means, namely personal computer or internet access, to every enrolled student so they can follow the distance learning classes, appropriately. Therefore, to apply the appropriate solutions, any student who does not have any of these means should inform the course coordinator.

2. To inform students of the different measures adopted, the department will use the platform, Faitic.

3. On top of that, in the case of cancelation of face-to-face classes, the teaching guide will show the next modifications:
A. Competences. They will not be modified.
B. Learning outcomes. They will not be modified.
C. Contents. They will not be modified.
D. Planning. It will not be modified.
E. Methodology. It will be modified:
Lecturing and Problem solving. They will require the employment of electronic means (virtual classroom of the Remote Campus or others).
Laboratory Practices. The department will provide every student access to dynamic simulation software, so that they can carry out the practices remotely instead of from the Mechanical Engineering laboratory. The professor will supervise these practices using electronic means (virtual classroom of the Remote Campus or others).
F. Tutoring Lessons. They will be carried out by previously arranged electronic means.
G. Assessment. Assessment methodologies/test will not be modified: Laboratory practical and Essay questions exam. Description, qualification, and competences, they will not be modified. All exams will use electronic means (virtual classroom of the Remote Campus or others); the department will publish in advance the specific rules for each test in the platform, Faitic. According to attendance at the virtual practice sessions, the professor will compute and validate each practice attendance on virtual classroom of the Remote Campus.
Partial tests for the evaluation of specific contests of the subject can be proposed. Once again, the professor will publish in advance the rules concerning each test in the platform, Faitic.
H. Bibliography. Besides the bibliographical references found in this guide, the documentation provided at Faitic, and the problem bulletins and previous exams, the professor might facilitate additional notes, videos, web-references, and others, so that students can appropriately follow the course during the non-face-to-face classes.
This guide can be modified following Rectoral rules.

IDENTIFYING DATA				
Environmental technology				
Subject	Environmental technology			
Code	V12G380V01401			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	#EnglishFriendly Spanish Galician English			
Department				
Coordinator	Álvarez da Costa, Estrella			
Lecturers	Álvarez da Costa, Estrella Cameselle Fernández, Claudio Escudero Curiel, Silvia Moldes Menduíña, Ana Belén Moldes Moreira, Diego Moure Varela, Andrés Rosales Villanueva, Emilio Salgado Seara, José Manuel Yañez Diaz, Maria Remedios			
E-mail	ealvarez@uvigo.es			
Web	http://moovi.uvigo.gal			
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. Subject of the "English Friendly" program. International students may request the teachers Remedios Yañez Diaz, Diego Moldes Moreira and Claudio Cameselle Fernández (M2, M3 ad M5 groups, respectively): a) Materials and bibliographic references for the follow-up of the subject in English. b) Attend tutorials in English. c) Tests and evaluations in English.			

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

Learning outcomes	Competences
Basic knowledge and application of environmental technologies and sustainability	CE16 CT2 CT3 CT10 CT19
Problem solving	CE16 CT2 CT3 CT10 CT19

Oral and writing communication	CE16	CT2 CT3 CT10
Knowledge application to practical and real cases	CE16	CT2 CT3 CT10 CT19
Analysis and synthesis	CE16	CT1 CT2 CT3 CT9 CT10 CT12 CT17 CT19
Ability to analyze and determine the social and environmental impact of the technical solutions to environmental problems	CG7	CT1 CT3 CT9 CT10 CT17 CT19

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	26	52	78
Problem solving	11	22	33

Laboratory practical	12	12	24
Objective questions exam	1	0	1
Problem and/or exercise solving	2	0	2
Report of practices, practicum and external practices	0	6	6
Case studies	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
Lecturing	Teaching in the classroom of the key concepts and procedures for learning the syllabus contents
Problem solving	Solving exercises with the teacher's help and independently
Laboratory practical	Application of the knowledge acquired to the resolution of problems of environmental technology, using equipment and facilities available in the laboratory/computer room.

Personalized assistance

Methodologies	Description
Laboratory practical	In tutorials, students can consult with their teacher any questions about laboratory practices or the report of practices to be done. The tutoring schedule of the teaching staff will be public and accessible to the students.
Lecturing	In tutorials, students can consult with their teacher any questions arising in the lectures and related to the contents seen in them The schedule of tutorials of teachers will be public and accessible to students.
Problem solving	In tutorials, students can consult their teacher any questions about the resolution of problems raised in the classroom. The tutoring schedule of the teaching staff will be public and accessible to the students.

