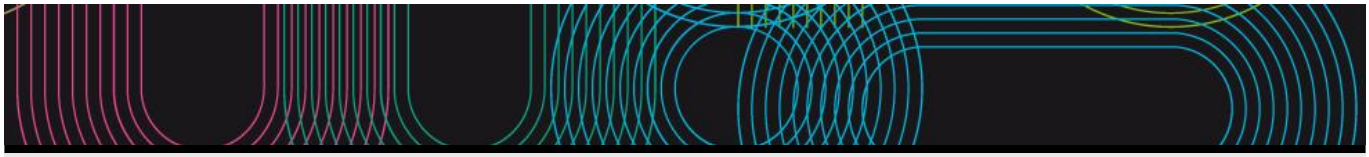

(*)Escola de Enxeñaría de Minas e Enerxía

Presentation

At the School of Mining and Energy Engineering of the University of Vigo we offer comprehensive training (undergraduate and master's degree level) in the field of mining, materials and energy engineering. The training offer of the center for the 2023/24 academic year is as follows:

Degree in Energy Engineering

In the Bachelor's Degree in Energy Engineering, we train professionals who contribute to achieve one of the Sustainable Development Goals of the 2030 Agenda: ensuring universal access to energy services while mitigating the climate impacts of energy production and use.

To meet this need, we offer the Bachelor's Degree in Energy Engineering, the only undergraduate program in Galicia. We educate engineers capable of designing, optimizing, and technically managing the technological processes in the energy sector, ranging from energy generation to the end-user level of thermal or electrical energy (production, storage, transportation, distribution, markets). In the current context, two areas of training are particularly relevant: (i) renewable energy generation technologies (such as wind, geothermal, hydroelectric, tidal, solar, wave, biomass, and biofuels, among others) and (ii) technological processes associated with energy efficiency.

Degree in Mining and Energy Resources Engineering

The Bachelor's Degree in Mining and Energy Resources Engineering is a **unique** program in Galicia and has been **declared as exceptional** within the Galician University System. It also has another distinctive feature: **it enables graduates to practice as regulated** mining engineers.

A regulated profession is that requiring specific accredited training. For certain regulated professions, this training corresponds to a university degree. This is the case for the Bachelor's Degree in Mining and Energy Resources Engineering, which qualifies graduates to practice as regulated Mining Engineers in three areas of technology (Order CIN 306/2009):

- Specialization in "Mining Operations": We educate engineers capable of designing and technically managing the processes that ensure the supply of mineral raw materials for the industry. This includes prospecting rocks and minerals, extraction, and preparation for material manufacturing.
- Specialization in "Materials Engineering": We educate engineers capable of designing and technically managing the manufacturing processes of materials (metals, plastics, ceramics, composites, new materials), as well as technological processes related to recycling, repair, reuse, quality control, and valorization of materials and waste.
- Specialization in "Energy Resources, Fuels, and Explosives": We educate engineers who have knowledge of and can characterize energy resources (such as wind, solar radiation, etc.) and are capable of designing and directing the technological processes in the energy sector, from energy generation to consumption. They also handle technological processes related to the use of fuels and explosives.

Master's Degree in Mining Engineering

Certain regulated professions require a higher level of education, and therefore, a master's degree is required to practice them. The Master's Degree in Mining Engineering **qualifies graduates as Mining Engineers (Order CIN 310/2009)**. This program **is also unique in Galicia** and provides advanced and specialized training in the fields of mining engineering, materials, and energy.

Both bachelor's degrees offered at the institution have direct access to the Master's Degree in Mining Engineering.

Interuniversity Master's Degree in Sustainable Water Management

This interuniversity master's degree is part of the G2030 catalogue of new degrees in the Galician University System (SUG), identified as essential for the training of future professional profiles in Galician society.

Specifically, graduates of this master's degree will be able to pursue careers as technical personnel, managers, or experts in sustainable water management, addressing future challenges in the water sector (water conservation, seawater desalination, collection and storage of rainwater, groundwater decontamination, use of new water processing technologies, digitalization, etc.).

This degree is interuniversity in nature, with a collaboration agreement between the three public universities in Galicia: UDC, USC, and UVigo.

School of Mining and Energy Engineering. Our Identity

We form engineers

At the School of Mining and Energy Engineering of the University of Vigo, we educate engineers who are professionals capable of addressing specific problems in the industry and society providing that these technological solutions are sustainable. This translates into education that goes beyond technological processes and includes training in economics, business, environment, safety, and health.

In addition, the education of engineers requires us to be in constant contact with the industry to understand its needs and the latest technologies. For this reason, the School maintains a permanent collaboration with industrial and business sectors, which includes students' participation in internships and numerous visits to industrial facilities to gain firsthand knowledge of technological processes.

Internacionalization

Our engineers will develop their professional activities in an international context. This is why we offer an Internationalization Plan that allows students to take up to 10 subjects, if desired, entirely in English. Furthermore, we actively work to facilitate student and faculty mobility abroad by establishing agreements with universities and research centers worldwide.

Equality

We want to emphasize our commitment to promoting equal values as a hallmark of our institution. We organize numerous activities with different objectives, including raising awareness about equality, promoting vocations in STEM disciplines, particularly in engineering, and providing mentorship and support to women in their professional activities, among others.

Scientific and Technological Outreach

A defining activity of the institution is our commitment to scientific and technological outreach. We work specifically with secondary schools (ESO) and high schools (Bachillerato), conducting conferences, workshops, award programs, competitions, and other activities aimed at showcasing our field of work and disseminating knowledge to society. Notably, we have the "Open Classroom for TechnoScience" initiative, which is a dedicated space for outreach activities.

Our University Community

The size of our institution encourages and facilitates interpersonal relationships among all members of the university community: students, faculty, and administrative staff. This is particularly relevant in the student-faculty relationship, which allows for personalized attention to students in the learning process. Our student body is especially dynamic and organizes numerous activities through student associations they participate in, such as the Student Delegation, Energy and Mining Sports Club, Technological Employment Forum, Uvigo Motorsport, CES Uvigo, and Uvigo SPACELAB.

Management Team and Coordination

MANAGEMENT TEAM:

Director

Elena Alonso Prieto (eme.direccion@uvigo.es)

Secretary

Guillermo García Lomba (eme.secretaria@uvigo.es)

Deputy Director of Economic Affairs, Infrastructure, and International Relations

Francisco Javier Deive Herva (eme.infraestructuras@uvigo.es, eme.internacional@uvigo.es)

Deputy Director of Planning and Academic Organization

María Araújo Fernández (eme.orgdocente@uvigo.es)

Deputy Director of Scientific Outreach and Student Recruitment

Raquel Pérez Orozco (eme@uvigo.es)

COORDINATION:

The Coordinating Procedure of the School of Mining and Energy Engineering is the instrument through which the content and implementation of various actions related to the coordination of the programs offered at the school are designed. Coordination of all activities is essential for the proper development of students. The coordination system is a fundamental element in the introduction of new objectives and methodologies, and it serves to enhance connections between faculty members and between faculty members and the school.

Bachelor's Degree in Energy Engineering (EI): Francisco Javier Deive Herva (deive@uvigo.es)

Bachelor's Degree in Mining and Energy Resources Engineering (IRME): Iria Feijoo Vázquez (ifeijoo@uvigo.es)

Master's Degree in Mining Engineering (UIM): Elena Alonso Prieto (ealonso@uvigo.es)

Master's Degree in Sustainable Water Management (IGSA): María Araújo Fernández (maraujo@uvigo.es)

1st Year of Bachelor's Degree Programs: Iria Feijoo Vázquez (ifeijoo@uvigo.es)

2nd Year of Bachelor's Degree Programs: Raquel Pérez Orozco (rporozco@uvigo.es)

3rd Year of Bachelor's Degree in IE: Pablo Eguía Oller (peguia@uvigo.es)

4th Year of Bachelor's Degree in IE: Ana María Rodríguez Rodríguez (aroguez@uvigo.es)

3rd & 4th Year of IRME: Fernando García Bastante (bastante@uvigo.es)

External Internships: Javier Taboada Castro (jtaboada@uvigo.es)

1st Year of UIM: Guillermo García Lomba (guille@dma.uvigo.es)

2nd Year of UIM: Marta Cabeza Simó (mcabeza@uvigo.es)

Extracurricular Activities: Ana María Rodríguez Rodríguez (aroguez@uvigo.es)

Follow-up of Graduates: Eduardo Liz Marzán (eliz@uvigo.es)

ICT: Joaquín Martínez Sánchez (aroguez@uvigo.es)

Scientific Outreach: Raquel Pérez Orozco (rporozco@uvigo.es)

Quality Assessment of the School: Guillermo García Lomba (guille@dma.uvigo.es)

Equality: Generosa Fernández Manín (gmanin@uvigo.es)

PAT/PIUNE: Ángeles Domínguez Santiago (admguez@uvigo.es)

School Web Page

http://minasyenergia.uvigo.es/es/

Assessment

Regarding assessment procedures, as stated in the Regulations for Students of the University of Vigo, students have the right (Art. 3.10) "to be evaluated through continuous assessment, with the option of global assessment tests in all subjects and evaluation opportunities throughout the academic year."

