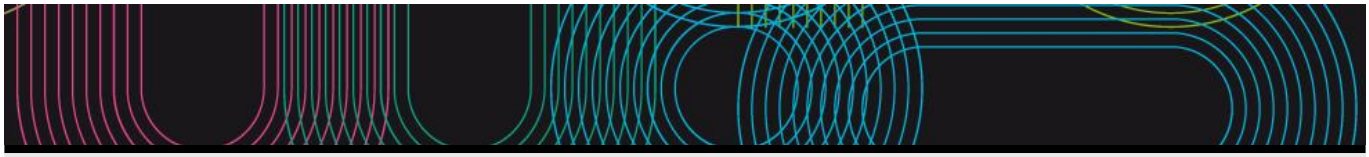

(*)Escola de Enxeñaría Industrial

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

Grado en Ingeniería en Tecnologías Industriales

Subjects

Year 3rd

Code	Name	Quadmester	Total Cr.
V12G363V01501	Applied electrotechnics	1st	6
V12G363V01502	Materials engineering	1st	6
V12G363V01503	Physics 3	1st	6
V12G363V01504	Hydraulic turbomachines	1st	6
V12G363V01505	Specialized mathematics	1st	6
V12G363V01602	Machine design and testing	2nd	6
V12G363V01603	Elasticity and additional topics in mechanics of materials	2nd	6
V12G363V01604	Manufacturing engineering	2nd	6
V12G363V01605	Electrical machines	2nd	6
V12G363V01606	Chemical technology	2nd	6

IDENTIFYING DATA				
Applied electrotechnics				
Subject	Applied electrotechnics			
Code	V12G363V01501			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language				
Department				
Coordinator	Novo Ramos, Bernardino			
Lecturers	Novo Ramos, Bernardino			
E-mail	bnovo@uvigo.es			
Web				
General description	The objective of Applied Electrotechnic is to complete the training of the students of the Industrial Technologies Degree in what is related with Three-phase Systems and Power Transformers. This subject will provide specific tools to analyse and evaluate the behaviour of the most usual electrical installations under balanced and unbalanced situations. The subject is conceived also, to provide the necessary knowledge and competencies to be able to follow some subjects in the 3rd and 4rd years of the Degree. The students have to be familiar with subjects like Basics of Theory of Circuits and Electric Machines and Calculus I and II because some of the information provided in these subjects will be necessary to follow Applied Electrotechnic, without and extra effort			

Training and Learning Results
Code

Expected results from this subject	
Expected results from this subject	Training and Learning Results

Contents	
Topic	
UNIT I: 3-PHASE CIRCUITS, POWER MEASUREMENTS AND REACTIVE POWER COMPENSATION. This Unit will allow the student to understand how to analyse 3-phase circuits under either balanced or unbalanced conditions Initially the unit covers the basic concepts for the analysis of balanced circuits. It continues analyising unbalanced circuits, the different methods to measure the electrical powers and the compensation of the reactive power.	Introduction: Generators, loads and 3-phase circuits Balanced 3-phase circuits. Voltages and currents. Conversion of 3-phase sources and loads. Analysis of balanced 3-phase circuits. Powers in balanced 3-phase circuits. Compensation. Analysis of unbalanced 3-phase circuits.
UNIT II: TRANSFORMERS This Unit will allow the student to learn about the constructive characteristics of the transformers, to determine its characteristic parameters and to understand the machine main properties and its utilization in the electrical systems.	Analogies between electric and magnetic circuits. Introduction to the transformers: constructive aspects. The ideal transformer. Operation of the real transformer. Equivalent circuit of the single-phase transformer real: e.m.f's and voltages. No-load and in short-circuit tests of the transformer. Voltage drops , losses and performance of a transformer. Autotransformers. 3-phasetransformers: Constitution, conection diagrams and tests. Instrument transformers.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	20	60	80
Problem solving	9	18	27

Collaborative Learning	9	9	18
Laboratory practical	9	9	18
Essay questions exam	7	0	7

*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 usual lecture
Problem solving	The professor will guide the first steps of the alumni in order to show them how to analyse diferent problems/sytuations and how to solve them
Collaborative Learning	Once taght how to solve a "generalistic problem" the alumni will have to create groups to find out the solutions to the same proposed problems related with the subject. They will be requested to collaborate in order to hand the professor the proper solution at the end of the session
Laboratory practical	Experimental solving of of proposed lab tests, realization of measurements and presentation of results.

Personalized assistance

Methodologies	Description
Laboratory practical	The doubts and questions that can arise during the classes or personal assignments of the students will be solved either in situ or during the tuition hours. The tuition personal attention should be required by e-mail. The professor will use his " Virtual Office" to solve any of these questions, if in-person tuition is not needed
Lecturing	he doubts and questions that can arise during the classes or personal assignments of the students will be solved either in situ or during the tuition hours. The tuition personal attention should be required by e-mail. The professor will use his " Virtual Office" to solve any of these questions, if in-person tuition is not needed
Problem solving	he doubts and questions that can arise during the classes or personal assignments of the students will be solved either in situ or during the tuition hours. The tuition personal attention should be required by e-mail. The professor will use his " Virtual Office" to solve any of these questions, if in-person tuition is not needed

Assessment

	Description	Qualification	Training and Learning Results
Lecturing	It will cover 30 of the mark . It wiil be about power transformers The student has to obtain a mark bigger than the 30% of the value of this part in order to compensate with the other part of the subject.	30	
Problem solving	First part : 3-ph systems (40%) Second part: Transformers (20%) The student has to obtain a mark bigger than the 30% of the value of this part in order to compensate with the other part of the subject.	60	
Laboratory practical	They will be valued as a 10% of the final mark	10	

Other comments on the Evaluation

Continuous assessment (100%):

At the end of each Part (I & II) the student will perform a test that will be scored from 0 to 10 points. The passing mark is 5. The test will cover theoretical issues and practical exercisesIn each Part the student can reach 50% of the final mark. The passed partial tests are released from the corresponding part in the final exam.
For the students who pass all tests, the final mark will be the average of the marks of the partial tests.
Students who fail any or all partial tests, will have take a final exam whrere she/he will be graded from 0 to 10 points.
To pass the subject it is necessary to achieve a minimum grade of 3 points in each part and an avereage mark bigger than 5.

Students approved by partial tests can modify (maybe improve) their mark by presenting to the final exam.
The professors will indicate the dates and places of publication of marks and revisions

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Electrical machines/V12G363V01605

Subjects that are recommended to be taken simultaneously

Physics: Physics 2/V12G363V01202
Mathematics: Calculus 2 and differential equations/V12G363V01204

Subjects that it is recommended to have taken before

Basics of circuit analysis and electrical machines/V12G363V01302

Other comments

Requirements: To enrol in this subject is necessary either to had surpassed or to be enrolled in all the subjects of the previous courses of the one where this subject is summoned

IDENTIFYING DATA				
Materials engineering				
Subject	Materials engineering			
Code	V12G363V01502			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	English			
Department				
Coordinator	Díaz Fernández, Belén			
Lecturers	Díaz Fernández, Belén			
E-mail	belenchi@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject combines the scientific fundamentals that prove the relation structure-properties-performance with technological aspects such as the manufacturing processes and the service conditions.			

Training and Learning Results	
Code	
B3	CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations.
B4	CG4 Ability to solve problems through initiative, decision-making, creativity, critical reasoning, and to communicate and transmit knowledge, skills and abilities in the field of industrial engineering.
B5	CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
B6	CG6 Capacity for handling specifications, regulations and mandatory standards.
B11	CG11 Knowledge, understanding and ability to apply the legislation relating to industrial installations.
C19	CE19 Knowledge and skills for engineering materials.
D1	CT1 Analysis and synthesis.
D5	CT5 Information Management.
D7	CT7 Ability to organize and plan.
D9	CT9 Application of knowledge.
D10	CT10 Self learning and work.
D15	CT15 Objectification, identification and organization.
D17	CT17 Working as a team.

Expected results from this subject	Training and Learning Results		
Knowledge of the main manufacturing and transformation processes used in the industry	B3	C19	D1
Probe the ability to select the most suitable forming process for each material	B4		D5
Knowledge of the joining processes used in the industry	B5		D7
Understand the complex relations between the properties of materials and the forming and joining processes in order to improve properties and to increase productivity	B6		D9
	B11		D10
Knowledge of the characteristics of the materials used in engineering			D15
Knowledge of the several types of materials and processes for their forming			D17
Knowledge of the criteria for the selection of the most suitable material for an specific application			
Propose operative solutions for the most common problems in the materials engineering field			
Analyse conclusions and results of tests and measurements			
Write with a suitable structure. Make a presentation with the available media			
Show the aptitude of communication and working in teams			
Identify the need of information and use the available media and services to design and perform a suitable search in the subject area			
Perform the assigned projects following the indications given by the lecturer			