Assessment

	Description	Qualification	Evaluated Competencess		
Objective questions exam	"FINAL EXAM" consisting of theoretical questions related to the syllabus of the subject. CG7, CE16 and CT19 competences will be assessed in this exam, based on student responses to the questions. CT1, CT3 and CT10 competences are also evaluated, since the exam is written and requires students' analysis and synthesis skills.	30	CG7	CE16	CT1 CT3 CT10 CT19
Problem and/or exercise solving	"FINAL EXAM" consisting of problems related to the syllabus of the subject. CT2, CT9 and CT19 competences will be assessed in this exam, 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 are also evaluated, since the exam is written and requires students' analysis and synthesis skills.	30			CT1 CT2 CT3 CT9 CT10 CT19
Report of practices, practicum and external practices	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	CG7	CE16	CT1 CT3 CT9 CT10 CT12 CT17

Case studies	All exercises, seminars, practical cases and theoretical / practical tests that are made and delivered to the teacher throughout the course, related to the concepts and contents of the syllabus. Throughout a four-month time several tests are performed. Competences CG7 and CE16 will be assessed considering the students answers to the theoretical questions. Competences CT2, CT10 and CT12 will be assessed considering the students answers to the exercises. Competenci CT3 will be assessed base on the two parts of the exam: theory and exercises; considering the precision and clarity of the answers.	30	CG7 CE16	CT2 CT3 CT10 CT12	

Other comments on the Evaluation

Evaluation:

A student who choose continuous assessment, to pass the course, must achieve a **MINIMUN SCORE** of **4.0 points** (out of10) ***in each of the parts of the "FINAL EXAM"*** , ie, theory (Objective questions exam) and problems (Problem and/orexercise solving). If a student reaches the minimum grade in both parts of the "FINAL EXAM", to pass the subject must obtain a **FINAL GRADE** of **≥ 5.0**, that is, when the sum of grades of the "Practice report", "Case study" and the "FINAL EXAM" (Exam of objective questions + Problem solving and/or exercises) is ≥ 5.0.

Students who "*officially renounces continuous assessment*", will make a "FINAL EXAM" (Objective questions exam + Problemand/or exercise solving) 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 constituentparts 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 "Case studies" and "Practices report" are maintained, and students only have to repeat the "FINAL EXAM", ie, "Objective questions exam" + "Problem and/or exercise solving".

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

Ethical commitment:

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

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

Sources of information

Basic Bibliography

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

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

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

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

Complementary Bibliography

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

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

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

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

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

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

Sharma, H. D., and Reddy, K. R., **Geoenvironmental engineering: site remediation, waste containment, and emerging waste management technologies**, John Wiley & Sons, 2004
Wark and Warner, **Contaminación del aire: origen y control**, Limusa, 1996
Jonker, G. y Harmsen, J., **Ingeniería para la sostenibilidad**, Reverté, 2014
Azapagic, A. and Perdan S., **Sustainable development in practice: Case studies for engineers and scientists**, Wiley, 2011
Reddy, K.R., Cameselle, C. and Adams, J.A., **Sustainable Engineering: Drivers, Metrics, Tools, and Applications**, Wiley, 2019

Recommendations

Subjects that it is recommended to have taken before

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

Other comments

Recommendations:
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.

Contingency plan

Description

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

=== ADAPTATION OF THE METHODOLOGIES ===

* Teaching methodologies maintained
All teaching methodologies planned will be maintained, although they would be adapted to remote teaching.

The " lectures" would be online, via the Remote Campus, Faitic or any other platform that the University of Vigo wouldprovide to the academic staff.

Of all " laboratory practices " initially planned, those non-experimental ones would be maintained, while the others would bereplaced by on-line practices.

* Non-attendance mechanisms for student attention (tutoring)
Tutoring would be online, in the teacher's "virtual office" or by e-mail. In any case, students should previously arrange withtheir teacher (by e-mail) the tutoring date.

* Modifications (if applicable) of the contents
In a virtual context, the three experimental practices would be replaced by online ones, maintaining the same contents.

=== ADAPTATION OF THE TESTS ===

In a virtual context, no changes would be required in the assessment criteria, or in the weighting of each test, in relation towhat is established for a presential assessment. Nor would it be necessary to make any changes in the type of tests .