The teaching guides provide information about the development of continuous assessment and global assessment tests, detailing how continuous assessment is conducted in the first and second opportunities. The guides also explain how global assessment is conducted if a student has opted out of continuous assessment.

Regarding opting out of continuous assessment, each subject establishes a deadline for requesting this option. The minimum deadline for opting out cannot be less than one month from the start of the subject.

If a student provides justification (documentary evidence and following the procedures established by the school) that they cannot attend a mandatory face-to-face activity due to one of the reasons stated in Article 15 of the Evaluation Regulations, the situation regarding the student's grades, teaching quality, and learning progress will be reviewed by the Standing Committee (Comisión Permanente), which will consider alternative solutions in coordination with the teaching team responsible for the subject.

If a student justifies that they cannot attend an evaluation test due to one of the reasons stated in Article 15 of the Evaluation Regulations, they have the right to take the evaluation test on another date determined by the faculty member responsible for the subject, aiming to reach a consensus with the student regarding the new date.

Any aspect or circumstance related to the content of the teaching guides or the development of assessment systems and tests that is not detailed in the guides or raises doubts of interpretation will be evaluated by the School's Standing Committee.

Grado en Ingeniería de los Recursos Mineros y Energéticos

Subjects

Year 2nd

Code	Name	Quadmester	Total Cr.
V09G311V01201	Circuits and electrical machines	1st	6
V09G311V01202	Materials technology	1st	6
V09G311V01203	Materials resistance	1st	6
V09G311V01204	Fluid mechanics	1st	6
V09G311V01205	Thermal systems	1st	6
V09G311V01206	Geology: Geology	2nd	6
V09G311V01207	Heat transmission	2nd	6
V09G311V01208	Environmental technology	2nd	6
V09G311V01209	Electrical Technology	2nd	6
V09G311V01210	Health and safety	2nd	6

IDENTIFYING DATA

Circuits and electrical machines

Subject	Circuits and electrical machines			
Code	V09G311V01201			
Study programme	Grado en Ingeniería de los Recursos Mineros y Energéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Galician English			
Department				
Coordinator	Miranda Blanco, Blanca Nieves Moreira Meira, Julio César			
Lecturers	Miranda Blanco, Blanca Nieves Moreira Meira, Julio César			
E-mail	blancan@uvigo.es jcmeira@uvigo.es			
Web	http://https://moovi.uvigo.gal/			
General description	This class constitutes a basic course of circuit theory and fundamentals of electric machinery and batteries. The most important blocks are direct current and altern current circuits (single-phase ant three-phase), transformers, synchronous and asynchronous machines and electric batteries.			

Training and Learning Results

Code	
A1	That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study
A2	That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study
A3	That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues
A4	That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized audience
A5	That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.
B1	Scientific and technical training and qualification as a Mining Engineer and knowledge of the functions of consultancy, analysis, design, calculus, project, construction, maintenance, preservation and exploitation.
B2	To be familiar with the multiple technical and legal factors involved in the process of development, within the field of mining engineering, with the knowledge acquired in accordance with section 5 of order CIN/306/2009, pertaining to geological and mining prospecting and investigation, the explorations of all sorts of geological resources, including groundwater, underground construction, underground storage, treatment and benefit plants, energy plants, mineral processing and steel and iron plants, building materials plants, carbon chemistry, petrochemistry and gas plants, waste treatment and tributary plants, explosives factories, and ability to use well-tested methods and accredited technologies, with the aim of achieving the highest efficiency and ensuring the protection of the Environment and the safety and health of workers and users.
B3	Ability to design, write and plan partial or specific projects within the units specified in the previous section, such as mechanical and electric plants and their maintenance, networks of energy transportation, facilities for transportation and storage of solid, liquid and gaseous materials, waste sites, tailing dams, foundation and support, demolition, restoration, controlled explosions and explosives logistics.
B4	Ability to design, plan, run, inspect, sign and manage projects, plants or facilities, within their field.
C17	Knowledge of the fundamentals of the electrical power system: generation of energy, transportation, distribution and delivery networks, as well as the types of lines and conductors. Knowledge of the regulations of high and low tension. Basic knowledge of electronics and control systems.
D1	Ability to draw links between the different elements of all the knowledge they acquired, understanding them as components of a body of knowledge with a clear structure and strong internal cohesion.
D3	To suggest and develop practical solutions, using the relevant theoretical knowledge, to phenomena and problems-situations of ordinary reality that are specific to engineering, developing appropriate strategies.
D5	To be familiar with the relevant sources of information, including constant updating, in order to practice one□s profession competently, accessing all the present and future tools of information search, constantly adapting to technological and social changes.

D6	To be familiar with and to be able to use the legislation applicable in this sector, to be acquainted with the social and business environments and to be able to deal with the relevant administration, integrating this knowledge into the drawing up of engineering projects and into the implementation of every aspect of their professional work.
D7	Ability to organize, understand, assimilate, produce and handle all the relevant information to develop their professional work, using appropriate computing, mathematical, physics tools, etc. when these are required.
D8	Understanding engineering within a framework of sustainable development with environmental awareness.

Expected results from this subject

Expected results from this subject	Training and Learning Results			
To master the analysis of electrical single-phase and three-phase circuits in steady state	A1 A3		C17	D1 D5
To know the fundamentals of electrical machines operation	A1 A3		C17	D1 D5
To know electronic devices for control of electrical machines	A1 A3		C17	D1 D5
To know and deal with the basic concepts of the design of low voltage installations	A4		C17	D1 D3 D5 D6 D7 D8
To know the operation of electric power systems, generation, transmission, storage and distribution of the electric energy	A1 A2 A3 A4 A5	B1 B2 B3 B4	C17	D1 D5 D7 D8
To know the legislation applicable to electric power systems	A4		C17	D1 D3 D5 D6 D7 D8
To know the devices of a distribution network: lines, cables and electric equipment		B1	C17	D1 D6 D7 D8

Contents

Topic	
Direct current circuits	Steady-state analysis Variables, magnitudes and units Resistances Power and energy Basic equations, mesh analysis and nodal analysis The Thevenin theorem
Single-phase circuits	Steady-state analysis Variables, magnitudes and units Coils and capacitors Power and energy: instantaneous, mean, complex, apparent, real and reactive powers, power factor Basic equations, mesh analysis and nodal analysis The Thevenin theorem The Boucherot theorem of conservation of power
Balanced three-phase circuits	Steady-state analysis Variables, magnitudes and units Power and energy: complex, apparent, real and reactive powers, power factor Delta-wye and wye-delta conversions Equivalent single-phase circuits Representation in per unit values Resolution of electrical networks
Transformers	Fundamentals Equivalent electric circuit The ideal transformer The non ideal transformer

Rotating altern current electrical machines	Characteristics and operating principles Asynchronous machines Synchronous machines Equivalent electrical circuits Powers and torques
Electrochemical batteries	Principle of operation Equivalent electrical circuit

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	36	70	106
Practices through ICT	10	20	30
Laboratory practical	4	7.5	11.5
Essay questions exam	2.5	0	2.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Explanation of the theory. Resolution of numerical examples
Practices through ICT	Simulation of numerical cases in computer laboratory
Laboratory practical	Use of electrical equipment

Personalized assistance	
Methodologies	**Description**
Lecturing	The students will have the opportunity of asking the staff all questions related with the class
Practices through ICT	The students will have the opportunity of asking the staff all questions related with the class
Laboratory practical	The students will have the opportunity of asking the staff all questions related with the class