Contents
Topic

Unit I: In-service materials performance.	Lesson 1. Fatigue Definition and importance. Fracture surface characteristics. S-N curve. Fatigue crack propagation and service life prediction. Cumulative fatigue damage: Palmgren-Miner□s rule. Influence of the mean stress: Goodman and Gerber criteria. Factors that influence on fatigue. Lesson 2. Fracture mechanics. Griffith and Irwin theories. Linear elastic fracture mechanics. Stress distribution at the crack tip: plain stress and plain strain. Plain strain fracture toughness. Lesson 3. Creep. Influence of temperature on strength. The creep curve: creep rate, creep strain, temperature and stress. Creep tests for metals and plastics. Influence of stress and temperature. Prediction of long-time properties. Development of creep resistant alloys. Materials selection. Deformation mechanisms. Lesson 4. Fundamentals of corrosion. Economic and social importance. Electrochemical corrosion. Thermodynamic analysis. Electrode potential and Pourbaix diagrams. Kinetic analysis. Corrosion rate. Polarization phenomena. Passivation. Corrosion control strategies: design, change of material and/or exposure environment, protective layers, cathodic and anodic protection.
Unit II: Metal-casting and forming processes, heat treatments and joining processes.	Lesson 5: Fundamentals of metal casting: especial casting methods. Castability: fluidity, no cavities and resistance to hot cracking. Casting alloys. Directional solidification, casting for single-crystal components and metallic glasses. Squeeze casting. Semi-solid forming (rheocasting and thixocasting). Lesson 6: Plastic forming of metals: cold working and hot forming. Strain hardening. Characteristics of cold working. Annealing of a cold-worked piece. Hot forming: dynamic recovery and dynamic recrystallization. Characteristics of hot forming. Benefits of hot forming for cast structures. Lesson 7. Heat treatments and thermomechanical treatments. Quench and hardenability. Tempering. Martempering and austempering. Thermomechanical treatments: definition and types. Controlled rolling, ausforming, isoforming and marforming. Lesson 8. Welding metallurgy. Classification of welding processes according to AWS. Thermal cycle: influencing factors. Weld zone: epitaxial and competitive growth. Heat affected zone. Solid solution strengthened alloys. Work-hardened alloys. Precipitation hardened alloys. Transformation hardening alloys. Post-welding treatments.
Unit III: Structural materials.	Lesson 9. Structural steels and stainless steels. Hot-rolled steels for general purposes. Microalloyed steels. Atmospheric corrosion resistant steels. Steels for quench and tempering. Low-temperature applications steels. Stainless steels. Passive layer characteristics. Classification. Lesson 10. Aluminum alloys. Strengthening of aluminum alloys. Classification of the aluminum alloys. Cast and wrought aluminum alloys. Lesson 11. Composite materials. Definition: advantages and drawbacks. Types of composite materials. Fiber-reinforced plastics: properties and fabrication. Laminated structures. Metallic and ceramic matrix composite materials.

Laboratory contents	Laboratory 1. Fractography and fatigue testing. Macroscopic and microscopic features of the fracture surfaces. Scanning Electron Microscope. Practical examples. Fatigue: general concepts. Fatigue testing: Wöhler curve. Factors that influence on fatigue. Examples. Laboratory 2. Corrosion technology. Corrosion protection. Electrochemical techniques for the corrosion assessment. Metallographic analysis. Assessment of protective layers. Thickness and adherence. Assessment of failure mechanisms. Laboratory 3. Metallography I: forming techniques. Cast structures: influence of cooling rate and alloying elements. Cold worked and hot formed structures. Laboratory 4. Metallography II: heat-treated alloys. Steels and Al alloys. Laboratory 5. Hardenability. Jominy test. Jominy curve. Objective and applications. Jominy test and results designation. Laboratory 6. Liquid penetrating and magnetic particles testing. Definition, objectives and applications. Testing methodology and report. Laboratory 7. Radiography and ultrasounds (I) Radiography: definitions, objectives and applications. Testing. Ultrasounds: through-transmission (transmitter-receiver) and pulse-echo modes. Ultrasonic inspection: calibration and thickness assessment. Laboratory 8. Ultrasonic inspection (II) Inspections of metallic pieces with a contact transducer. In-situ assessment of concrete structures. Sclerometer test: surface hardening and strength relationship. Ultrasonic inspections with the direct transmission mode. Ultrasonic pulse velocity in concrete: indirect mode. Ultrasonic pulse velocity and strength relationship. Laboratory 9. Exposition of projects. Each student will participate in the exposition of his/her group and will answer the questions posed either by the lecturer and/or by students from other groups.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	33	56	89
Problem solving	4	8	12
Seminars	3	3	6
Laboratory practical	13	19	32
Mentored work	0	11	11

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

Methodologies

	Description
Lecturing	Presentations given by the lecturer of the main contents of the subject
Problem solving	Proposal of a set of problems/exercises that students must resolve by themselves. Guidelines, required formulas and common routines will be given in the classroom. Some problem will be resolved at the classroom, by the lecturer or by a student.
Seminars	Additional explanations to solve the main difficulties about the subject contents
Laboratory practical	Activities for application of the theoretical knowledge to particular situations and for the acquisition of basic skills and procedures related to the subject. Students will use the laboratories with the suitable equipment and devices.
Mentored work	Students, individually or in group, elaborate a document or presentation about some important topic related to the subject. Student can be asked to prepare a seminar, a short research, a summary of a document or conference...

Personalized assistance

Methodologies	Description

Mentored work	Personalized attention, the lecturer will guide the preparation of the project. Any difficulty/doubt will be attended. This support can be provided either in person or electronically (email, videoconference, campus remoto ...) after being formally requested.
Seminars	Personalised attention, time devoted to help students with any difficulty or doubt. This support can be provided either in person or electronically (email, video-conference, campus remoto ...) after being formally requested.

Assessment

	Description	Qualification	Training and Learning Results	
Lecturing	The assessment will be completed with two written exams of short questions, tests or exercises. The purpose is to assess the level of knowledge achieved along the course. One of the tests will be done during the learning period (30%) and the other in the date established by the administration (40%)	70	B3 B4 B5 B6 B11	D5 D7 D9 D10 D15
Laboratory practical	The laboratory activities will be assessed through the students attendance and participation, preparation of reports and a final test at the end of the learning period	20		D5 D9 D10 D15 D17
Mentored work	It will be assessed by the handed reports and/or the exposition in the classroom of the prepared project.	10	B3 B4 B11	D9 D10 D15

Other comments on the Evaluation

FIRST ATTEMPT:

a) Option 1: continuous evaluation

The continuous assessment will be conducted during the learning process (teaching period of the subject) according to the criteria established in the previous section. The contribution of each item to the final score is as follows:

1) Laboratory work (20%). The contents worked in the laboratory will be assessed with an exam, that could be taken by the middle of December, in the week established by the administration for the continuous assessment tests. In addition, the attendance to the laboratory sessions as well as the preparation of reports will be considered.

2) Preparation and presentation of a project (10%).

3) Mid-term exam including some of the contents explained in the classroom (30%).

4) Final exam including the remaining contents (those not included in the mid-term exam, 40%). This exam will be taken in the data officially established by the administration.

A **minimum score, 40%,** is required in the two written exams (mid-term and final) to pass the subject under the continuous evaluation plan:

I. In case the minimum score was not achieved in the mid-term exam (1.2 out of 3), the student will be transferred to the comprehensive assessment methodology (option 2) after formally renouncing to the continuous evaluation option.

II. In case the **minimum score was not achieved in the final exam** (1.6 out of 4), the score achieved in items 1) and 2) will not be considered in the total grading.

b) Option 2: comprehensive evaluation Students have the right to renounce to the continuous assessment system. This option must be formally asked within the period established by the lecturer and informed at the beginning of the course. In this situation, a comprehensive final exam will be taken which includes the entirety of the contents of the subject (laboratory and theory), and its weight is 100%. The minimum score to pass it is 5 out of 10. The date of the exam will be fixed by the administration and can be checked at http://eei.uvigo.es.

SECOND ATTEMPT (exam in July):a) The score partially obtained from the continuous assessment option (items 1) and 2)) will be kept unless the student requests to be cancelled in due course (once cancelled student will be evaluated as described in b)). The exam will cover uniquely the contents explained in the classroom. The weight of this exam in the grading will be 70%, being a minimum of 40% (2.8 out of 7) required to pass. The final score will be the sum of the mark in this exam and the marks obtained in items 1) and 2). b)Under the comprehensive assessment system, the totality of the

contents of the subject (those given in the classroom and in the laboratory) will be included in this final exam and the student could achieved 100% of the grading (the minimum mark to pass the exam will be 5 out of 10). The date of the exam will be fixed by the administration and can be checked at http://eei.uvigo.es.

EXTRAORDINARY CALL: the exam (questions, tests and/or exercises) will include the totality of the contents and the qualification will be 100%. **Ethical commitment**: student is expected to show an ethical behaviour. In the case a fraudulent behaviour is detected (copy, plagiarism, use of forbidden electronic devices, or others), the student will fail and its final score will be 0.

Sources of information
Basic Bibliography
Kalpakjian, S. and Schmid, S. R.,, **Manufacturing Engineering and Technology**, Pearson/Prentice Hall,
Mikell P. Groover, **Fundamentals of Modern Manufacturing: Materials, Processes, and Systems**, John Wiley & Sons,
Dieter, G. E., **MECHANICAL METALURGY**, McGraw-Hill Book Company,
Complementary Bibliography
Reina Gómez, M., **Soldadura de los aceros, aplicaciones.**, Gráficas Lormo,
Sindo Kou, **Welding Metallurgy**, John Wiley & Sons,
Krauss, G., **Steels: Heat Treatment and Processing Principles**, ASM International,
Brooks, CH., **Principles of the Surface Treatment of Steels.**, Inc. Lancaster,
Randall, M. G., **Sintering: Theory and Practice**, John Wiley & Sons,
Beeley, P., **Foundry Tecnology**, Butterworth-Heineman, Ltd.,

Recommendations
Subjects that continue the syllabus
Fundamentals of manufacturing systems and technologies/V12G363V01402
Mechanics of materials/V12G363V01404
Manufacturing engineering/V12G363V01604
Subjects that it is recommended to have taken before
Materials science and technology/V12G363V01301

IDENTIFYING DATA				
Physics 3				
Subject	Physics 3			
Code	V12G363V01503			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	López Vázquez, José Carlos			
Lecturers	López Vázquez, José Carlos			
E-mail	jclopez@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	The main goals of Physics III are: a) To get a deeper understanding of the physical foundations of engineering, specifically those related to electromagnetic and wave phenomena. b) To introduce the use of mathematical tools, in particular vector analysis and differential equations and their associated boundary value problems, within the framework of problems and models in Physics. c) To combine theoretical education and a practical engineering approach, stressing the relevance of fundamentals to deal with problem analysis and synthesis of solutions in real-life situations. d) To relate the topics in the fundamentals of electromagnetism and wave phenomena to the contents of other more technological subjects included in the curriculum for the Degree. The topics of Physics III are, essentially, an introduction to wave phenomena in general (three units) and the study of classical electromagnetism using an axiomatic approach employing a mathematical treatment based on differential vector operators (four units).			