Therefore, the assessment criteria are maintained, adapting the tests, if necessary and as indicated in the Rector's Resolution, to the telematic resources made available to the teaching staff

IDENTIFYING DATA				
Resistance of materials				
Subject	Resistance of materials			
Code	V12G380V01402			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Caamaño Martínez, José Carlos Riveiro Rodríguez, Belén			
Lecturers	Caamaño Martínez, José Carlos Cabaleiro Núñez, Manuel Caride Tesouro, Luís Miguel Fuentes Fernández, Eugenio Ignacio Lorenzo Mateo, Jaime Alberto Pereira Conde, Manuel Riveiro Rodríguez, Belén			
E-mail	jccaam@uvigo.es belenriveiro@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	Introduction to linear elastic materials, and analysis of internal loadings, stress and strain relationships. Study of the fundamentals of mechanics of materials and particularization for shafts and beam structures.			

Competencies	
Code	
CG3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
CG4	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.
CE14	CE14 Knowledge and use of the principles of strength of materials.
CT1	CT1 Analysis and synthesis
CT2	CT2 Problems resolution.
CT9	CT9 Apply knowledge.
CT10	CT10 Self learning and work.
CT16	CT16 Critical thinking.
CT17	CT17 Working as a team.

Learning outcomes	Competences		
To know the differences between rigid solid and elastic solid.	CG3	CE14	CT1
To know the stress and deformation states in a deformable solid and the relationship between them.	CG4		CT2 CT9
Apply the acquired knowledge to the determination of the maximum values of stress at a point of a deformable solid.			CT10 CT16
T know the basic principles governing the Mechanics of Materials.			CT17
To know the relationships between the different stress resultants and the stresses.			
To apply the knowledge acquired to the determination of stress resultant diagrams.			
To apply the acquired knowledge about stresses applied to bar elements.			
To know the basics about deformations of bar elements.			
To apply the knowledge acquired to the dimensioning of bar elements.			

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

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

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	49	81.5
Laboratory practical	9	23	32
Project based learning	9	24.5	33.5
Essay questions exam	3	0	3

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

Methodologies

	Description
Lecturing	Lecture where theoretical principles are presented using digital media, videos and blackboard.
Laboratory practical	Activities of application of the knowledge to concrete situations and of acquisition of basic skills and procedural skills related with the subject of study.
Project based learning	Resolution of problems related to real case studies.

Personalized assistance

Methodologies	Description
Laboratory practical	The students can ask the lecturers for the clarification of those concepts presented in the lecturers and practicals, as well as to clarify / discuss any doubts that may appear after the end of the sessions. The tutoring sessions may be carried out by telematic means (Remote Campus, Faitic, etc.) under the modality of prior agreement.

Assessment

	Description	Qualification	Evaluated Competencess		
Laboratory practical	A) it will evaluate the attendance and active participation in all the practicals of the semester, as well as the correct delivery (time and form) of all the documentation requested (reports, exercises, etc.). Practical sessions will be held in a fixed date, so it is not possible to attend the practical in a later date. Whether the student does not attend to a practical, he/she must demonstrate that the absence was due to unavoidable reasons (e.g. medical reasons). Practicals will marked with the value indicated, only when the student reaches the minimum mark in the written exam, which is 45%. (See following section: 'Other comments')	2.5	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16 CT17

Project based learning	C) Written tests to evaluate the individual work delivered by the student. It will be compulsory the attendance to the 90% of the practicals to obtain the marks given in section C. The marks obtained in the sections A will proportionally affect to the marks of the section C. The section C will be marked with a maximum value of 12,5% of the total mark, only when the student reach the minimum mark in the written exam, which is 45%. (See following section: 'Other comments')	12.5	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16
Essay questions exam	Written exam in the dates established by the School.	85	CG3 CG4	CE14	CT1 CT2 CT9 CT10 CT16

Other comments on the Evaluation

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

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

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

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

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

Sources of information

Basic Bibliography

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

Manuel Vázquez, **Resistencia de materiales**,

Complementary Bibliography

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

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

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

Recommendations

Other comments

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

Contingency plan

Description

=== ADAPTATION OF THE ASSESSMENT ===
* Teaching methodologies that do not change
All the methodologies keep being the same as they can be held using the Campus Remoto platform complemented with faitic:
- Lecturing
- Project based learning
- Laboratory practical (only if mix teaching is adopted)

* Teaching methodologies to be modified
- "Laboratory practical" will be substituted by "Systematic observation", which will be measured by carrying out experiments or reports that the students can carry out from their homes. The periodicity would be weekly and of temporary dedication equivalent to the laboratory practices.