Assessment						
	Description	Qualification	Training and Learning Results			
Lecturing	It includes solving of exercises similar to those explained during the masterclasses. Three partial written exams will be carried out, each one with a weight of 10% of the total mark, about monophasic circuits, triphasic circuits and electrical machines. Besides, an examination will be performed in the official date established in the calendar of the school. This exam will include contents about all the matter and will represent 40% out of the total qualification. Expected results of this subject: To master the analysis of electrical single-phase and three-phase circuits in steady state To know the fundamentals of electrical machines operation To know electronic devices for control of electrical machines To know and deal with the basic concepts of the design of low voltage installations To know the legislation applicable to electric power system	70	A1 A3		C17	D1 D3 D5 D6 D7 D8
Practices through ICT	It covers the attendance to the practices and the presentation of the reports about solving the proposed activities. To pass this part it is necessary to attend a minimum of 75% out of the practical classes. Expected results from this subject: To know the operation of electric power systems, generation, transmission, storage and distribution of the electric energy To know the devices of a distribution network: lines, cables and electric equipment	30	A1 A2 A3 A4 A5	B1 B2 B3 B4	C17	D5 D6 D7 D8

Other comments on the Evaluation

CONSIDERATIONS ON CONTINUOUS ASSESSMENT

The final mark of the students selecting the continuous evaluation is obtained from the sum of the marks got in the partial tests, the final exam and the practices with the support of ICT.

CONSIDERATIONS ON THE GLOBAL EVALUATION

Students who refuse to carry out the continuous assessment will have the option of taking a final exam in which they will be able to obtain 100% of the grade.

In this case, the students will take two tests:

- Final exam: will account for 70% of the grade

- Test corresponding to practices with the support of ICT: it will mean 30%. This test may be replaced by the delivery of the practice report, in the case of students who attended at least 75% of the practices.

SECOND CHANCE CONSIDERATIONS

The conditions established for the first opportunity are maintained.

Sources of information
Basic Bibliography
Jesús Fraile Mora, **Máquinas eléctricas**, Ibergarceta,
José Fernández Moreno, **Teoría de circuitos**, Paraninfo,
Charles K. Alexander, Mathew N. O. Sadiku, **Fundamentals of electric circuits**, McGraw Hill,
Stephen J. Chapman, **Electric machinery fundamentals**, McGraw Hill,
Complementary Bibliography
Fermín Barrero, **Sistemas de energía eléctrica**, Paraninfo,
John Grainger, **Power system analysis**, McGraw Hill,

Recommendations

Subjects that it is recommended to have taken before
Physics: Physics II/V09G311V01107

IDENTIFYING DATA				
Materials technology				
Subject	Materials technology			
Code	V09G311V01202			
Study programme	Grado en Ingeniería de los Recursos Mineros y Energéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Galician English			
Department				
Coordinator	Pérez Pérez, María del Carmen			
Lecturers	Pérez Pérez, María del Carmen			
E-mail	cperez@uvigo.es			
Web	http://moovi.uvigo.gal/course/view.php?id=3281			
General description	Material Technology is a second-year subject with a marked technological character. It is common for all students, regardless of the specific orientation. The objective is to present the fundamentals of Materials Science and Technology in a comprehensible way to students, focusing on the relationship between internal structure - properties - processing of materials. The learning outcomes are focused on: 1. Understanding the fundamental concepts of bonds, structure, and microstructure of different types of materials. 2. Understanding the relationship between the microstructure of the material and its mechanical, electrical, thermal, and magnetic behavior. 3. Knowing the main techniques of structural characterization of materials. 4. Acquiring skills in the handling of diagrams and graphics. 5. Be able to interpret and implement material testing standards. 6. Acquiring skills in performing tests. 7. Analyzing the results obtained taking the corresponding conclusions. 8. Developing scientific viewpoint and experimental methodology in the approach and solution of problems related to Materials Technology.			

Training and Learning Results	
Code	
A1	That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study
A2	That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study
A3	That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues
A4	That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized audience
A5	That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.
B7	Ability to do, within the field of mining engineering, with the knowledge acquired in accordance with section 5 of order CIN/306/2009, measurements, stakeouts, planes and maps, calculations, assessments, risk analyses, expert reports and studies, work plans, environmental and social impact studies, restoration plans, quality control systems, prevention systems, analysis and assessment of the properties of metal, ceramic, refractory, synthetic and other materials, soil and rock mass classification and other works of a similar kind.
C11	Ability to know, understand and use the principles and technology of materials.
D1	Ability to draw links between the different elements of all the knowledge they acquired, understanding them as components of a body of knowledge with a clear structure and strong internal cohesion.
D4	To foster collaborative working, communication, organization and planning skills, along with the ability to take responsibilities in a multilingual, multidisciplinary work environment that promotes education for equality, peace and respect for fundamental rights.
D5	To be familiar with the relevant sources of information, including constant updating, in order to practice one□s profession competently, accessing all the present and future tools of information search, constantly adapting to technological and social changes.
D7	Ability to organize, understand, assimilate, produce and handle all the relevant information to develop their professional work, using appropriate computing, mathematical, physics tools, etc. when these are required.

D10 To become aware of the need for continuous training and the constant improvement of quality, developing the values that are characteristic of scientific thinking, showing flexible, open and ethical attitudes in the face of different situations and opinions, particularly as regards non-discrimination on the grounds of gender, race or religion, respect for fundamental rights, accessibility, etc.

Expected results from this subject

Expected results from this subject	Training and Learning Results			
To understand the basic concepts related to bonding, structure, and microstructure of the different types of materials.	A1 A2 A3	B7	C11	D1 D5
Understanding of the relation between the microstructure and its mechanical, electric, thermal and magnetic behaviour.	A1 A2 A3	B7	C11	D5 D7
Understanding of the basics of the mechanical of the metals, ceramics, polymers, and composites.	A1 A2 A5	B7	C11	D1 D5 D7
To know the main techniques for structural characterization of materials.	A1 A4 A5	B7	C11	D1 D5
To acquire skills in the handle of diagrams and graphics.	A1 A2 A3 A4 A5	B7	C11	D5 D10
Capacity to apply standards for materials testing.	A1 A2 A5	B7	C11	D4 D5
To acquire skills for performing tests.	A1 A2 A5	B7	C11	D1 D5 D10

Contents

Topic	
CHAPTER I. INTRODUCTION	I.1. The Science and Engineering of the Material. Definitions. I.2. Types of materials. Evolution and trends. I.3. Structure - Properties - Processing relations. I.4. Introduction to the mechanical, electrical, thermal, and magnetic properties of the materials. I.5. Introduction to the concept of design and selection of materials.
CHAPTER II. CRYSTAL STRUCTURES. UNIT CELLS	II.1. Crystal / amorphous arrangements. Differences. II.2. Characteristics of the crystal structures. Metallic, ionic, and covalent crystals. II.3. Study of the metallic crystals: BCC, FCC, HCP. II.4.Crystallographic directions. Crystallographic planes (Miller indices). II.5. Resolution of the crystal structure: X-ray diffraction.
CHAPTER III. IMPERFECTION IN SOLIDS. DIFFUSION	III.1. Point defects. III.2. Linear defects (dislocations). Physical meaning of the dislocations. III.3. Surface defects. III.4. Diffusión. Mechanisms. III.5. Fick's laws (stationary and non-stationary states). III.6. Industrial application of diffusion phenomena.
CHAPTER IV. TESTING AND MECHANICAL PROPERTIES	V.1. Elastic deformation. Young modulus. IV.2. Plastic deformation. IV.3. The tensile test: use of stress-strain diagram. IV.4. The compression and bend tests for brittle materials. IV.5. Hardness of materials. Hardness tests. IV.6. Impact test: toughness. IV.7. Fracture toughness: fracture mechanics. IV.8. Fatigue tests.
CHAPTER V. MECHANISMS OF DEFORMATION	V.1. Slipping mechanism: dislocations and plastic deformation. V.2. Deformation by twinning. V.3. Strain hardening by cold working. V.4. Annealing: recovery, recrystallization, and grain growth.