Training and Learning Results	
Code	
B10	CG10 Ability to work in a multidisciplinary and multilingual environment.
C2	CE2 Understanding and mastering the basics of the general laws of mechanics, thermodynamics, waves and electromagnetic fields, as well as their application for solving engineering problems.
D10	CT10 Self learning and work.

Expected results from this subject	Training and Learning Results		
To know and to understand the physical foundations of electricity and magnetism as well as of vibrations and waves.	B10	C2	
To know and to be able to apply, in simple cases, vector analysis and differential equations of mathematical physics, as problem solving tools within the framework of fundamentals of physics.	B10	C2	
To be able to establish efficient strategies and procedures for solving problems in fundamentals of physics related to industrial technologies.	B10	C2	
To be able to implement specific solutions in the laboratory to experimental problems in fundamentals of physics.	B10	C2	D10

Contents	
Topic	
I.1. WAVE MOTION	1.1. Wave phenomena 1.2. Fundamental characteristics of waves 1.3. The wave equation 1.4. Plane waves 1.5. Wavefront and wavevector 1.6. Cylindrical and spherical waves 1.7. Longitudinal and transverse waves 1.8. Huygens' principle 1.9. Reflection and refraction of waves

I.2. MECHANICAL WAVES	2.1. The nature of mechanical waves 2.2. Longitudinal waves in thin rods 2.3. Longitudinal waves in springs 2.4. Transverse waves in strings 2.5. Power flow and intensity of a wave 2.6. Longitudinal waves in fluids
I.3. DESCRIPTION OF PHYSICAL QUANTITIES BY MEANS OF VECTOR ANALYSIS	3.1. Differential of arc of a curve 3.2. Scalar fields 3.3. Directional derivative 3.4. Gradient 3.5. Vector fields 3.6. Flux of a vector field 3.7. Solenoidal fields 3.8. Divergence of a vector field 3.9. Ostrogradski-Gauss' theorem or divergence theorem 3.10. Divergence of a solenoidal field 3.11. Circulation of a vector field 3.12. Rotation or curl of a vector field 3.13. Stokes' theorem 3.14. Conservative fields
II.1. GENERAL EQUATIONS OF ELECTROMAGNETISM	1.1. Definition of electric and magnetic fields 1.2. Field sources: macroscopic electric charges and currents 1.3. Relations among fields E and B and their sources: Maxwell's equations 1.4. Free charge 1.5. Polarization charge 1.6. Electric current 1.7. Polarization current 1.8. Magnetization current 1.9. Maxwell's equations as a function of fields E, D, B, and H 1.10. Boundary conditions for electromagnetic fields 1.11. Electrodynamic potentials 1.12. The energy law of the electromagnetic field
II.2. TIME-INDEPENDENT FIELDS: ELECTROSTATICS, STEADY ELECTRIC CURRENT AND MAGNETOSTATICS	2.1. Fundamental equations of electrostatics 2.2. Electric dipole 2.3. Fundamental equations for steady electric current 2.4. Equations including media properties 2.5. Electrical resistance 2.6. Joule's law 2.7. Electromotive forces and generators 2.8. Potential distribution in a resistor 2.9. Fundamental equations of magnetostatics 2.10. Equations including media properties 2.11. Magnetic forces 2.12. Magnetic circuit 2.13. Magnetic dipole
II.3. ELECTROMAGNETIC INDUCTION AND QUASISTATIC FIELDS	3.1. Electromagnetism in moving media 3.2. Galilean transformation of electric and magnetic fields 3.3. Electromotive force around a circuit 3.4. Faraday's law of electromagnetic induction 3.5. Definition of quasistatic fields 3.6. Self-inductance and mutual inductance 3.7. Magnetic energy
II.4. ELECTROMAGNETIC WAVES	4.1. Wave equations for fields E and H 4.2. E.M. monochromatic plane waves in lossless media 4.3. E.M. monochromatic plane waves in lossy media 4.4. Incidence of a plane wave on an interface between two perfect dielectrics 4.5. Incidence of a plane wave on an interface between a perfect dielectric and a conductor
III.1 LABS: STRUCTURED ACTIVITY SESSIONS	1.1 Structured activity sessions: - Experimental data processing (approximate quantities, measurement of physical magnitudes, error estimation) - Adequate operation with basic measurement instruments (flex-meter, micrometer, multimeter (analog and digital), oscilloscope) - Laboratory experiments with mechanical or electromagnetic waves (emission and reception of ultrasonic waves, microwaves or light waves, standing waves along one direction, Michelson interferometer)

III.2 LABS: UNSTRUCTURED ACTIVITY (OPEN LAB) SESSIONS	2.1. Unstructured activity (open lab) sessions: - A practical problem, formulated with basic initial data, will be assigned to each working team. Then, under the teacher's supervision, each team must analyze the problem, select a possible solution and carry it out in the lab - For the open lab problems, a diversity of topics and experimental techniques are considered within the field of wave and electromagnetic phenomena, in particular, electric current conduction and electromagnetic induction in quasi-static regime - As a reference, some open lab problems that can be proposed are: measuring the electric field on a weakly conducting sheet, numerical solution of the Laplace equation, measuring the self-inductance of a coil or a solenoid, measuring the mutual inductance of two coils or two solenoids - As an option, the open lab session may be replaced by a well-documented piece of work reporting some topic/technique/process/device related to science or technology where wave or electromagnetic phenomena play an essential role. The report must include a model of the problem, clearly identifying the relevant quantities and physical laws

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	20	30	50
Problem solving	11.5	30.5	42
Laboratory practical	18	18	36
Essay questions exam	2	0	2
Problem and/or exercise solving	2	0	2
Report of practices, practicum and external practices	0	18	18

*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 main topics of the subject are introduced by the teacher using projected presentations and the chalkboard, emphasizing the theoretical basis and fundamentals and stressing the critical or key points. Occasionally, demonstrative experiments or audiovisual material may be employed
Problem solving	Academic problems related to the topics of the subject are formulated and worked out at the chalkboard by the teacher or the students. By practicing standard schemes, formulas or algorithms and by analyzing the results, the student must develop adequate skills to be able to obtain the correct solution to the problem on his/her own at the end of the course
Laboratory practical	Activities for applying the knowledge to particular situations and for developing basic and procedural skills related to the subject. These activities will be held in specific rooms with specialized equipment (laboratory and computer rooms)

Personalized assistance

Methodologies	Description
Lecturing	In tutoring hours
Laboratory practical	In tutoring hours
Problem solving	In tutoring hours

Assessment

	Description	Qualification	Training and Learning Results
Essay questions exam	Tests that includes open questions on a topic. Students should develop, relate, organize and present knowledge on the subject in an argued response	50	B10 C2
Problem and/or exercise solving	Test in which the student must solve a series of problems and/or exercises in a time/conditions set by the teacher	40	B10 C2 D10
Report of practices, practicum and external practices	Each team should write a report on the activities carried out. The report must include the tasks and procedures developed, the results obtained or the observations taken, as well as a detailed description of the data processing and analysis	10	B10 C2 D10

Other comments on the Evaluation

1. Ordinary call (December-January)

1.1 Continuous assessment

- The final mark G0 results from the classroom mark A0 (80% of the final mark), on topics of Parts I and II, and the lab mark L0 (20% of the final mark), on topics of Part III.

- Mark A0 combines the classroom mark C0 (40% of the final mark), that is obtained from theoretical-practical tests (essay-questions and problem/exercise solving) to be developed during the term, and the classroom mark F0 (40% of the final mark), that is obtained from an end-of-term theoretical-practical test to be held on the same date that the exam of the ordinary call.

- Mark L0 combines the mark L01 (10% of the final mark), that is obtained from theoretical-practical tests to be developed during the term (essay-questions and problem/exercise solving) on topics of Part III.1, and the mark L02 (10% of the final mark) that is obtained from a lab report corresponding to topics of Part III.2. Only students that have regularly attended the lab sessions can obtain a mark L0 different form "0,0".

- The final mark of the continuous assessment in the ordinary call is obtained as

G0 = A0 (80%) + L0(20%) = C0 (40%) + F0 (40%) + L01 (10%) + L02 (10%)

- To pass the course, a student must obtain a final mark G0 equal to or higher than 5.

1.2 Global assessment

- Those students who have been granted the waiver of the continuous assessment in the ordinary call will obtain 100% of their final mark G1 from a exam corresponding to the ordinary call.

- The final mark G1 results from the classroom mark A1 (80% of the final mark), on topics of Parts I and II, and the lab mark L1 (20% of the final mark), on topics of Part III.1.

- Mark A1 combines marks C1 (40%of the final mark) and F1 (40% of the final mark), that are obtained from theoretical-practical tests (essay-questions and problem/exercise solving).

- Mark L1 (20% of the final mark) is obtained from a theoretical-practical test (essay-questions and problem/exercise solving).

- The final mark of the global assessment in the ordinary call is obtained as

G1 = A1 (80%) + L1(20%)= C1 (40%) + F1 (40%) + L1 (20%)

- To pass the course, a student must obtain a final mark G1 equal to or higher than 5.

2. Extraordinary call (June-July)

- All students, whether they have waived continuous assessment or not, will obtain 100% of their final mark G2 from an exam corresponding to the extraordinary call.

- The final mark G2 results from the classroom mark A2 (80% of the final mark), on topics of Parts I and II, and the lab mark L2 (20% of the final mark), on topics of Part III.1.

- Mark A2 combines marks C2 (40% of the final mark) and F2 (40% of the final mark), that are obtained from theoretical-practical tests (essay-questions and problem/exercise solving).