* Non-attendance mechanisms for students personal attention (tutoring)
The tutoring will be carried out by email to the teacher of the subject, who will be able to solve the doubts by email, or invite the student to participate in a tutorial through the remote teaching tools, Remote Campus, Teams, etc.).

* Changes in the contents (if applicable)
No modification in the contents is envisaged.

* Additional bibliography
Detailed notes will be provided to complement the material presented in the classes taught through the Remote Campus.

* Other

=== ADAPTACIÓN DE LA EVALUACIÓN ===
* Tests that are modified
[Laboratory practical] => [Systematic observation] [5%]
(this correspond to mark "A", in the formula for continuos assessment)

[Project based learning]=> [Resolution of exercises] [10%]
(this correspond to mark "C", in the formula for continuos assessment)

The Continuous Assessment Mark (NAC), will be calculated as follows: NAC = (0'5·A) + 1,0 (C)·A; where A y C: 0-1.

[Essay question exam] => [Essay question exam] [50%]

* New Tests
[objective questions exam][35%]
Throughout the course, questionnaires will be carried out for the subjects previously taught, so that the subject can be monitored using telematic means.

* Additional information

IDENTIFYING DATA				
Fundamentals of automation				
Subject	Fundamentals of automation			
Code	V12G380V01403			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Type	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://moovi.uvigo.gal/			
General description	In this matter present the basic concepts of the systems of industrial automation and of the methods of control, considering like central elements of the same the programmable programmable logic controller and the industrial controller, respectively.			

Competencies	
Code	
CG3	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.
CE12	CE12 Know the fundamentals of automation and control methods.
CT2	CT2 Problems resolution.
CT3	CT3 Oral and written proficiency.
CT6	CT6 Application of computer science in the field of study.
CT9	CT9 Apply knowledge.
CT16	CT16 Critical thinking.
CT17	CT17 Working as a team.
CT20	CT20 Ability to communicate with people not expert in the field.

Learning outcomes	Competences		
Purchase a global and realistic vision of the current scope of industrial automation systems.	CG3	CE12	CT17 CT20
Know which are the constitutive elements of an industrial automation system, its sizing and as they work.	CG3	CE12	CT2 CT6 CT20
Knowledge applied on the programmable logic controllers, its programming and its application to industrial automation systems.	CG3	CE12	CT2 CT6 CT9 CT16 CT17
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.	CG3	CE12	CT3 CT6 CT17 CT20
General concepts of the technicians of industrial controllers tuning.	CG3	CE12	CT2 CT9 CT16

Contents
Topic

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

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Laboratory practical	18	30	48
Problem solving	0	15	15
Lecturing	32.5	32.5	65
Essay questions exam	3	19	22

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

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

Personalized assistance

Methodologies	**Description**
Lecturing	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed). For all teaching modalities, the tutoring sessions may be carried out by telematic means (email, videoconference, FAITIC forums, ...) under the modality of prior agreement.
Laboratory practical	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). For all teaching modalities, the tutoring sessions may be carried out by telematic means (email, videoconference, FAITIC forums, ...) under the modality of prior agreement.
Problem solving	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed). For all teaching modalities, the tutoring sessions may be carried out by telematic means (email, videoconference, FAITIC forums, ...) under the modality of prior agreement.
Tests	**Description**
Essay questions exam	For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed). For all teaching modalities, the tutoring sessions may be carried out by telematic means (email, videoconference, FAITIC forums, ...) under the modality of prior agreement.

Assessment

	Description	Qualification	Evaluated Competencess		
Laboratory practical	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	CG3	CE12	CT3 CT6 CT9 CT16 CT17 CT20
Essay questions exam	Final examination of the contents of the matter, that will be able to include problems and exercises, with a punctuation between 0 and 10 points.	80	CG3	CE12	CT2 CT3 CT16

Other comments on the Evaluation

- Continous Assesment of student work practices along established laboratory sessions will be held in the semester, with the assistance to them mandatory. In the case of not overcome, a review of practices, conditioned to having passed the script test, will take place in the second call, on a date after the script test, in one or more sessions and including the contents not passed in ordinary practice sessions.