CHAPTER VI. SOLIDIFICATION AND SOLID-STATE TRANSFORMATION	VI.1. Principles of solidification: pure metals. Nucleation and growth steps. VI.2. Mechanism of strengthening by grain size reduction. VI.3. Solidification in ingot casting: cast structure. VI.4. Alloys: solid solution and intermediate phases. Solid-Solution Strengthening. VI.5. Cooling curves: pure materials and alloys. VI.6. Phase diagrams (I). Total solubility (binary isomorphous systems). Microsegregation. Eutectic and peritectic systems. VI.7. Phase diagrams (II). Solid-state transformations. Partial solubility in a solid state. Dispersion strengthening. Eutectoid reaction.
CHAPTER VII. MATERIALS FOR ENGINEERING (I): METALLIC MATERIALS	VII.1. Ferrous alloys: steels and cast irons. VII.2. The Iron-Iron Carbide (Fe-Fe3C) phase diagram. Allowing elements and designation. VII.3. Isothermal Transformation Diagrams (TTT). Continuous Cooling Transformation Diagrams (CCT). VII.4. Heat treatment of steels: annealing, normalizing, quenching, and tempering. VII.5. Cast irons. Types: white cast iron, gray cast iron, ductile cast iron, and compacted graphite cast iron. VII.6. Nonferrous alloys. Light alloys (based on Al, Ti). Alloys based on Cu, Pb, Sn, Zn, and Ni.
CHAPTER VIII. MATERIALS FOR ENGINEERING (II): CERAMIC MATERIALS	VIII:1. Crystal structures. VIII.2. Traditional ceramics: clay products, refractories, abrasives, cement, and concrete. VIII.3. Advanced ceramics. VIII.4. Glass ceramics: Characteristics, viscous deformation. VIII.5. Heat treatments and chemical treatments of glasses. Vitroceramics. Characteristics.
CHAPTER IX. MATERIALS FOR ENGINEERING (III): POLYMERIC MATERIALS	IX.1. Polymerization. Types of polymers. IX.2. General characteristics: thermal, mechanical, and chemical behavior. IX.3. Thermoplastic plastics: structure, crystallinity. Types. IX.4. Thermosetting plastics: structure. Types. IX.5. Elastomeric materials: structure, vulcanization. Rubbers, thermoplastic elastomers. Types
CHAPTER X. MATERIALS FOR ENGINEERING (IV): COMPOSITE MATERIALS	X.1. Classification and general characteristics. Matrix and disperse phases. X.2. Polymer matrix composites reinforced with fiber. X.3. Metal matrix composites and ceramic matrix composites. X.4. Laminar composites and sandwich structures.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	22	35.5	57.5
Problem solving	10	27	37
Laboratory practical	14	14	28
Case studies	4	6	10
Report of practices, practicum and external practices	0	14	14
Problem and/or exercise solving	1.5	0	1.5
Essay questions exam	1	0	1
Objective questions exam	0	1	1
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Presentation by the teacher of the contents on the subject under study, theoretical and/or guidelines for a job, exercise, or project to be developed by the student.
Problem solving	Activity which formulated problem and/or exercises related to the course. The student should develop appropriate solutions or right through the exercise routines, application of formulas or algorithms, application processing procedures available information, and interpretation of the results. It is often used to complement the lecture.
Laboratory practical	Activities application of knowledge to specific situations and basic skills acquisition and related procedural matter under study. They are developed in specific spaces with specialized equipment (Laboratories, computer rooms, etc ...)
Case studies	Analysis of an event, issue, or actual event in order to know, interpret, solve, generate hypotheses, comparing data, reflect, complete knowledge, diagnose, and training in alternative dispute resolution procedures.

Personalized assistance	
Methodologies	**Description**
Lecturing	Time devoted to attend and resolve doubts related to the main topics of the subject. In general, it will be developed individually, in-office hours, which will be provided in the presentation of the subject and it will be available to students in the online platform used by the teacher and the students. Doubts will also be solved directly in class, during the lectures. The tutorial sessions may be carried out by telematic means (email, videoconference, Moovi forums, ...) with prior agreement
Problem solving	Time devoted to attend and resolve doubts related to the main topics of the subject. In general, it will be developed individually, in-office hours, which will be provided in the presentation of the subject and it will be available to students in the online platform used by the teacher and the students. Doubts will also be solved directly in class, during the lectures. The tutorial sessions may be carried out by telematic means (email, videoconference, Moovi forums, ...) with prior agreement
Laboratory practical	Time devoted to attend and resolve doubts related to the main topics of the subject. Generally, students will be advised in small groups, although it can be done individually. This activity can be developed directly during laboratory activity or in-office hours. Useful information (office hours) will be provided at the beginning of the course. The tutorial sessions may be carried out by telematic means (email, videoconference, Moovi forums, ...) with prior agreement
Case studies	Time that each teacher reserves to attend and solve doubts to the students in relation to aspects of the subject. Generally, In general, it will be developed individually, in-office hours, which will be provided in the presentation of the subject and it will be available to students in the online platform used by the teacher and the students. Doubts will also be solved directly in class, during the lectures. The tutorial sessions may be carried out by telematic means (email, videoconference, Moovi forums, ...) with prior agreement.

Assessment					
	Description	Qualification	Training and Learning Results		
Report of practices, practicum and external practices	Each laboratory session generates a report that must be done by the students individually. The expected results: the knowledge of the basis of the mechanical behaviour of the metals, ceramics, and polymers. The knowledge of the main techniques for structural characterization of materials. The acquisition of skills for handling diagrams and plots. The capacity to apply standards for materials testing and the development of skills for performing tests.	10	A1 A2 A3 A5	C11	D5
Problem and/or exercise solving	These are exercises in which the contents are put into practice. theories presented in the magisterial session. They will be carried out throughout the semester, two short tests that will consist of exercises (each has a weighting of 10%). In the written exam to be held at the official date established by the center, exercises will be included (with a weighting of 25%). The results expected from this subject are: To understand the basic concepts related to bonding, structure, and microstructure of the different types of material. To understand the relationship between the microstructure and its mechanical, electric, thermal and magnetic behaviour. To know the main techniques for structural characterization of materials. To acquire skills in diagrams and graphics handling	45	A1 A2 A3	C11	D5
Essay questions exam	They consist in short questions included in the final exam. The expected results achieved are: The understanding of the basic concepts related to bonding, structure, and microstructure of the different types of materials. The understanding of the relation between the material microstructure and its mechanical, electrical, thermal and magnetic behaviour. The knowledge of the main techniques for structural characterization of materials. The acquisition of skills for handling diagrams and plots.	15	A1 A2 A3 A4	C11	D5

Objective questions exam	Tests assessing knowledge that includes closed with response alternatives questions (true/false, multiple choice, matching of elements...). Three tests will be carried out, two related to the subject taught in the master sessions and a third focused on knowledge acquired in laboratory practices. Each of them represents the 10%. The results expected from this subject are: To understand the basic concepts related to bonding, structure, and microstructure of the different types of material. To understand the relationship between the microstructure and its mechanical, electric, thermal and magnetic behaviour. To know the main techniques for structural characterization of materials. To acquire skills in diagrams and graphics handling.	30	A1 A2 A5	C11	D5

Other comments on the Evaluation

Those students who refuse to carry out continuous assessment may achieve 100% of the grade in the written exam, both at first and second chance.

On the second opportunity, the written exam will be worth 100% of the grade for all students, and will include the resolution of exercises as well as development questions and objective questions.

Exam schedule. Verify/consult updated information on the center's website:

http://minaseenerxia.uvigo.es/es/docencia/examenes

Sources of information

Basic Bibliography

Callister, William D.; Rethwisch, David G.,, **Ciencia e Ingeniería de Materiales**, 2ª, Reverté, 2016

Callister, William D.; Rethwisch, David G.,, **Materials Science and Engineering. An Introduction,**, 9th, Wiley, 2014

Asleland, Donald R. ; Fulay, Pradeep P. ; Wright, Wendelin J., **Ciencia e Ingeniería de Materiales**, 5ª, CENGAGE Learning, 2015

Asleland, Donald R. ; Fulay, Pradeep P. ; Wright, Wendelin J., **Science and Engineering of Materials**, 7th, CENGAGE Learning, 2015

Shackelford, James F., **Introduction to Materials Science for Engineers**, 8th, Pearson Education, 2016

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

Pero-Sanz, Antonio J., **Ciencia e ingenieria de materiales. Estructura, transformaciones, propiedades y selección**, 5ª, CIE-Dossat, 2000

Complementary Bibliography

Smith, W.; Hashemi, Javad, **Fundamentos de la ciencia e ingeniería de materiales**, 5ª, McGraw-Hill, 2010