- Mark L2 (20% of the finalmark) is obtained from a theoretical-practical test (essay-questions and problem/exercise solving).

- The final mark of the continuous or global assessment in the extraordinary call is obtained as

G2 = A2 (80%) + L2(20%)= C2 (40%) + F2 (40%) + L2 (20%)

- To pass the course, a student must obtain a final mark G2 equal to or higher than 5.

3. Common features and interconnection among the assessment alternatives

- In the continuous and global assessment modalities for the ordinary and extraordinary calls that have been defined in the previous sections, we can classify marks that are equivalent to each other in three sets with three elements each: classroom marks C0, C1 and C2, classroom marks F0, F1 and F2 and lab marks L0, L1 and L2. If C is the most recent valid mark from C0, C1 and C2, F is the most recent valid mark from F0, F1 and F2 and L is the most recent valid mark from L0, L1 and L2, the final mark G in the ordinary or the extraordinary call, either for continuous or global assessment, is obtained as

G =C(40%) + F (40%) + L(20%)

- To pass the course, a student must obtain a final mark G equal to or higher than 5 in any of the assessment alternatives.

- To obtain the final mark G2 in the extraordinary call the students, whether they have waived continuous assessment or not, can choose between:

a) answering the part of the exam of the extraordinary call corresponding to marks C2, F2, and/or L2, that will be used in the formula of the final mark of the extraordinary call G2.

b) use the most recent valid mark of each type (C0 or C1, F0 or F1 and/or L0 or L1) to be used instead of marks C2, F2 and/or L2, respectively, in the formula of the final mark of the extraordinary call G2, not taking the corresponding part of the exam of this call.

4. End-of-degree call

- The end-of-degree call follows the same assessment scheme as the extraordinary call.

- The end-of-degree assessment is completely independent of the assessments in the ordinary and extraordinary calls (in particular, the features and interconnections described in the previous section do not apply).

5. Supplementary assessment rules

- Students should not have access to or use any electronic device during the tests and exams, unless specifically authorized. The mere act of taking an unauthorized electronic device into the examination room will result in the student failing the subject and the final mark in the corresponding call will be "suspenso (0,0)".

- The tests and exams will be jointly set and assessed by the teaching team of the subject.

- The dates for the exams in each call will be assigned by the board of directors of the School ofIndustrial Engineering (E.E.I.).

6. Ethical commitment

Every student is expected to behave in an appropriate ethical manner. Should unethical conduct be detected (copying, plagiarism, utilization of unauthorized electronic devices, or others), the student will be considered not to have fulfilled the necessary requirements to pass the subject. In this case, the final mark in the corresponding call will be "suspenso (0,0)".

Sources of information

Basic Bibliography

J. L. Fernández, M. J. Pérez-Amor, **Guía para la resolución de problemas de electromagnetismo. Compendio de teoría**, Reverté, 2012

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

M. Alonso y E. J. Finn, **Física**, Addison-Wesley Iberoamericana, 2000

M. Alonso and E. J. Finn, **Physics**, Pearson, 1992

Complementary Bibliography

M. R. Spiegel, **Análisis vectorial**, McGraw-Hill, serie Schaum, 2011

M. R. Spiegel, **Schaum's Outline of Vector Analysis**, McGraw-Hill, Schaum's Outline Series, 2009

D. K. Cheng, **Fundamentos de electromagnetismo para ingeniería**, Addison-Wesley, 1997

D. K. Cheng, **Fundamentals of Engineering Electromagnetics**, Prentice Hall 1993, Pearson 2014,

J. A. Edminister, **Electromagnetismo**, McGraw-Hill, serie Schaum, 1992

J. A. Edminister, M. Nahvi, **Schaum's Outline of Electromagnetics**, McGraw-Hill, Schaum's Outline Series, 2013

I. Bronshtein, **Manual de matemáticas para ingenieros y estudiantes**, MIR 1982, MIR-Rubiños 1993,

I. N. Bronshtein, K. A. Semendyayeb, **Handbook of Mathematics**, Springer, 2007

M. R. Spiegel, **Fórmulas y tablas de matemática aplicada**, McGraw-Hill, serie Schaum, 2014

M. R. Spiegel, S. Lipschutz, J. Liu, **Schaum's Outline of Mathematical Handbook of Formulas and Tables**, McGraw-Hill, Schaum's Outline Series, 2011

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/V12G360V01102
Physics: Physics 2/V12G360V01202
Mathematics: Algebra and statistics/V12G360V01103

Mathematics: Calculus 1/V12G360V01104
Mathematics: Calculus 2 and differential equations/V12G360V01204

Other comments

Requirements: To register in this subject, it is mandatory to have been registered or to be registered in all the subjects corresponding to the first and second years of the curriculum of the Degree in Industrial Technologies Engineering

In particular, it is highly recommended to have reviewed the topics in Physics and Mathematics included within the subjects that should have been passed previously

In the event of discrepancy, the Spanish version of this syllabus prevails

IDENTIFYING DATA				
Hydraulic turbomachines				
Subject	Hydraulic turbomachines			
Code	V12G363V01504			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	English			
Department				
Coordinator	Conde Fontenla, Marcos			
Lecturers	Conde Fontenla, Marcos			
E-mail	mfontenla@uvigo.gal			
Web	http://moovi.uvigo.gal			
General description	This syllabus presents information the Hydraulic Turbomachines course that belongs to the 3rd year of the degree in Industrial Technologies Engineering, 2020-2021, in accordance to the marked guidelines by the European Space of Upper Education. This is a first course in Hydraulic Turbomachines, focusing on the topics that are relevant to Industrial Technologies Engineering applications. The course is intended to acquire essential knowledge about the fundamental principles and performance of Hydraulic Turbomachines, studying the main parts of a turbomachines and their classification, the application of fundamental Euler□s theorem, and the performance of both turbines and pumps with different arrangements in hydroelectric power plants and pumps stations, respectively. Finally, some brief comments are explained to acquire fundamental knowledge of fans, airfoils and positive displacement machines			

Training and Learning Results	
Code	
B3	CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations.
C8	CE8 Knowledge of the basic principles of fluid mechanics and their application to solving problems in the field of engineering. Calculation of pipes, channels and fluid systems.
C25	CE25 Applied knowledge of the basics of fluidmechanics systems and machines.
D2	CT2 Problem solving.
D9	CT9 Application of knowledge.
D10	CT10 Self learning and work.

Expected results from this subject	Training and Learning Results		
Understand fundamentals of hydraulic machines	B3	C8 C25	D2 D9 D10
Acquire skills for sizing pumps facilities and fluid machines	B3	C8 C25	D2 D9 D10

Contents	
Topic	
1.- Introduction	1.- Turbomachinery. Classification 2.- Hydraulic turbomachines 3.- Applications to the Industry 4.- General specifications
2.- Transfer of Energy	1.- Equation of conservation of the energy 2.- Hydraulic turbomachines applications 3.- Dimensionless parameters 4.- Power and efficiencies
3.- Similarity and Characteristic Curves	1.- Similarity in hydraulic turbomachines 2.- Practical application of similarity laws 3.- Comparison of hydraulic turbomachines 4.- Characteristic curves in hydraulic pumps 5.- Characteristic curves in hydraulic turbines 6.- Dimensionless coefficients. Specific speed and specific power

4.- Transfer of Work	1.- Fundamental equation of hydraulic turbomachinery: Euler's equations. Expressions 2.- One-dimensional (ideal) theory of hydraulic turbomachinery 3.- Two-dimensional (ideal) theory of hydraulic turbomachinery 4.- Real flow. Losses 5.- Cavitation in HTM
5.- Fluids machines of low pressure rise	1.-Classification 2.- Fans. Characteristic curves 3.- Wind turbines. Classification - Disk actuator theory.Betz's limit - Fundamentals Theory of Airfols. NACA Airfoils - Blade element theory - Characteristic curves
6.- Positive displacement machines and hydraulic transmissions	1.- Types and classification 2.- Alternative and rotatory pumps. 3.- Hydraulic engines of positive displacement 4.- Transmissions and hydraulic couplings
Laboratory sessions	1. Introduction to the pneumatic systems: - detailed description of the pneumatic systems and his components. -Basic circuits. -Problems resolutions 2. Resolution of problems of of hydraulic turbomachines 3. Hydraulic turbines - Hill chart Francis Turbine 4. Resolution of problems of Positive displacemetn machines

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	31.5	60.5	92
Laboratory practical	6	10	16
Problem solving	12	27	39
Essay questions exam	1	0	1
Essay questions exam	0.75	0	0.75
Essay questions exam	0.75	0	0.75
Essay questions exam	0.5	0	0.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Readings solution of problems
Laboratory practical	Practices of pneumatic (see description in contents) Practices of HTM (see description in contents)
Problem solving	Calculation methods and techniques Interpretation of results Practical cases

Personalized assistance	
Methodologies	**Description**
Problem solving	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
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	Training and Learning Results		
Laboratory practical	Assessment may include: - Problem solving - Practical reports - Oral/written practical questions	10	B3	C8 C25	D9 D10
Essay questions exam	Final written exam on the official date indicated by the school that may consist of: - Theoretical/practical questions - Exercise/problem solving - Topic to be developed Minimum required grade: 4 out of 10.	40	B3	C8	D2 D9 D10
(*)	N/A	-			
Essay questions exam	Partial written test that may consist of: Theoretical/practical questions Exercise/problem solving Topic to be developed	20	B3	C8 C25	D2 D9 D10
Essay questions exam	Partial written test that may consist of: Theoretical/practical questions Exercise/problem solving Topic to be developed	20	B3	C8 C25	D2 D9 D10
Essay questions exam	Partial written test that may consist of: Theoretical/practical questions Exercise/problem solving Topic to be developed	10	B3	C8 C25	D2 D9 D10

Other comments on the Evaluation

Global Evaluation:

In the two official editions, renouncement of continuous assessment will be carried out following the procedure and deadline established by the institution. The global evaluation methodology will consist of a single written exam on the official date set by the school, which will account for 100% of the grade, and all theoretical and practical contents of the subject will be evaluated.