- The assesment of the practices for students who officially renounces Continuous Assesment will be carried out in a review of practices, conditioned to having passed the script test, in the two calls, on a date after the script test, in one or more sessions and including the same contents of the ordinary practice sessions..
- It may demand previous requirements to the realisation of each practice in the laboratory, so that they limit the maximum qualification to obtain.
- It must pass both tests (script and practices) to pass the matter, give the total score at the rate indicated above. In case of no longer than two or one test, scaling may be applied to partial notes that the total does not exceed 4.5.
- In the final exam may establish a minimum score on a set of issues to overcome.
- In the second call of the the same course, students should examine the tests (script and/or practices) not passed in the first one, with the same criteria of that.
- According to the Rule of Continuous Assesment, the subject students to Continuous Assesment that present to some activity evaluable collected in the Teaching Guide of the matter, will be considered like "presented".
- Ethical commitment: student is expected to present an adequate ethical behavior. If you detect unethical behavior (copying, plagiarism, unauthorized use of electronic devices, and another ones), it follows that the student does not meet the requirements for passing the subject. In this case the global qualification in the present academic course will be of suspense (0.0).

Sources of information

Basic Bibliography

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

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

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

Complementary Bibliography

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

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

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

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

Recommendations

Subjects that continue the syllabus

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

Subjects that are recommended to be taken simultaneously

Electronic technology/V12G380V01404

Subjects that it is recommended to have taken before

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

Other comments

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

Contingency plan

Description

Considering the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University establishes an extraordinary planning that will be activated when the administrations and the institution determine it. It is based on safety, health and responsibility, and it guarantees teaching in an online or semi-presential modalities. These already planned measures will guarantee, at the required time, the development of teaching in a more agile and effective way, because they will be known in advance by students and teachers through the standardized tool for teaching guides DOCNET

=== ADAPTATION OF THE METHODOLOGIES ===

* Teaching Methodologies that keep

- Lecturing.
- Problem solving.

- Laboratory practices without use of instrumentation.

* Teaching methodologies that modify

- Laboratory practices with use of instrumentation: will be replaced by activities in virtualized environments.

* Adaptation of tutorial sessions and personalized attention

The tutorial sessions may be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement.

=== ADAPTATION OF THE EVALUATION ===

Keep the type of proofs and his weighting in the final qualification, adapting his realization to the circumstances.

IDENTIFYING DATA				
Electronic technology				
Subject	Electronic technology			
Code	V12G380V01404			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Nogueiras Meléndez, Andres Augusto			
Lecturers	Domínguez Gómez, Miguel Ángel Nogueiras Meléndez, Andres Augusto Pérez López, Serafín Alfonso Verdugo Mates, Rafael			
E-mail	aaugusto@uvigo.gal			
Web	http://moovi.uvigo.gal/			
General description	The objective of this course is to provide the students with the theoretical and practical fundamental knowledge in electronics' five main areas: analog electronics, digital electronics, industrial sensors, power electronics and communications electronics. In case of any discrepancy between this translation of the guide and the Spanish version, the valid one is the Spanish version.			

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

Learning outcomes	Competences			
Know the operation of the electronic devices.	CB2 CB4	CG1 CG3 CG13	CE11 CE12 CE20	CT2 CT2 CT3 CT4 CT5 CT6 CT9 CT10 CT10 CT12 CT15 CT17
Know the electronic systems of conditioning and acquisition of data.	CB2 CB4	CG1 CG13	CE11 CE12 CE20	CT2 CT3 CT4 CT5 CT6 CT10 CT10 CT12 CT15
Identify the different types of industrial sensors.				CT10
Know the digital electronic systems basic.			CE11	CT2 CT9 CT17

Know the electronic circuits for the communication of information.	CG1 CG3 CG3 CG10	CE16	CT10

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

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	25	0	25
Problem solving	8	0	8
Previous studies	0	49	49
Autonomous problem solving	0	46	46
Laboratory practical	18	0	18
Objective questions exam	1	0	1
Essay questions exam	3	0	3