Smith, W.; Hashemi, Javad, **Foundations Of Materials Science And Engineering**, 5th, McGraw-Hill Education, 2009

J.M. Montes; F.G. Cuevas; J. Cintas, **Ciencia e Ingeniería de los Materiales**, 1ª, Paraninfo, 2014

Recommendations

Subjects that are recommended to be taken simultaneously

Materials resistance/V09G311V01203

Subjects that it is recommended to have taken before

Physics: Physics I/V09G311V01102
Physics: Physics II/V09G311V01107
Chemistry/V09G311V01105

IDENTIFYING DATA				
Resistencia de materiais				
Subject	Resistencia de materiais			
Code	V09G311V01203			
Study programme	Grao en Enxeñaría dos Recursos Mineiros e Enerxéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	1c
Teaching language	Castelán			
Department	Enxeñaría dos materiais, mecánica aplicada e construción			
Coordinator	García González, Marcos			
Lecturers	Caride Tesouro, Luís Miguel García González, Marcos			
E-mail	marcos.g.glez@uvigo.es			
Web	http://https://dept05.webs.uvigo.es/gl/			
General description	Nesta materia estudaranse os fundamentos da elasticidade e profundarase no estudo da resistencia de materiais, co fin de poder aplicar os coñecementos adquiridos ao comportamento de sólidos reais (estruturas, máquinas e elementos resistentes en xeral).			

Resultados de Formación e Aprendizaxe	
Code	
A1	Que os estudantes demostrasen posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral, e adóitase atopar a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo.
A2	Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo.
A3	Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética.
A4	Que os estudantes poidan transmitir información, ideas, problemas e solucións a un público tanto especializado coma non especializado.
A5	Que os estudantes desenvolvesen aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía.
B1	Capacitación científico-técnica para o exercicio da profesión de Enxeñeiro Técnico de Minas e coñecemento das funcións de asesoría, análise, deseño, cálculo, proxecto, construción, mantemento, conservación e explotación.
B3	Capacidade para deseñar, redactar e planificar proxectos parciais ou específicos das unidades definidas no apartado anterior, tales como instalacións mecánicas e eléctricas e co seu mantemento, redes de transporte de enerxía, instalacións de transporte e almacenamento para materiais sólidos, líquidos ou gaseosos, vertedoiros, balsas ou presas, sostemento e cimentación, demolición, restauración, voaduras e loxística de explosivos.
B4	Capacidade para deseñar, planificar, operar, inspeccionar, asinar e dirixir proxectos, plantas ou instalacións, no seu ámbito.
C13	Coñecemento de resistencia de materiais e teoría de estruturas.
D1	Capacidade de interrelacionar todos os coñecementos adquiridos, interpretándoos como compoñentes dun corpo do saber cunha estrutura clara e unha forte coherencia interna.
D3	Propoñer e desenvolver solucións prácticas, utilizando os coñecementos teóricos, a fenómenos e situacións-problema da realidade cotiá propios da enxeñería, desenvolvendo as estratexias adecuadas.
D9	Entender a transcendencia dos aspectos relacionados coa seguridade e saber transmitir esta sensibilidade ás persoas da súa contorna.

Resultados previstos na materia		
Expected results from this subject	Training and Learning Results	
Coñecer as diferenzas entre sólido ríxido e sólido elástico.	A1 A2 A3 A4 A5	C13

Coñecer os estados de tensións e de deformacións nun sólido deformable e a relación entre eles.	A1 A2 A3 A4 A5		C13	
Aplicar o coñecemento adquirido á determinación dos valores máximos da tensión nun punto dun sólido deformable.		B1 B3 B4	C13	D1 D3 D9
Coñecer os principios básicos que rexen a Resistencia de Materiais.	A1 A2 A3 A4 A5		C13	
Coñecer as relacións entre as diferentes solicitaciones e as tensións que estas orixinan.	A1 A2 A3 A4 A5		C13	
Aplicar o coñecemento adquirido sobre tensións ao cálculo das mesmas en elementos barra e en estruturas isostáticas sinxelas.		B1 B3 B4	C13	D1 D3 D9
Coñecer as deformacións de elementos barra e dalgunhas estruturas isostáticas sinxelas.		B1 B3 B4	C13	D1 D3 D9
Aplicar o coñecemento adquirido sobre deformacións á resolución de problemas hiperestáticos.		B1 B3 B4	C13	D1 D3 D9
Coñecer o fenómeno do pandeo.	A1 A2 A3 A4 A5		C13	
Aplicar os coñecementos adquiridos ao dimensionamiento de elementos barra		B1 B3 B4	C13	D1 D3 D9

Contidos	
Topic	
Introdución de materia	Xeneralidades Definicións
Fundamentos de elasticidade	Introdución ao estudo da elasticidade Tensións en sólidos elásticos (Vector tensión, compoñentes intrínsecas do vector tensión, matriz de tensións, tensións e direccións principais, círculos de Mohr en tensións) Deformacións (Matriz de deformación, deformacións principais, vector deformación unitaria, compoñentes intrínsecas do vector deformación unitaria, círculos de Mohr en deformacións) Relacións entre tensións e deformacións Elasticidade bidimensional (Estado de deformación plana, Estado tensional plano, Depósitos de parede delgada)
Criterios de fallo	Criterio da tensión normal máxima Criterio de Saint-Venant Criterio de Tresca Criterio de Von-Mises Coeficiente de seguridade
Tracción-compresión	Tracción e compresión isostática. Cálculo de tensións e deformacións. Tracción e compresión hiperestáticas. Tensións orixinadas por variacións térmicas ou defectos de montaxe
Cortadura	Aplicación ao cálculo básico de unións
Aplicación ao cálculo básico de unións	Solicitaciones. Relación entre esforzo cortante, momento flector e densidade de carga Diagramas de solicitaciones Concepto de deformada ou elástica

Flexión	Flexión pura. Tensión de Navier Flexión desviada Flexión simple. Fórmula de Zhuravski Ecuación da elástica. Aplicación a algúns casos particulares Teoremas 1º, 2º, 3º e 4º de Mohr Efecto do esforzo cortante na deformación das vigas. Simetría e antisimetría. Flexión hiperestática. Método xeral de cálculo. Vigas continuas
Torsión	Definición Teoría elemental de Coulomb Diagramas de momentos torsores Análises de tensións e de deformacións Torsión hiperestática
Solicitaciones compostas	Flexión e torsión combinadas en eixos de sección circular. Cálculo de tensións e de deformacións. Concepto de centro de cortadura. Flexión composta en corpos de pouca esbeltez. Cálculo de tensións e determinación da liña neutra. Cálculo de tensións e deformacións en estruturas plano-espaciais
Columnas. Fundamentos de pandeo	Tipos de equilibrio Carga crítica de Euler Lonxitude de pandeo Límites de aplicación da teoría de Euler

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	36	0	36
Prácticas de laboratorio	10	0	10
Seminario	4	0	4
Resolución de problemas de forma autónoma	0	77.5	77.5
Resolución de problemas	0	20	20
Resolución de problemas e/ou exercicios	2.5	0	2.5

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

Metodoloxía docente

	Description
Lección maxistral	Presentaranse os aspectos xerais da materia de forma estruturada, facendo especial énfase nos fundamentos e aspectos máis importantes ou de máis difícil comprensión para o alumnado. Utilizarase como guía o primeiro libro citado na bibliografía e cada semana indicarase na plataforma MOOVI o contido que se traballará durante a seguinte semana, para que o alumnado póidao traballar previamente e seguir así as explicacións con maior aproveitamento.
Prácticas de laboratorio	Prácticas de laboratorio cooperativas coas que se porán en práctica os conceptos teóricos vistos na aula. Tras a súa realización deberase facer unha análise dos resultados obtidos. Recollerase un informe das mesmas.
Seminario	Actividades enfocadas ao traballo sobre un tema específico, que permiten profundar ou complementar os contidos da materia. Distribuiranse en varias sesións ao longo do curso concretadas a inicios de curso
Resolución de problemas de forma autónoma	Exporanse exercicios e/ou problemas para resolver de forma autónoma, dando os resultados dos mesmos, que permitirán avaliar ao alumnado o grao de consecución das competencias da materia
Resolución de problemas	Cada semana dedicarase un tempo á resolución por parte do alumnado de exercicios ou problemas propostos, relacionados co contido que se estea vendo no momento

Atención personalizada

Methodologies	Description
Lección maxistral	Tempo adicado polo profesorado a atender as necesidades e consultas do alumnado relacionadas co estudo e/o temas vinculados coa materia e as actividades desenroladas. Para todas as modalidades de docencia, as sesións de tutorización poderán realizarse por medios telemáticos (correo electrónico, videoconferencia, foros de MOOVI, ...) baixo a modalidade de concertación previa.