Continuous Assessment: *Ordinary Call /First attempt*.

It will consist of different tests conducted throughout the course and a final exam on the official date previously set by the institution. In this final exam, a minimum grade of 4 out of 10 will be required to pass the subject. To pass, the final grade must be at least 5 out of 10. If the minimum grade is not achieved in the final exam, the student will be awarded a grade of 4.5.

Continuous Assessment: *Extraordinary Call / Second attempt*.

The student may decide within the established deadlines whether to maintain the grade from the practical component and partial tests of the continuous assessment (60%), or to choose the global evaluation. The exam will be held on the official date previously set by the institution. In this final exam, a minimum grade of 4 out of 10 will be required to pass the subject. To pass, the final grade must be at least 5 out of 10. If the minimum grade is not achieved in the final exam, the student will be awarded a grade of 4.5.

Ethical Behavior: It is expected that the student demonstrates appropriate ethical behavior, paying particular attention to what is indicated in Articles 39, 40, 41, and 42 of the Regulations on evaluation, grading, and quality of teaching and the student learning process at the University of Vigo (approved on April 18, 2023).

Sources of information

Basic Bibliography

Viedma A., Zamora B., **Teoría y Problemas de máquinas hidráulicas**, 3º Ed., Horacio Escarabajal Editores., 2008

Mataix, C., **Turbomáquinas Hidráulicas**, Editorial ICAI, 1975

Mataix, C., **Mecánica de Fluidos y Máquinas Hidráulicas**, Editorial del Castillo S.A., 1986

Srinivasan, K.M., **rotodynamic Pumps**, New Age International Publishers, 2008

Complementary Bibliography

Hernández Krahe, J. M, **Mecánica de Fluidos y Máquinas Hidráulicas.**, UNED, 1998

Krivchenko, G, **Hydraulic Machines: Turbines and Pumps**, 2ª ed., Lewis, 1994

Creus, A., **Neumática e Hidráulica.**, Marcombo Ed., 2011
Karassik, I. J., **Pump Handbook**, 2ª ed., Nueva York, McGraw-Hill., 1986

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/V12G360V01102
Physics: Physics 2/V12G360V01202
Mathematics: Calculus 2 and differential equations/V12G360V01204
Fluid mechanics/V12G360V01403

Other comments

Recommends to the student:
Attend to class
Spend the hours outside the classroom studying the subject

IDENTIFYING DATA				
Matemáticas da especialidade				
Subject	Matemáticas da especialidade			
Code	V12G363V01505			
Study programme	Grao en Enxeñaría en Tecnoloxías Industriais			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3	1c
Teaching language				
Department				
Coordinator	Vidal Vázquez, Ricardo			
Lecturers	Vidal Vázquez, Ricardo			
E-mail	rvidal@uvigo.es			
Web				
General description				

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos	
Topic	
Tema 1. Resolución de ecuacións non lineais	1. Métodos directos, de bisección e de punto fixo. 2. Métodos de linealización.
Tema 2. Ampliación de ecuacións diferenciais	1. Métodos numéricos de Euler e Runge-Kutta.
Tema 3. Variable complexa	1. O corpo dos números complexos 2. Funcións holomorfas 3. Integración complexa 4. Series de potencias 5. Series de Laurent 6.Teorema dos residuos 7. Transformada z
Tema 4. Análise de Fourier e Transformadas integrais	1. Espazos con produto escalar 2. Sistemas ortonormaies completos 3. Series de Fourier trigonométricas 4. Problemas de SturmLiouville 5. Transformada de Fourier 6. Transformada de Laplace 7. Aplicacións

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	31	62	93
Prácticas con apoio das TIC	18	27	45
Exame de preguntas de desenvolvemento	3	3	6
Resolución de problemas e/ou exercicios	0	6	6
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Lección maxistral	Exposición da teoría.Translación de problemas técnicos a modelos matemáticos.
Prácticas con apoio das TIC	Técnicas de cálculo e programación, presentación e interpretación de solucións.

Atención personalizada	
Methodologies	**Description**

Lección maxistral	O profesor atenderá as dúbidas e preguntas do alumnado.
Prácticas con apoio das TIC	O profesor atenderá as dúbidas e preguntas do alumnado.

Avaliación

	Description	Qualification	Training and Learning Results
Exame de preguntas de desenvolvemento	Realizarase un exame final de resolución de problemas na aula informática onde se poderán utilizar os programas preparados polo alumno, sobre os contidos de toda a materia.	40	
Resolución de problemas e/ou exercicios	Avaliación continua: Asistencia as clases teóricas e practicas(10%). Presentación dunha worksheet en Sage cos traballos propostos ó alumno: Traballo 1º (metade de curso): 20% Traballo 1º (final de curso): 30%	60	

Other comments on the Evaluation

Para os alumnos que renuncien á avaliación continua o examen final suporá o 100% da nota.

A avaliación dos alumnos en segunda convocatoria consistirá nun exame sobre os contidos da totalidade da materia, que suporá o 100% da nota.

COMPROMISO ÉTICO:

"Esperase que o alumno presente un comportamento ético adecuado. En caso de detectar un comportamiento non ético (copia, plaxio, utilización de aparellos electrónicos non autorizados, e outros) se considerará que o alumno non reúne os requisitos necesarios para superar a materia. Neste caso a calificación global no presente curso académico será de suspenso (0.0)."

Bibliografía. Fontes de información

Basic Bibliography

E. Corbacho, **Matemáticas de la Especialidad**, Curso 2014-2015,

F. De Arriba, E. Corbacho, MC. Somoza, R. Vidal, **Implementación e desenvolvemento de aulas de matemáticas avanzadas en Sage**, 2018

F. De Arriba, A. Castejón, E. Corbacho, MC. Somoza, R. Vidal, **Implementacióne e desenvolvemento de aulas de xeometría euclídea e diferencial en Sage**, 2020

M.R. Spiegel, **Análisis de Fourier. Teoría y problemas**,

M. Crouzeix , A.L. Mignot, **Analyse numérique des équations différentielles**,

Complementary Bibliography

P.G. Ciarlet, **Introduction à l'analyse numérique matricielle et à l'optimisation**,

H. Rinhard, **Éléments de mathematiques du signal**,

D.G Zill, **Ecuaciones diferenciales con aplicaciones de modelado**,

Recomendacións

Subjects that it is recommended to have taken before

Matemáticas: Álxebra e estatística/V12G360V01103
Matemáticas: Cálculo I/V12G360V01104
Matemáticas: Cálculo II e ecuacións diferenciais/V12G360V01204

Other comments

Requisitos:
Para matricularse nesta materia é necesario superar ou ben estar matriculado de todas as materias dos cursos inferiores ao curso no que está situada esta materia.

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

IDENTIFYING DATA				
Machine design and testing				
Subject	Machine design and testing			
Code	V12G363V01602			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	González Baldonedo, Jacobo			
Lecturers	González Baldonedo, Jacobo Segade Robleda, Abraham			
E-mail	jacobo.gonzalez.baldonedo@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	This subject is intended to allow the students to apply the fundamentals of Mechanism and Machines Theory to the design of machines as well as the necessary knowledge, comprehension, and application of these concepts concerning to the field of Mechanical engineering. It also provides the students with the most important concepts related to the design of machines. The students will know and apply analysis methods for the design of machines by applying analytical methods or/and through the effective use of simulation software.			

Training and Learning Results	
Code	
B3	CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations.
B4	CG4 Ability to solve problems through initiative, decision-making, creativity, critical reasoning, and to communicate and transmit knowledge, skills and abilities in the field of industrial engineering.
B5	CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
B6	CG6 Capacity for handling specifications, regulations and mandatory standards.
B11	CG11 Knowledge, understanding and ability to apply the legislation relating to industrial installations.
C13	CE13 Knowledge of the principles of the theory of machines and mechanisms.
C26	CE26 Knowledge and abilities to calculate, design and test machines.
D2	CT2 Problem solving.
D9	CT9 Application of knowledge.
D16	CT16 Critical thinking.
D20	CT20 Ability to communicate with people not expert in the field.

Expected results from this subject	Training and Learning Results		
Knowledge of calculation methods applied in Mechanical design.	B3 B4 B5	C13 C26	D2 D9 D16
Knowledge and design capabilities applied in mechanical power transmissions.	B6	C13 C26	D2 D9 D16 D20
Knowledge of the fundamental laws applied in the study of machine elements.	B11	C13 C26	D2 D9 D16 D20
Calculation capabilities and analysis applied for different machine components.	B3 B11	C13 C26	D2 D9 D16

Contents
Topic

Mechanical design	1. Design vs. static loads 2. Design vs. dynamic loads
Power Transmissions	3. Introduction to power transmission systems 4. Gears (spur, bevel, and worm gears) 5. Axles and shafts
Machine elements	6. Clutches and brakes 7. Bolted joints and power screws 8. Plain and ball bearings

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	23	19.5	42.5
Problem solving	9	30	39
Laboratory practical	18	45	63
Problem and/or exercise solving	2.5	0	2.5
Problem and/or exercise solving	0	3	3

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

Methodologies

	Description
Lecturing	Lectures about the topics of the subject
Problem solving	Discussion of exercises
Laboratory practical	Practical sessions including specific material and software tools.