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

Methodologies	
	Description
Lecturing	These sessions will be held in the rooms and dates fixed by the direction of the school. They will consist in an oral explanation by the professor of the most important parts of the course, all related with the materials that the student had to work previously. This is intended to favor the active participation of the students, that will have occasion to rise doubts and questions during the sessions. Active participation is desired during all the sessions.
Problem solving	During these sessions, in the classroom, interleaved with the lectures, the professor will proceed to solve examples and/or exercises that properly illustrate the problems to solve. As long as the number of participants in the classroom allows, active participation will be promoted.
Previous studies	Previous preparation of the theoretical sessions: Prior to the start of the theoretical sessions, the students will have available a series of materials that have to prepare, as the sessions will relay on them. Previous preparation of the laboratory sessions: It is mandatory that the students make all the assigned previous tasks prior to access the laboratory. These task are intended to greatly improve the laboratory knowledge acquisition. The achieved report will be taken into account when the laboratory session is to be evaluated.
Autonomous problem solving	Self study and review of the theoretical sessions for knowledge consolidation: The student must study, in a systematic time schedule, after each lecture session, in order to dissipate any doubts. Any doubts or unsolved questions will have to be expose to the professor as soon as possible in order to enhance the feedback of the learning process.
Laboratory practical	Laboratory sessions will be held in the time schedule established by the school's head teacher. Students will work in groups of two students each. The sessions will be supervised by a professor, who will control the assistance and will also evaluate the harnessing of it. During the laboratory sessionsthe students will make activities of the following kinds: - Assembling electronics circuits - Use of electronic instrumentation - Measure of physical variables on circuits - Do calculations related to the circuit and/or the measurements - Collect data and represent it (diagrams, charts, tables) At the end of each laboratory session each group will deliver the corresponding score sheets.

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

Assessment					
	Description	Qualification	Evaluated Competencess		
Laboratory practical	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		CE11	CT9 CT10 CT17
Objective questions exam	These partial tests evaluate part of the theoretical content of the subject. They will consist of individual objective tests related to a set of topics of the subject.	80	CG3	CE11	CT2 CT9 CT10

Essay questions exam	It will consist of an objective individual test where the entire content of the subject will be evaluated. It will be held at the end of the semester at the times established by the center's management.	80	CG3	CE11	CT2 CT9 CT10

Other comments on the Evaluation

EVALUATION AND GRADING OF THE SUBJECT

The evaluation of the subject is continuousand consists of the following elements:

Self assessment :

Associated with each topic there are severalself-assessment questionnaires. There are short questionnaires after each section or pill into which each topic is divided, and a larger and more comprehensive questionnaire at the end of each topic. These self-assessment questionnaires have no influence on the grade. The purpose of these questionnaires is to help students assess their level of knowledge about each of the topics. The answers of these questionnaires by the students provide valuable information to the teaching staff about those aspects of the subject in which the students find greater difficulties.

Laboratory sessions:

The evaluation of the laboratory sessions accounts for 20% of the course grade. The laboratory sessions are evaluated one by one, obtaining a grade for each session. The evaluation criteria are: attendance, punctuality, prior preparation and performance. The laboratory session grade (NP) will be obtained by averaging the grades of all the sessions, with the following requisites:

- A minimum attendance of 80% must be recorded, otherwise the laboratory grade will be zero.
- A minimum of 3.3 points in the grade of theory must be reached (NT), otherwise the laboratory grade will be zero.

Theory:

The evaluation of the theory part (NT) accounts for 80% of the course grade. For its evaluation, the subject will be divided into two parts (P1 and P2), each covering approximately 50% of the contents of the subject and three evaluation sessions will be held, distribute das follows:

First session: It will take place approximately in the middle of the semester. This session will exclusively evaluate P1.

Second session: It will be held on the date and time established by the center for the final exam in May. In this session each student will be able to take advantage of one of the following options:

- Incomplete option: Only P2 is examined. Students who have obtained a grade equal to or greater than 3.3 points in P1 may choose this option. If the grade obtained in P2 is equal to or greater than 3.3 points, the resulting grade will be NT = (P1 + P2) / 2. If the grade obtained in P2 is less than 3.3 points, NT will be calculated in the same way, but its maximum value will be limited to 3.6 points.
- Complete option: The student renounces the grade of P1 obtained in the first session and takes a complete exam (EC) of the entire theory. The grade will be NT = EC.

Third session: It will be done on the date and time established by the center for the final exam in July. In this session, the students will take a complete exam (EC). The grade will be NT = EC.

The final grade (NA) will be calculated asfollows: NA = 0.2x (NL) + 0.8x (NT)

Other considerations

For the present academic year, the laboratory qualifications of the two previous years will be kept and considered valid.