Resolución de problemas	Tempo adicado polo profesorado a atender as necesidades e consultas do alumnado relacionadas co estudo e/o temas vinculados coa materia e as actividades desenroladas. Para todas as modalidades de docencia, as sesións de tutorización podrán realizarse por medios telemáticos (correo electrónico, videoconferencia, foros de MOOVI, ...) baixo a modalidade de concertación previa.

Avaliación

	Description	Qualification	Training and Learning Results		
Prácticas de laboratorio	Consistirá en informes de prácticas e exame final. PRÁCTICAS EXPERIMENTAIS: As prácticas axustaranse ás directrices dadas antes da súa realización. Será necesaria a entrega de informes das prácticas experimentais realizadas, un total de 4 prácticas. Cada un deles será avaliado entre 0/10. Os informes suporán o 5% do valor EXAME AVALIACIÓN: Unha vez rematadas as mesmas, realizarase unha xornada de prácticas para realizar un exame sobre o alcance e contido dos temas/conceptos expostos durante as mesmas. Avaliarase a partir de 0/10. Representará o 15% do valor total deste concepto. NOTA: A distribución previa do 20% da cualificación obtida terase en conta na primeira oportunidade do curso académico. Na segunda oportunidade, só representará o 10% do peso da nota final. Resultados previstos na materia: Aplicar o coñecemento adquirido sobre tensións ao cálculo das mesmas en elementos barra e en estruturas isostáticas sinxelas Coñecer as deformacións de elementos barra e dalgunhas estruturas isostáticas sinxelas Aplicar o coñecemento adquirido sobre deformacións á resolución de problemas hiperestáticos Coñecer o fenómeno do pandeo	20	B1 B3 B4	C13	D1 D3 D9
Resolución de problemas	2 EXERCICIOS AVALIABLES: Na clase de AULA consideraranse exercicios de casos de estruturas deformables e/ou probas conceptuais. A súa valoración será de 0 a 10 puntos. Cada un dos exercicios realizados representará un 20% por este concepto NOTA: A cualificación será tida en conta SÓ na primeira oportunidade do curso académico. Resultados de previstos na materia: Coñecer os estados de tensións e de deformacións nun sólido deformable e a relación entre eles. Aplicar o coñecemento adquirido á determinación dos valores máximos da tensión nun punto dun sólido deformable. Coñecer os principios básicos que rexen a Resistencia de Materiais Coñecer as relacións entre as diferentes solicitaciones e as tensións que estas orixinan	40	A1 A2 A3 A4 A5	C13	

Resolución de problemas e/ou exercicios	A proba realizarase na data oficial sinalada polo centro no calendario de exames. Proba para a avaliación das competencias adquiridas na materia, consistente na resolución por parte do alumnado de problemas e/ou cuestións teóricas breves. A duración da proba, así como o peso de cada pregunta, anunciarase no momento da súa realización. Resultados previstos na materia: Coñecer as diferenzas entre sólido ríxido e sólido elástico Aplicar os coñecementos adquiridos ao dimensionamiento de elementos barra. NOTA: A distribución previa do 40% da cualificación obtida terase en conta na primeira oportunidade do curso académico. Na segunda oportunidade, representará o 90% do peso da nota final.	40	A1 A2 A3 A4 A5	B1 B3 B4	C13	D1 D3 D9

Other comments on the Evaluation

Para superar a materia será necesario obter unha puntuación **mínima de 5 sobre 10.**

Segunda oportunidade de avaliación continua:

Nesta segunda oportunidade, as prácticas de laboratorio só representarán o 10% do peso da nota final, reservándose o 90% restante para a avaliación de problemas e/ou exercicios.

Consideracións de avaliación global:

O alumnado poderá optar a unha avaliación global que terá un peso do 100% da nota, tanto na primeira como na segunda oportunidade. Nesta proba valoraranse as competencias de toda a materia. Ábrese un prazo a partires dun mes dende o inicio da actividade docente para solicitar a **RENUNCIA** á avaliación continua. Dita solicitude entregarase escaneada coa sinatura do alumnado e subirase en formato pdf á plataforma MOOVI. Dita solicitude terá que ser confirmada polo profesorado da materia.

Durante o presente curso NON se gardarán as cualificacións obtidas das prácticas de laboratorio de cursos anteriores nin das probas de seguimento, xa que se modifica a súa avaliación.

Calendario de exames. Verificar/consultar de forma actualizada na páxina web do centro:http://minaseenerxia.uvigo.es/é/docencia/examenes

Bibliografía. Fontes de información

Basic Bibliography

José Antonio González Taboada, **Tensiones y deformaciones en materiales elásticos**, 1ª, Tórculo,

José Antonio González Taboada, **Fundamentos y problemas de tensiones y deformaciones en materiales elásticos**, 1ª, Tórculo,

Complementary Bibliography

Recomendacións

Subjects that it is recommended to have taken before

Física: Física I/V09G311V01102
Física: Física II/V09G311V01107

Other comments

Coñecementos previos necesarios: *Vectores, centros de gravidade e momentos de inercia

IDENTIFYING DATA				
Fluid mechanics				
Subject	Fluid mechanics			
Code	V09G311V01204			
Study programme	Grado en Ingeniería de los Recursos Mineros y Energéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Conde Fontenla, Marcos Molares Rodríguez, Alejandro			
Lecturers	Conde Fontenla, Marcos Molares Rodríguez, Alejandro			
E-mail	mfontenla@uvigo.gal a.molares@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The course of Fluid Mechanics represents a basic course in any enginerring degree. The main target, concerning students of energy engineering and mining and energy resources, is to acquire the knowledge and needed tools to know how to analyze and understand fluid problems of different types, supporting other later and advenced courses, centered in the dynamic fluids, both basic and oriented to real problems in the field of engineering. The development of generic skills and competences such as teamwork and autonomous learning is also encouraged. Fluid Mechanics describes the relevant physical phenomena of fluid motion, describing the general equations of such motions. This knowledge provides the basic principles needed to analyze any system concerning liquids and gases. The field of application of Fluid Mechanics is very wide: transport of fluids in pipelines, aeronautics, engines, ships, biological flows, aerodynamics, etc. The principles of Fluid Mechanics are necessary for fields so diverse as: - Design of hydraulic machinery. - Lubrication. - A/C and ventilation systems. - Design of pipelines. - Transport sector: transmission, air conditioning, exhaust system, aerodynamics and hydrodynamics, cooling, etc. - Aerodynamics of structures and buildings - Conventional and renewable thermal and fluid power plants			

Training and Learning Results	
Code	
A1	That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study
A2	That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study
A3	That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues
A4	That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized audience
A5	That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.
B1	Scientific and technical training and qualification as a Mining Engineer and knowledge of the functions of consultancy, analysis, design, calculus, project, construction, maintenance, preservation and exploitation.
B2	To be familiar with the multiple technical and legal factors involved in the process of development, within the field of mining engineering, with the knowledge acquired in accordance with section 5 of order CIN/306/2009, pertaining to geological and mining prospecting and investigation, the explorations of all sorts of geological resources, including groundwater, underground construction, underground storage, treatment and benefit plants, energy plants, mineral processing and steel and iron plants, building materials plants, carbon chemistry, petrochemistry and gas plants, waste treatment and tributary plants, explosives factories, and ability to use well-tested methods and accredited technologies, with the aim of achieving the highest efficiency and ensuring the protection of the Environment and the safety and health of workers and users.