Personalized assistance

Methodologies	Description
Lecturing	Group or individual tutorial sessions 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	Training and Learning Results		
Laboratory practical	The attendance and participation of students in laboratory practices will be valued. To complete the practice activities, a online questionnaire will need to be solved, covering aspects derived from the material taught in the practice.	30		C13 C26	D2 D9 D16 D20
Problem and/or exercise solving	Several problem-solving tests will be formulated in Moovi, which will be solved virtually. The scheduling of these tests will be done with sufficient advance notice and in accordance with the current regulations.	30	B3 B4 B5 B6 B11	C13 C26	D2 D9 D16
Problem and/or exercise solving	Students will be evaluated in a final written exam on the date established in the exam calendar. This test will assess all the content developed in the subject.	40	B3 B4 B5 B6 B11	C13 C26	D2 D9 D16 D20

Other comments on the Evaluation

Continuous Assessment

1st Edition

The subject will be approved if a final grade of 5 or higher is obtained as follows:

- Attendance and successful completion of laboratory/computer room/equivalent classroom will have a maximum rating of 3 points towards the final grade. To add the practice grade, a minimum attendance of 7 sessions is required, and a minimum rating of 1 point out of 3 for the practice activities.

- The problem-solving tests in Moovi will have a maximum rating of 3 points towards the final grade. To have this section count, a minimum of 1 point out of 3 is required.
- The final exam will have a maximum rating of 4 points towards the final grade. A minimum of 1.5 out of 4 is established for this part of the evaluation system. If the minimum is not obtained in the final exam, the final grade will be the rating of this test weighted out of 10.

2nd Edition

In the second edition, the problem-solving tests can be retaken, so the final test will have a maximum rating of 7 points with a minimum score of 2.5 (out of 7). The grade for those who do not reach the minimum in this part will be the rating of the problem-solving test weighted out of 10 points.

Overall Evaluation

For those who opt for the global evaluation system following the mechanisms established by the School of Industrial Engineering, the evaluation system will consist of the following sections:

- Evaluation of the practical part: This test consists of solving a series of questions related to the content taught in the practical sessions of the subject. It will have a maximum rating of 3, and a minimum of 1 point must be obtained for it to count.
- Problem-solving and/or exercises test: The final exam will have a maximum rating of 7 points towards the final grade. A minimum of 2.5 out of 7 is established for this part of the evaluation system. If the minimum is not obtained in the final exam, the final grade will be the rating of this test weighted out of 10.

Ethical Commitment

It is expected that the student presents appropriate ethical behavior. In the event of detecting unethical behavior (copying, plagiarism, use of unauthorized electronic devices, among others), it will be considered that the student does not meet the necessary requirements to pass the subject. In this case, the overall grade for the current academic year will be a fail (0.0).

The use of any electronic devices during assessment tests will not be allowed unless expressly authorized. The introduction of an unauthorized electronic device in the exam room will be considered grounds for not passing the subject in the current academic year, and the overall grade will be a fail (0.0).

*A numerical grading system from 0 to 10 points will be used according to the current legislation (RD 1125/2003 of September 5, BOE of September 18).

Sources of information

Basic Bibliography

Norton, R., **Machine Design. An Integrated Approach**, Pearson, 2012

Shigley, J.E, **Mechanical Engineering Design**, 9ª edición, Mc Graw Hill, 2012

Norton, R., **Diseño de Máquinas. Un Enfoque Integrado**, Pearson, 2012

Shigley, J.E, **Diseño de en Ingeniería Mecánica**, 9ª edición, Mc Graw Hill, 2012

Complementary Bibliography

Mott, Robert L., **Machine Elements in Mechanical Design**, Pearson, 2006

Lombard, M, **Solidworks 2013 Bible**, Wiley, 2013

Hamrock, Bernard J, et al., **Fundamental Machine Elements**, Mc Graw Hill, 2000

Mott, Robert L., **Diseño de elementos de máquinas**, Pearson, 2006

Hamrock, Bernard J, et al., **Elementos de Máquinas**, Mc Graw Hill, 2000

Recommendations

Subjects that it is recommended to have taken before

Materials science and technology/V12G360V01301
Mechanics of materials/V12G360V01404
Mechanism and machine theory/V12G360V01303

IDENTIFYING DATA				
Elasticity and additional topics in mechanics of materials				
Subject	Elasticity and additional topics in mechanics of materials			
Code	V12G363V01603			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Riveiro Rodríguez, Antonio			
Lecturers	Comesaña Piñeiro, Rafael Riveiro Rodríguez, Antonio			
E-mail	ariveiro@uvigo.es			
Web				
General description	This course will study the fundamentals of elasticity and deepen the study of mechanics of materials in order to be able to apply their knowledge to the actual behavior of solids (structures , machinery and resistant elements in general). This course, along with mechanics of materials course, is a holder of more specialized subjects whose object is the mechanical design.			

Training and Learning Results	
Code	
B3	CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations.
B4	CG4 Ability to solve problems through initiative, decision-making, creativity, critical reasoning, and to communicate and transmit knowledge, skills and abilities in the field of industrial engineering.
C14	CE14 Knowledge and use of the principles of strength of materials.
D2	CT2 Problem solving.
D5	CT5 Information Management.
D9	CT9 Application of knowledge.
D10	CT10 Self learning and work.
D17	CT17 Working as a team.

Expected results from this subject	Training and Learning Results		
Knowledge of the foundations of the elasticity theory	B3	C14	
Further deepening on mechanics of materials and stress analysis	B3 B4	C14	D2 D10
Knowledge of deformations in beams and shafts	B3 B4	C14	D2 D9
Ability to apply the knowledge of elasticity and mechanics of materials, and to analyze the mechanical performance of machines, structures, and general structural elements	B4	C14	D2 D5 D9
Ability to take decisions about suitable material, shape and dimensions for a structural element subjected to a specific load	B4	C14	D2 D5 D9 D17
Knowledge of different solving methods for structural problems and ability to choose the most suitable method for each specific problem	B4	C14	D2 D5 D9

Contents
Topic

Fundamentals of elasticity	Introduction to the theory of elasticity Stress analysis of elastic solids Strain Stress-strain relationships Two-dimensional elasticity
Criteria of failure	Saint-Venant's failure criterion Tresca's failure criterion Von-Mises' failure criterion Safety coefficient
Bending	Non uniform bending: Shear stresses. Zhuravski expression Principal stresses. Stress trajectories Bending and axial load: Normal stresses. Neutral axis Eccentric axial loads Kern of the cross-section Beams of different materials
Bending. Statically indeterminate beams	General method Settlements in fixed supports Continuous beams Simplifications in symmetric and antisymmetric beams
Torsion	Definition Coulomb's fundamental theory Static torque diagrams Stress and angle of twist Statically indeterminate problems
Combined loads	Definition Bending and torsion loaded circular shafts Shear center Stress and strain calculation in plane-spatial structures
Strain energy and energy methods	Strain energy: Axial load/shearing loads/bending/torsion/general expression. Clapeyron's theorem Indirect and direct work Maxwell-Betti Reciprocal Theorem. Applications. Castigliano's theorem. Mohr's integrals. Applications. Principle of virtual works.
Trusses	Definition and general comments Degree of indeterminacy Analytical method of force calculation Pinned joint displacement determination External indeterminacy and internal indeterminacy
Structures with rigid joint connections	Definition Joint stiffness factor and distribution factor Degree of indeterminacy. Analysis by the stiffness method.
Moving loads	Influence lines. Definition and general properties.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	0.5	0	0.5
Previous studies	0	6	6
Lecturing	13	26	39
Problem solving	18	22	40
Laboratory practical	18	7	25
Autonomous problem solving	0	15	15
Problem and/or exercise solving	2	17.5	19.5
Self-assessment	0	5	5

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

Methodologies

	Description
Introductory activities	Introduction to the subject: Course aims, expected learning outcomes, course syllabus, teaching methods, assessments and grading policy.

Previous studies	Student previous activities to lectures. The students will receive detailed instructions to complete and send certain exercises before lectures/laboratory sessions. The purpose of this assessment is to optimize the session outcome. The delivery of these exercises will modify the obtained qualification of the continuous assessment (laboratory practices and conceptual tests) as explained in the section of "Other comments and second call" in this guide.
Lecturing	The contents of the subject will be presented in a organized way. Special emphasis will be put on the fundamentals of the subject and on the most troublesome points. To improve the comprehension, the contents of the next lectures will be announced on Tema platform on a weekly basis.
Problem solving	Each week will devote a time to the resolution by part of the student of exercises or problems proposed, related with the content studied in each moment.
Laboratory practical	Application of theory concepts to laboratory collaborative works.
Autonomous problem solving	The students will be supplied with exercises and problems to solve, the solutions will be provided for level self-evaluation.

Personalized assistance

Methodologies	Description
Autonomous problem solving	The lecturers are at disposal of the students during office hours to solve any question related to the subject contents. The students will be able to verify if the completed assignments are correct and to identify the mistakes of miscalculations. The detailed schedule will be provided to the students at the beginning of the course through the TEMA platform. Any modification will be previously announced.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	Active participation in all classes will be valued, and when applicable, the submission of the lab reports and their content will be assessed according to the guidelines provided by the lecturers. The grading will be on a scale of 0 to 10. The grade obtained will be the same in both the first and second opportunities of the course's examination session.	5	B4 C14 D2 D5 D9 D10 D17
Problem and/or exercise solving	Several tests will be proposed to assess the acquired learning results in the subject. They will consist of problem-solving and/or theoretical questions by the students. None of these tests will exceed 40% of the overall grade for the subject. The tests will be conducted throughout the course during class hours and/or on dates/times approved by the institution. The final test will be performed during the official examination schedule approved by the Comisión Permanente of the School of Industrial Engineering. It will be graded on a scale of 0 to 10. The minimum average grade for all tests will be 4.5/10, with a minimum grade of 4/10 required for each individual test. In the second opportunity of the course's examination session, there will be a single test that encompasses all the content of the subject, carrying a weight of 95% of the final grade. In this case, the minimum mark to pass the subject will be 4.5/10. The duration of the test, as well as the weight of each question, will be provided at the time of the test.	95	B3 C14 D2 B4 D9

Other comments on the Evaluation

It will be necessary to obtain a minimum score of 5 out of 10 to pass the subject. Students who have been granted with the waive of continuous assessment may take the final exam, which will be the 100% of the final mark. This exam will assess the competencies covered in the entire subject.