Those students to whom the management of thecenter grants the waiver of continuous evaluation will be evaluated, on the same day and time of the final exam established by the center (second and / or third session). The evaluation will consist of two tests: An exam in full modality (EC) with a weight of 80% on the final grade. A specific laboratory test, weighing 20% on the final grade. In principle, this specific test will be carried out after the written test in the electronic laboratories of the corresponding center's site.

In the extraordinary call End of Degre estudents will take a theory exam that will have a weight of 80% on the final grade. The remaining 20% will be obtained from the qualification of aspecific laboratory test.

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

Recommendations:

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

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

The students must meet the deadlines for all the activities.

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

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

Exams lacking some of the sheets will not be graded.

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

Competencies Acquisition and Its Influence on Assesments

In this subject all the different activitiesare designed to assess the students in the competencies, and the acquisition ofthe competencies defines the final mark. Here follows a description of how thecompetencies and activities are related.
CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
The acquisition of this competency is providedby the contents of the topics of the subject. All activities ofself-assessment, the laboratory sessions and the different test are elaborated to evaluate the knowledge of the technical subjects.
CE11 Knowledge of the fundamentals ofelectronics.
This competency is warrant to be acquired along all the lectures, the laboratory sessions, the self-assessment activities andt he tests.
CT2 Problems resolution.
The students will exercise this competency by means of the following activities: self-assessment activities, bulletin of problems and previous theoretical solution of experiments to be made at the laboratory. This competency is also acquired along all thetest (for each block and the individual one), as they mainly are composed by problems to be solved.
CT9 Apply Knowledge
This competency is mainly acquired during the laboratory sessions, where the theoretical knowledge from problems, designs and simulations should match the assembly of circuits and real measures. Laboratory sessions are evaluated one by one, scoring an average of marks, if there is a minimum number of attended sessions with a minimum score.
CT10 Self learning and work
The self learning process is fundamental to achieve the score to approve the subject. In order to motivate students in the task of acquiring the theoretical knowledgeneed, self-assessment test (on line), lectures based on the remote learningplatform (faitic) and bulletins of problems have been created. Theself-assessment test also provide feedback to the professors about the main difficulties found by students. On thelaboratory sessions, the previous preparation is an explicit method of evaluation. In order to made this preparation, each of the laboratory sessions has its specific documentation and tutorials.
CT17 Working as a team
The students exercise this competency at the laboratory sessions, by making teamsof two people. Cooperation in most of the sessions is needed to perform the assembly of circuits, make the measurements and take notes. The professor in charge of the laboratory session verifies the previous work and how each session is going along, watching that both members cooperate to achieve the best possible result. Scores for students can be different if the professor detects that one of the team member is not cooperating.

Sources of information

Basic Bibliography

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

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

Complementary Bibliography

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

Recommendations

Subjects that are recommended to be taken simultaneously

Fundamentals of automation/V12G380V01403

Subjects that it is recommended to have taken before

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

Contingency plan

Description

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

=== ADAPTATION OF THE METHODOLOGIES ===

An attempt will be made to ensure that the degree of attendance in teaching activities is the maximum that guarantees the safety and health of all parties involved. In any case, the guidelines will be followed in instructions indicated by the management of the center.
In the event that there is a situation in which the teaching activities cannot be attended, neither the content nor the learning results contemplated in the subject will be affected. To this end, the following adaptations will be made.

Theory sessions:

In the event that they cannot be attended, remote classrooms or any other means enabled by the university will be used for their delivery. The contents taught will be the same.

Laboratory sessions:

In the event that they cannot be attended, remote classrooms or any other means enabled by the university will be used for their delivery. In those situations where the sessions are not face-to-face, simulation tools will be preferably used.

Tutorials:

For the situation of non-attendance, email and, if necessary, telephone or videoconference will be used preferably.

Evaluation:

In the event that the tests cannot be carried out in person, they will be carried out by telematic means. The number of assessment tests will not change, nor will the relative weight of each one of them in the grade of the course.