B3	Ability to design, write and plan partial or specific projects within the units specified in the previous section, such as mechanical and electric plants and their maintenance, networks of energy transportation, facilities for transportation and storage of solid, liquid and gaseous materials, waste sites, tailing dams, foundation and support, demolition, restoration, controlled explosions and explosives logistics.
B4	Ability to design, plan, run, inspect, sign and manage projects, plants or facilities, within their field.
C15	Knowledge of the principles of fluid mechanics and hydraulics.
D1	Ability to draw links between the different elements of all the knowledge they acquired, understanding them as components of a body of knowledge with a clear structure and strong internal cohesion.
D3	To suggest and develop practical solutions, using the relevant theoretical knowledge, to phenomena and problems-situations of ordinary reality that are specific to engineering, developing appropriate strategies.
D4	To foster collaborative working, communication, organization and planning skills, along with the ability to take responsibilities in a multilingual, multidisciplinary work environment that promotes education for equality, peace and respect for fundamental rights.
D5	To be familiar with the relevant sources of information, including constant updating, in order to practice one's profession competently, accessing all the present and future tools of information search, constantly adapting to technological and social changes.
D10	To become aware of the need for continuous training and the constant improvement of quality, developing the values that are characteristic of scientific thinking, showing flexible, open and ethical attitudes in the face of different situations and opinions, particularly as regards non-discrimination on the grounds of gender, race or religion, respect for fundamental rights, accessibility, etc.

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Understand the basic topics of Fluid mechanics and Hydraulics	A1 A2 A3	B1 B2 B3 B4	C15	D1 D5 D10
Acquire the capacity to apply these basic knowledge to the resolution of problems concerning fluid mechanics and hydraulics	A2 A3 A4 A5	B1 B2 B3 B4	C15	D1 D3 D4 D5 D10
Discover the more extended experimental processes employed in fluid flows	A2 A3 A4 A5	B1 B2 B3 B4	C15	D1 D3 D4 D5 D10
Dominate the current techniques for the analysis of the fluid flow	A3 A4 A5	B1 B2 B3 B4	C15	D1 D3 D5 D10
Achieve skills in the process of industrial problems analysis concerning gases and liquid flows	A3 A4 A5	B3 B4	C15	D1 D3 D5

Contents

Topic	
1.- Fundamental concepts of the fluids	1.1.- Concept of fluid. 1.2.- Continuum hypothesis. 1.3.- Viscosity. 1.4.- Basic rheology: Navier-Poisson's law and Newton's law of the viscosity. 1.5.- Pressure and head: static, dynamic and piezometric. 1.6.- Forces on fluids: body and surface forces. 1.7.- Stress tensor on a fluid particle. 1.8.- Other properties of interest in fluid mechanics.

2.- General study about the movement of the fluids	2.1.- Classical approaches: Euler vs. Lagrange. 2.2.- Concept of velocity field. 2.3.- Cinematic basic: acceleration and tensor of velocity variation. 2.4.- Stresses and deformations of the fluid particle: relationship with the tensor of velocity variation. 2.5.- Classification of fluid flows: - according to cinematic conditions - according to geometrical conditions - according to mechanical conditions of the boundary - according to conditions of the internal movement 2.6.- System vs. volume of control 2.7.- Integrals extended to fluid volumes: Reynolds Transport theorem. 2.8.- Integral relations for a volume of control: conservation of mass, conservation of momentum and conservation of energy. 2.9.- Differential relations for a fluid particle: continuity and second Newton's law. Navier-Stokes equations. 2.10.- Particular cases: Euler's equation, Bernoulli's theorem, in-compressible flow, and vorticity.
3.- Dimensional analysis and similarity flowed-dynamic. Applications.	3.1.- Introduction to the dimensional analysis. 3.2.- Pi Buckinghan's theorem. 3.3.- Dimensionless main groups in Fluid mechanics: physical significance. 3.4.- Similarity: partial and total. Effect of scale.
4.- Laminar flow	4.1.- Introduction. 4.2.- Simplified Navier-Stokes' equations: One-dimensional steady flow of liquids. 4.3.- Particular cases: Couette's flow and Hagen-Poiuseuille's flow. 4.4.- Head loss in laminar flow: friction factor.
5.- Turbulent flow	5.1.- Introduction. 5.2.- Statistical approach of the turbulence. 5.3.- RANS models for the turbulence. 5.4.- Other models of interest in modelling the turbulence. 5.5.- Description of the boundary layer. 5.6.- Measure and estimation of the head loss in turbulent flows: - Nikuradse's chart - Moody's diagram - empirical formulae for flow in pipes
6.- Flow of liquids in pipes of variable section	6.1.- Introduction 6.2.- Secondary head loss: - Loss at the entrance of a tube - Loss at the tube exit - Losses in valves - Losses in elbows and other adapters - Losses in valves 6.3.- Systems of pipes: series and parallel. 6.4.- Networks of pipes: equations for the nodes and equations for the meshes. 6.5.- System-pump coupling.
7.- Steady flow in channels	7.1.- Introduction. 7.2.- Energy losses. 7.3.- Equations for uniform steady flow: Optimal section. 7.4.- Equations for non-uniform steady flow. 7.5.- Energy conservation in transitions. 7.6.- Hydraulic jump. 7.7.- Measurement of flow and regulation: gates.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	15	29	44
Practices through ICT	4	4.5	8.5
Laboratory practical	14	20	34
Problem solving	17	3	20
Autonomous problem solving	0	41	41
Essay questions exam	0.83	0	0.83
Problem and/or exercise solving	1.67	0	1.67

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

Methodologies	
	Description
Lecturing	Oral presentations and dissertations in the classroom, developing the different topics of the course. It is strongly recommended that the student have previous read the material at home in order to contribute with questions or doubts in class-time.
Practices through ICT	They will tackle some basic method of resolution of problems associated the networks of pipe employing programs of generic calculation: leaf of calculate and/or software of mathematics. The licence of the same will be GNU GPL, or commercial subsidised by the school/university.
Laboratory practical	Up to ten laboratory practices will be carried out in order to clarify knowledge acquired in the classroom. The relevant guides will be provided for each practice in such a way that, after data collection, they can return to the teacher the results and conclusions of the experimental work, after a deep analysis of them.
Problem solving	Exercises are previously given to the students, bringing them a try to solve by themselves. Later, some of them will be solved in class by the students and/or the teacher
Autonomous problem solving	The students will solve the proposed problems. They can ask for support during the scheduled tutorship hours

Personalized assistance	
Methodologies	**Description**
Autonomous 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 tutorship. Updated information of the tutorship timetables will be given to the students during first week of class. Tutorshiping will take place both in face-to-face or distance modes, by means of the e-learning applications offered by the University of Vigo or equivalent methods.

Assessment				
	Description	Qualification	Training and Learning Results	
Laboratory practical	Submission of a report/questionnaire and/or oral examination of at least two experimental/IT practices to be carried out throughout the course. Consult detailed methodology in the section "other comments on the evaluation". EXPECTED RESULTS: Understand the basics of fluid mechanics and hydraulics through experimentation or simulation. Ability to apply these basic knowledge in solving fluid mechanics and hydraulics problems. Know the most used experimental processes when working with fluid flows. Employ current techniques available for fluid flow analysis. Acquire skills in the process of analyzing industrial problems concerning fluids.	10	A1 B1 C15 D1 A2 B2 D3 A3 B3 D4 A4 B4 D5 A5 D10	
Problem solving	These are two continuous assessment tests that will be carried out throughout the course. They will consist of written exercises/problem solving tests. Each one will have a weight of 12.5% of the total grade. Consult detailed methodology in the section "other comments on the evaluation". EXPECTED RESULTS Understand the basics of Fluid Mechanics and Hydraulics. Ability to apply basic knowledge in solving fluid mechanics and hydraulics problems. Acquire skills on the process of analysis of industrial processes where fluids play a main role.	25	A1 B1 C15 D1 A2 B2 D3 A3 B3 D4 A4 B4 D5 A5 D10	
Essay questions exam	It will consist of two written tests that may consist of: theoretical / practical questions that include resolution of exercises and problems and/or topic to be developed. Each test will represent 12.5%;of the total grade. For more information, see the detailed methodology in the section "other comments on the evaluation" EXPECTED RESULTS: Understand the basics of Fluid Mechanics and Hydraulics. Ability to apply basic knowledge in solving fluid mechanics and hydraulics problems. Acquire skills on the process of analysis of industrial processes where fluids play a main role.	25	A1 B1 C15 D1 A2 B2 D3 A3 B3 D4 A4 B4 D5 A5 D10	
Problem and/or exercise solving	This test will coincide with the official exam established in the center's calendar. It will consist of a written test for the resolution of exercises / problems. Consult the detailed methodology in the "other comments on the evaluation" section. EXPECTED RESULTS: Understand the basics of Fluid Mechanics and Hydraulics. Ability to apply basic knowledge in solving fluid mechanics and hydraulics problems. Acquire skills on the process of analysis of industrial processes where fluids play a main role.	40	A1 B1 C15 D1 A2 B2 D3 A3 B3 D4 A4 B4 D5 A5 D10	

Other comments on the Evaluation

The student will be able to freely choose the evaluation methodology (Global or Continuous) within the established deadline and procedure set by the school, and in any case in accordance with current regulations.