Comments regarding continuous assessment activities:

The failure to submit lab reports, whether justified or not, will not result in the repetition of the lab practice on a different date.

The dates and locations for all exam sessions will be set by the School of Industrial Engineering before the start of the course and will be made public.

Ethical commitment: it is expected an adequate ethical behavior of the student. If any unethical behavior is detected (cheating, plagiarism, unauthorized use of electronic devices, etc.), it will be considered that the student does not meet the necessary requirements to pass the course. In such cases, 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

José Antonio González Taboada, **Tensiones y deformaciones en materiales elásticos**, 1st ed., Tórculo, 1997

José Antonio González Taboada, **Fundamentos y problemas de tensiones y deformaciones en materiales elásticos**, 1st ed., Tórculo, 2008

Manuel Vázquez, **Resistencia de Materiales**, 4th ed., Ed. Noela, 2008

Complementary Bibliography

Luis Ortiz Berrocal, **Elasticidad**, 3rd ed., McGraw-Hill, 1998

Robert Mott, Joseph A. Untener, **Applied Strength of Materials**, 6th ed., CRC Press, 2016

Ansel C. Ugural, Saul K. Fenster, **Advanced Mechanics of Materials and Applied Elasticity**, 6th ed., Pearson, 2021

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/V12G360V01102
Physics: Physics 2/V12G360V01202
Mechanics of materials/V12G360V01404

Other comments

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

The original teaching guide is written in Spanish. In case of discrepancies, shall prevail Spanish version of this guide.

IDENTIFYING DATA				
Manufacturing engineering				
Subject	Manufacturing engineering			
Code	V12G363V01604			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Pereira Domínguez, Alejandro Prado Cerqueira, María Teresa			
Lecturers	Prado Cerqueira, María Teresa			
E-mail	tprado@uvigo.es apereira@uvigo.es			
Web				
General description				

Training and Learning Results	
Code	
B3	CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations.
C20	CE20 Applied knowledge of systems and manufacturing processes, metrology and quality control.
D2	CT2 Problem solving.
D8	CT8 Decision making.
D9	CT9 Application of knowledge.
D10	CT10 Self learning and work.
D17	CT17 Working as a team.
D20	CT20 Ability to communicate with people not expert in the field.

Expected results from this subject	Training and Learning Results		
- Know the technological basis and the basics of manufacturing processes	B3	C20	D2
- Understand the basics of manufacturing systems			D8
- Acquire skills for the selection of manufacturing processes and developing manufacturing planning			D9
			D10
- Develop skills for making assemblies and parts in CADCAM environments			D17
- Application of CAQ technologies			D20

Contents	
Topic	
Thematic block I: Integration of Design of product and manufacture.	Chapter 0. Design of product and of process chapter 1. Systems of manufacture. Chapter 2. Technologies of additive manufacturing Chapter 3. Design of product for manufacturing (DFMA)
Thematic block II: Design and planning of processes of manufacture.	Chapter 4. Methodology of Design and Planning of processes of manufacture. Chapter 5. Choosing of operations, tools, toolings and conditions of process. chapter 6. Datums, fixturing and toolings. Chapter 7. Technicians of improvement of design and processes.
Thematic block III: Resources of the Systems of Manufacture.	Chapter 8. Machines tools with Numerical Controland components Chapter 9. Industrial robots and logistics devices. Systems of positioning, maintenance Chapter 10. Systems of measurement and verification in lines of manufacture. Definition of control charts

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Problem solving	18	16	34
Laboratory practical	18	0	18
Mentored work	0	60	60
Lecturing	14	14	28
Objective questions exam	2	0	2
Essay	2	0	2
Essay questions exam	2	2	4
Presentation	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
Introductory activities	Introduction Objective theoretical topics practical topics Assestment Develop of projects. Desing and Develop Bibliographic Resources
Problem solving	Development of real practical cases and exercises on the following contents 1. Distribution in plant 2. Design of product / tooling 3. Application *DFMA 4. Application dimensional tolerances, geometrical and of superficial finishing 5. Design of operations of manufacture. 6. Conditions of process manufacturing. 7. Calculus of speeds, feeds, strengths and powers in manufacture 8. Procedures of measurement.
Laboratory practical	*P1-2 PLM. Design of product and of process. Platform CADCAM available (Catia, NX, Fusion) 2h +2h P3 Planning process of manufacturing. Design of Tooling for product 2h P4 -5 -6 Programming assisted of machined tooling, CAM, (Catia, NX, Fusion, □) 6h P7 -8 -9 Supervsing works 6*h
Mentored work	Project (Work to make by student. It would correspond to Groups C of 5 students) Total 18*h
Lecturing	Synthetic teaching of the topics Proposition real cases and problems

Personalized assistance

Methodologies	Description
Mentored work	Attending Works and supervising projects (groups from among 3 and 5 people).

Assessment

	Description	Qualification	Training and Learning Results		
Objective questions exam	Examination with questions type test, in which the no hit answers discount. The test can comport questions of type problems and development.	40	B3	C20	D2 D8 D9
Essay	Development of project of course. It will evaluate , the capacity of work in team, creativity, autonomous work and in case of public presentation the capacity of communication and synthesis.	40		C20	D2 D9 D10 D17 D20
Essay questions exam	Development of problems and or cases	10		C20	D2 D8 D9 D10

Presentation	Exhibition of Development of work made	10	D17 D20

Other comments on the Evaluation

The evaluation consists of:
To.-) Examination of objective questions : Compulsory and has to have a note &*gt; 4 to be able to compensate with work or with Examination of questions of development Value 40%

practical Part, to choose between *B1 or *B2
*B1.-)I work Project. Value 40%
*B2.-)Examination of questions of development: Consistent in problems and or cases. Value 40%

The final note composes of To +*B, being *B= *B1 or *B2

ethical Commitment: it expects that the present student a suitable ethical behaviour.&*nbsp;In the case to detect a no ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices, and others) 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).

Sources of information

Basic Bibliography

Complementary Bibliography

Pereira A., Prado T., **Notes of the subject IF**, 2015,
Pereira A., **Exercises and cases of manufacturing Engineering**, 2016,
Kalpakjian, S., **Manufacturing Engineering and Technology**, 7th ed.,

Recommendations

Subjects that it is recommended to have taken before

Fundamentals of manufacturing systems and technologies/V12G360V01402

Other comments

Requirements:
To enrol in this matter is necessary to have surpassed or be enrolled of all the matters of the inferior courses to the course in which it is situated this matter.

IDENTIFYING DATA				
Electrical machines				
Subject	Electrical machines			
Code	V12G363V01605			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language				
Department				
Coordinator	Novo Ramos, Bernardino			
Lecturers	Novo Ramos, Bernardino			
E-mail	bnovo@uvigo.es			
Web				
General description				

Training and Learning Results
Code

Expected results from this subject	
Expected results from this subject	Training and Learning Results

Contents	
Topic	
UNIT I: INTRODUCTION TO THE ELECTRICAL MACHINES	I-1 Electromagnetic and electro-mechanic fundamental laws. General behaviour notes: Physical arrangement of the electrical machines. Types of machines. Losses. Energy balance. Efficiency. Heating. Cooling. Rated power. Insulation types. Degrees of mechanical protection and construction types. Nameplate. I-2 Usual construction: Magnetic poles. Windings. I-3 M.M.F□s and E.M.F□s inside the machine: Fields generated with concentrated and distributed windings. Rotating magnetic field. Winding factor
UNIT II: INDUCTION MOTORS (ASYNCHRONOUS)	II-1 Three-phase induction machine Construction characteristics. Operating principles. Electrical equivalent circuit. Powers and torques. Electrical tests. Energy balance and efficiency. T-s curve. Operation modes. Starting methods and speed control. AC motor protection and control switchgear. Security oriented control circuits Security oriented protection schemes II-2 Single-phase induction motor Construction characteristics. Operating principles. Electrical equivalent circuit. Starting methods.
UNIT III: SYNCHRONOUS MACHINES (GENERATORS)	UNIT III: SYNCHRONOUS MACHINES (GENERATORS) Construction characteristics. Operating principles. Armature reaction. Salient poles and cylindrical rotor machines. Electrical equivalent circuit. Stand-alone and grid-connected behaviours. Synchronous motor: Characteristics and uses.
UNIT IV: D.C. MOTORS. SPECIAL MACHINES	IV-1 Classic D.C. motor: Construction characteristics. Operating principles. Excitation systems. Armature reaction. Commutation. Speed control. Nameplate information. IV-2 Special machines: BLDC, Stepper Motors.