IDENTIFYING DATA				
Fluid mechanics				
Subject	Fluid mechanics			
Code	V12G380V01405			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language				
Department				
Coordinator	López Veloso, Marcos			
Lecturers	Gil Pereira, Christian López Veloso, Marcos Molares Rodríguez, Alejandro Paz Penín, María Concepción Román Espiñeira, Ignacio Javier			
E-mail	marcoslpzveloso@uvigo.es			
Web				
General description	This syllabus presents information about the Fluid mechanics course during the 2nd year of the degree in Mechanical Engineering, 2019-2020, in accordance to the guidelines by the European Space of Upper Education. This is a first course in fluid mechanics, focusing on the topics that are relevant to Mechanical Engineering applications. The course is intended to acquire essential knowledge needed to analyze devices with fluid as a working material, such us hydraulic machinery, lubrication devices, heating and cooling systems, pipes systems, pneumatic systems, aero and hydrodynamics devices, windturbines, etc. It includes stress and strain rate descriptions, fluid statics, use of differential and finite control volume analysis with continuity, momentum, and energy equations, Bernoulli and Euler equations, incompressible viscous flow using Navier-Stokes equations, dimensional analysis, laminar and turbulent pipe flow.			

Competencies	
Code	
CG4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
CG5	CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
CE8	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.
CT2	CT2 Problems resolution.
CT9	CT9 Apply knowledge.
CT10	CT10 Self learning and work.

Learning outcomes			
Learning outcomes	Competences		
CG5 Knowledge for the realisation of measurements, calculations, assessments, evaluations, studies, reports, plans of works and other analogous works.	CG4 CG5	CE8	CT2 CT9 CT10
CG4 Capacity to: solve problems with initiative and creativity, take decisions, develope critical reasoning and capacity to communicate and transmit knowledge and skills in the field of the industrial engineering.	CG4 CG5	CE8	CT2 CT9 CT10
RI2 Knowledge of the basic principles of the fluid mechanics and his application to the resolution of problems in the field of the engineering. Intended learning outcomes are, understanding of the basics of flow behaviour in engineering systems, awareness of the physical laws that govern fluid motion and development of analytical skills for simple flow systems, e.g. calculation of pipes, channels and fluid systems	CG4 CG5	CE8	CT2 CT9 CT10
CT2 Resolution of problems.	CG4 CG5	CE8	CT2 CT9 CT10

Contents
Topic

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

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	60.5	93
Problem solving	14	33	47
Laboratory practical	4	0	4
Essay questions exam	3	0	3
Problem and/or exercise solving	3	0	3

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

Methodologies

	Description

Lecturing	They explain the foundations of each subject needed to solve practical problems. It includes mainly lectures baut can also includes: Readings bibliographic Review Solution of problems Conferences Oral Presentations
Problem solving	They will apply the concepts tackled in the lectures. It includes activities such as: Readings Seminars Solution of problems Team working Study of practical cases
Laboratory practical	Fundamentally, they will consist on activities of experimentation, although they also can include: Practical cases Simulation Solution of problems Team working

Personalized assistance

Methodologies	Description
Lecturing	Personalized attention will be given to the students during class (throughout the possible questions that could arise) and during the specific timetable of the teacher for tutorships. Updated information of the tutorships timetables will be given to the students
Laboratory practical	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	Evaluated Competencess		
Essay questions exam	Written exam consisting of: theoretical questions practical questions resolution of exercises/problems short covering of a topic	80	CG4 CG5	CE8	CT2 CT9 CT10
Problem and/or exercise solving	(*)Resolución de problemas e/ou exercicios propostos, que poderán incluír: - un número de entregas semanais (non presencial) - resolucións presenciais en horario de prácticas como reforzo de temas - Informe as actividades realizadas nas sesións de laboratorio, resultados da experimentación, etc.	20	CG4 CG5	CE8	CT2 CT9 CT10

Other comments on the Evaluation

Continuous evaluation: represents 20% of the grade. Except official renounce of the student, the course is followed under continuous assessment mode.

Continuous assessment grading is not saved year after year

Final exam: 80% of the total mark.

If the student does not attend the none of two final exams, the student will be graded as "non-attendance".

Summer final exam: the same criteria as in 1st call will be applied;
Ethical Commitment: In case of noticing a non ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices, and others) it will be considered that the student does not gather the necessary requirements to pass the course. In this case, the global qualification iof the present academic course will be failed (0.0).

Sources of information

Basic Bibliography

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

Antonio Crespo, **Mecánica de fluidos**,

Complementary Bibliography

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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**,
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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

Contingency plan

Description

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

* Teaching methodologies modified

* Non-attendance mechanisms for student attention (tutoring)

* Modifications (if applicable) of the contents

* Additional bibliography to facilitate self-learning

* Other modifications

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

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

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

* New tests