Planning			
	Class hours	Hours outside the classroom	Total hours

Problem solving	8	16	24
Laboratory practical	10	16	26
Lecturing	29.5	65	94.5
Objective questions exam	1	0	1
Problem and/or exercise solving	1.5	0	1.5
Laboratory practice	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
Problem solving	Student will be required to work in groups to solve and present some proposed ac machines problems. This activity could be done using the "virtual office" if presentiality is not posisible due to the COVID19 University self-quarantine polilcies
Laboratory practical	Typical lab session in the Electrical Machines laoratory. They can be done online (iusing some machine simulation software) if presentiality is not posisible due to the COVID19 University self-quarantine polilcies During these lessons students will apply the theoretical knowledge provided during the theory lessons, and at the same time they will learn how to protect themselves, other people and the machines against ANY possible electrical hazzard. Active and Passive Security will be taught and followed in these hours
Lecturing	Typical lecture. Either presential or using the "virtual office" facility. The place will depend on the COVID19 University self-quarantine polilcies

Personalized assistance

Methodologies	Description
Lecturing	Course-related discussions, asking for extra help, seeking clarification of material presented in class and following up on aspects of the class you find compelling can be done during the "Office Hours". They can be presential or "virtual". The student should ask the lecturer (e-mail) in order to decide the day and the time
Problem solving	Course-related discussions, asking for extra help, seeking clarification of material presented in class and following up on aspects of the class you find compelling can be done during the "Office Hours". They can be presential or "virtual". The student should ask the lecturer (e-mail) in order to decide the day and the time

Assessment

	Description	Qualification	Training and Learning Results
Problem solving	The assessment method will be a numerical resolution of some exercises of electrical machines A minimum mark of 30% will be required in this part	40	
Laboratory practical	the student should complete properly the practices proposed along the course to get the maximum 20% of the mark. The professor will decide the final mark depending of the laboratory results of every student	20	
Lecturing	The assessment method will be a test, to be done individually without the use of any information source. There will be one unique test for the whole subject, and it will cover not only the theoretical lessons but the practical lab tests. A minimum mark of 30% will be required in this part Part of this qualification percentage could be obtained with some continuous evaluation in the lab lessons, depending on the lecturer. (10/60). Student will be properly informed if this option is activated.	40	

Other comments on the Evaluation

To pass the subject a minimum of 5/10 will be required (result of the sum of the 2 parts)

If the student final mark is bigger than 5, but the minimum in each part is not reached, the overall given mark will be 4.0

(FAILED)

Commitment: An student ethical behaviour is expected. If a non-ethical behaviour is detected (copying, cheating in any way, using unlicensed electronic devices, and others), it will be considered that the student does not gather the necessary requirements to pass the subject. In case of some unethical behaviour the mark will be 0.0 (FAILED) The COVID19 University policies can modify the final exam type, if we have to move to a "virtual exam". Any change will be announced properly so the students can adapt their learning processes to the new situation

Sources of information

Basic Bibliography

Complementary Bibliography

B. Novo, **Class notes**,

Any ac machines book,

Recommendations

Subjects that are recommended to be taken simultaneously

Automation and control fundamentals/V12G363V01304

Subjects that it is recommended to have taken before

Physics: Physics 1/V12G363V01102
Physics: Physics 2/V12G363V01202
Basics of circuit analysis and electrical machines/V12G363V01302
Applied electrotechnics/V12G363V01501

IDENTIFYING DATA				
Chemical technology				
Subject	Chemical technology			
Code	V12G363V01606			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	English			
Department				
Coordinator	Rosales Villanueva, Emilio			
Lecturers	Rosales Villanueva, Emilio Sanroman Braga, María Ángeles			
E-mail	emiliorv@uvigo.es			
Web				
General description	In this subject, students learn the basic aspects of Chemical Engineering and the fundamentals of the basic operations most employed in industry.			

Training and Learning Results	
Code	
B3	CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations.
B4	CG4 Ability to solve problems through initiative, decision-making, creativity, critical reasoning, and to communicate and transmit knowledge, skills and abilities in the field of industrial engineering.
C4	CE4 Ability to understand and apply the basic knowledge of general chemistry, organic chemistry and inorganic chemistry, and their applications in engineering.
D2	CT2 Problem solving.
D9	CT9 Application of knowledge.
D10	CT10 Self learning and work.
D17	CT17 Working as a team.

Expected results from this subject	Training and Learning Results		
To know the bases of chemical technology.	B3	C4	D9
To apply mass and energy balances to real systems.	B4	C4	D2 D9 D10 D17
To know and understand the basic aspects of mass transfer.	B3	C4	D9
To know the fundamentals of separation processes and their application to real cases.	B4	C4	D2 D9 D10 D17

Contents	
Topic	
Introduction	Chemical Engineering. Basic principles. Chemical processes. Unit conversion and calculation tools
Mass and energy balances	Mass balances for systems without chemical reaction. Mass balances for systems with chemical reaction. Energy balances
Implementation of balances into chemical reactor design	Stoichiometry. Reaction rate. Ideal reactors
Mass transfer	Introduction. Mass transfer equations: individual and global coefficients
Distillation and rectification of liquid mixtures	Vapour-liquid equilibrium. Simple distillation. Rectification. Azeotropic and extractive distillation.
Liquid-liquid extraction	Fundamentals. Binary and ternary mixtures. Factors that affect the separation. Operation by simple contact, multiple contact in direct current, multiple contact in multiple countercurrent
Other operations in chemical processes	Gas absorption. Liquid-solid extraction. Adsorption and ion exchange.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	15	40	55
Problem solving	17	31	48
Laboratory practical	8	8	16
Studies excursion	4	1	5
Simulation	4	2	6
Problem and/or exercise solving	3	9	12
Report of practices, practicum and external practices	0	2	2
Objective questions exam	1.5	4.5	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	Direct oral exposition of the most important contents of the subject by the lecturer.
Problem solving	The lecturer suggests various problems to the students so they can work on them at home. Then, the lecturer solves them in the seminar classes. Besides along the course made diverse controls in which the students will have to resolve problems of the level of similar difficulty to the made in class.
Laboratory practical	The students will perform some experiments in the laboratory related to the topics covered throughout the course. The aim of the laboratory practices is to deepen basic concepts.
Studies excursion	Visits of the students to companies of the surroundings to make an approach to the business reality and visualise the application of the theoretical contents given in the subject.
Simulation	Learning and utilisation of programs of simulation applied to the contents of the subject.

Personalized assistance

Methodologies	Description
Lecturing	The students can ask the lecturer any question about the theoretical and practical aspects of this subject, about this methodology and the correction of the assessment tests.
Problem solving	The students can ask the lecturer any question about the theoretical and practical aspects of this subject, about this methodology and the correction of the assessment tests.
Laboratory practical	The students can ask the lecturer any question about the theoretical and practical aspects of this subject, about this methodology and the correction of the assessment tests.
Studies excursion	The students can ask the lecturer any question about the theoretical and practical aspects of this subject, about this methodology and the correction of the assessment tests.
Simulation	The students can ask the lecturer any question about the theoretical and practical aspects of this subject, about this methodology and the correction of the assessment tests.

Assessment

	Description	Qualification	Training and Learning Results		
Studies excursion	Questions and activities related to the visit to be made will be carried out. These may take place before or after the visit.	5	B4	C4	D2 D9 D10 D17
Simulation	Realisation of diverse simulations of chemical processes that will have to deliver after the sessions of simulation that will make along the course	15	B3 B4	C4	D2 D9 D10 D17
Problem and/or exercise solving	The students will make diverse controls, stating each one of them of problems.	40	B3 B4	C4	D2 D9
Report of practices, practicum and external practices	It will be evaluated in this item both the realisation of the practices of laboratory like the reasoning and treatment of the results obtained in the development of the practical classes of laboratory.	10		C4	D9 D10 D17
Objective questions exam	This evaluation test includes two types of exams with objective questions: + multiple-choice questions in the lecture sessions, which will represent 10% of the total. + Short questions that will be asked in different controls throughout the course, which will represent 20% of the total value of the exam.	30	B3 B4	C4	D2 D9 D10 D17

Other comments on the Evaluation

ASSESSMENT:
The participation of the student in any of the evaluation systems of the subject(laboratory practicals, problem solving and exercises, simulation, field trip, exam of objective questions) will imply the condition of presented and its qualification in the minutes. A minimum attendance of 75% of the practicals, field trips and simulations of the course is required to have theright to the evaluation of the same. Otherwise, the mark for these evaluation systems will be 0.0.

A student who "does not officially waive the continuous assessment" will be failed if he/she does not achieve a MINIMUM mark of 4.0 points (out of 10) in each of the tests described above. The student will pass the subject if the FINAL GRADE is ≥5.0, that is, if the sum of the grades obtained in the different evaluation systems of the subject is ≥ 5.0.

Second call: In the second round, students will take a final exam in which they will be assessed on all the teaching methodologies applied
throughout the course. This mark will be 100% of the grade.
STUDENTS RELEASED FROM CONTINUOUS ASSESSMENT: When the School releases a student from the continuous assessment process, a "FINAL EXAMINATION" will be held on the
dates established in the school calendar. The grade will be the sum of 90% of the mark obtained in the "FINAL EXAMINATION" and 10% of the laboratory practicals mark.
ETHICAL COMMITMENT: The student is expected to present adequate ethical behaviour. In the event that unethical behaviour 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 for the assessment exams is not allowed unless explicitly authorised. The fact of introducing unauthorised electronic devices in the examination room will be considered as a reason for not to pass the subject in the current academic year and will hold overall rating (0.0).

Sources of information

Basic Bibliography

Himmelblau, D.M., **Basic principles and calculations in chemical engineering**, 7th, Prentice Hall International, 2004

Felder, R.M. and Rousseau, R.W., **Elementary principles of chemical processes**, 3rd, John Wiley & Sons, Inc., 2005

Chopey, N.P., **Handbook of Chemical Engineering Calculations**, 3rd, McGraw-Hill Companies, 2003

Fogler, H.S., **Elements of Chemical Reaction Engineering**, 5th, Prentice Hall International,

Levenspiel, O., **Chemical Reaction Engineering**, 3rd,

Coulson, J.M. and others, **Chemical Engineering vol. 1 and vol 2**, 5th, Butterworth-Heinemann, 2002

McCabe, W.L., Smith, J.C. and Harriott, P., **Unit operations of chemical engineering**, 5th, McGraw-Hill International Editions, 1993

Seader, J.D., Henley, E.J., Roper, D.K., **Separation process principles. Chemical and Biochemical Operations**, 3rd, John Wiley & Sons, Inc., 2011

Complementary Bibliography

Treybal, R.E., **Mass-transfer operations**, 3rd,

Ocón, J. y Tojo, G., **Problemas de Ingeniería Química**, 3rd,

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/V12G360V01102
Physics: Physics 2/V12G360V01202
Mathematics: Calculus 1/V12G360V01104
Mathematics: Calculus 2 and differential equations/V12G360V01204
Chemistry: Chemistry/V12G360V01205

Other comments

Requirements: To enrol in this subject, it is necessary to have passed or be enrolled in every subject of inferior courses. In case of discrepancies, it will prevail the Spanish version of this document.