The problem of students choosing one evaluation methodology or another, according to the maximum weights established, is most dramatically manifested in the case of two students who take the final exam/retest and obtain exactly the same grade (for example, 6/10); one passes because he has chosen the global evaluation, while the other fails because of selecting the continuous evaluation and only obtained a 4.2 out of 10 in the average of the continuous evaluation tests.

To mitigate this contradiction in the regulations in the case of continuous assessment mode, two grades will be calculated for each student, and the higher of the two will be selected.

Continuous Evaluation Mode

In the calculation of the final grade, four evaluation blocks will be considered with the following weights:

· First partial test of continuous evaluation, weight: 25%. Test consisting of theoretical/practical questions, including problem-solving and/or a topic to develop. It may include multiple-choice questionnaires.

· Second partial test of continuous evaluation, weight: 25%. Test consisting of theoretical/practical questions, including problem-solving and/or a topic to develop. It may include multiple-choice questionnaires.

· Final test of continuous evaluation (retest), weight: 40%. Test consisting of theoretical/practical questions, including problem-solving and/or a topic to develop. It may include multiple-choice questionnaires.

· Practical work, weight: 10%. Submission of a report/questionnaire and/or oral examination of at least two experimental/IT practices to be carried out throughout the course.

In the spirit of the above paragraph, the final course grade will be assigned to all students using the following formula:

Final Grade = max {0.6 NC + 0.4 NF , NF + (1/20)NC(10 - NF)}

where NC is the weighted average of the two continuous evaluation tests and practical (in the range of 0 to 10) and NF is the grade of the final exam (retest) (also out of 10).

Global Evaluation Mode

A final exam will be held on the official date approved by the school, with a maximum score of 100%.

Second opportunity call

In the second opportunity call (extraordinary in July), the same methodology as in the first opportunity will apply, with a new final evaluation test for students who choose continuous evaluation and a new final exam for those following the global evaluation. In the continuous evaluation mode, therefore, the grades of the partial tests and practical work are retained.

Exam Timetable: Exam dates and rooms must be verified in the official webpage of the school:

minaseenerxia.uvigo.es/gl/docencia/examenes

Sources of information

Basic Bibliography

White, Frank M., **Mecánica de fluidos**, 6ª, McGraw-Hill, 2009

White, Frank M., **Fluid Mechanics**, 6ª, McGraw-Hill, 2009

Crespo Martinez, Antonio, **Mecánica de fluidos**, 1ª, Thomson, 2006

Complementary Bibliography

Streeter, Victor L. et al, **Fluid Mechanics**, 9ª, McGraw-Hill, 2000

Heras, Salvador de las, **Mecánica de fluidos en ingeniería**, 1ª, Iniciativa Digital Politècnica, 2012

Barrero Ripoll, Antonio et al., **Fundamentos y Aplicaciones de la Mecánica de Fluidos**, 1ª, McGraw-Hill, 2005

Batchelor, G. K., **An introduction to fluid dynamics**, Cambridge Mathematical Library edition, Cambridge Cambridge University Press, 2000

Hernández Krahe, J. M, **Mecánica de Fluidos y Máquinas Hidráulicas**, 1ª, Servicio de publicaciones de la UNED, 2000

Agüera Soriano, José, **Mecánica de fluidos incompresibles y turbomáquinas hidráulicas**, 1ª, Ciencia 3, 1996

Fox, Robert W.; McDonald, Alan T, **Introducción a la Mecánica de Fluidos**, 2ª, Interamericana - Mc-Graw Hill, 1995

Recommendations

Subjects that are recommended to be taken simultaneously

Materials resistance/V09G311V01203
Thermal systems/V09G311V01205

Subjects that it is recommended to have taken before

Physics: Physics I/V09G311V01102
Physics: Physics II/V09G311V01107
Mathematics: Linear algebra/V09G311V01103
Mathematics: Calculus I/V09G311V01104
Mathematics: Calculus II/V09G311V01109

IDENTIFYING DATA				
Thermal systems				
Subject	Thermal systems			
Code	V09G311V01205			
Study programme	Grado en Ingeniería de los Recursos Mineros y Energéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Granada Álvarez, Enrique			
Lecturers	Granada Álvarez, Enrique Lopez Mera, David			
E-mail	egranada@uvigo.es			
Web	http://https://moovi.uvigo.gal/			
General description	The aim of the subject is that the students get the necessary knowledges to be able to tackle ingeneering projects where the thermal energy was involved taking into account the interaction between systems and as they affect the interactions the thermal properties of the substances that configure them. It looks for a macroscopic classical approach understanding, perfect and improve the performance of those processes in which there is exchange of energy in general and thermal in particular.			

Training and Learning Results	
Code	
A1	That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study
A2	That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study
A3	That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues
A4	That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized audience
A5	That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.
B1	Scientific and technical training and qualification as a Mining Engineer and knowledge of the functions of consultancy, analysis, design, calculus, project, construction, maintenance, preservation and exploitation.
B2	To be familiar with the multiple technical and legal factors involved in the process of development, within the field of mining engineering, with the knowledge acquired in accordance with section 5 of order CIN/306/2009, pertaining to geological and mining prospecting and investigation, the explorations of all sorts of geological resources, including groundwater, underground construction, underground storage, treatment and benefit plants, energy plants, mineral processing and steel and iron plants, building materials plants, carbon chemistry, petrochemistry and gas plants, waste treatment and tributary plants, explosives factories, and ability to use well-tested methods and accredited technologies, with the aim of achieving the highest efficiency and ensuring the protection of the Environment and the safety and health of workers and users.
B3	Ability to design, write and plan partial or specific projects within the units specified in the previous section, such as mechanical and electric plants and their maintenance, networks of energy transportation, facilities for transportation and storage of solid, liquid and gaseous materials, waste sites, tailing dams, foundation and support, demolition, restoration, controlled explosions and explosives logistics.
B4	Ability to design, plan, run, inspect, sign and manage projects, plants or facilities, within their field.
C4	Understanding and mastery of the essential concepts of the general laws of mechanics, thermodynamics, fields and waves and electromagnetism, and their application for solving specific problems in the field of engineering.
D1	Ability to draw links between the different elements of all the knowledge they acquired, understanding them as components of a body of knowledge with a clear structure and strong internal cohesion.
D2	Ability to develop a project to completion in any field of this branch of engineering, combining appropriately the knowledge acquired, consulting the relevant sources of information, carrying out any required inquiries, and joining interdisciplinary work teams.
D3	To suggest and develop practical solutions, using the relevant theoretical knowledge, to phenomena and problems-situations of ordinary reality that are specific to engineering, developing appropriate strategies.
D4	To foster collaborative working, communication, organization and planning skills, along with the ability to take responsibilities in a multilingual, multidisciplinary work environment that promotes education for equality, peace and respect for fundamental rights.

D7	Ability to organize, understand, assimilate, produce and handle all the relevant information to develop their professional work, using appropriate computing, mathematical, physics tools, etc. when these are required.
D8	Understanding engineering within a framework of sustainable development with environmental awareness.

Expected results from this subject

Expected results from this subject	Training and Learning Results			
Know the technological base on which support the most recent investigations in applications of the thermodynamic engineering.	A1 A2 A3 A4 A5	B1 B2 B3 B4	C4	D1 D2 D3 D4 D7 D8
Comprise the basic appearances of balance of mass and energy in thermal systems.	A3 A5	B1	C4	D2 D3
Know the experimental process used when it works with transfer of energy.	A3	B1 B3	C4	D2 D3
Dominate the available current technicians for the analysis of thermal systems.	A5	B2 B4	C4	D2 D3
Deepen in the technicians of analysis of processes.	A1	B2	C4	D2 D3

Contents

Topic	
Introduction to the thermal systems.	Thermodynamic system. Thermodynamic properties. Units. Thermal balance, principle zero of the thermodynamics. Concept of temperature.
Thermal state equations thermal properties of a system.	Equation of thermal state. Thermal properties of a system. Ideal gases. Equations of state of the real gases.
Work and the first principle of the thermodynamics. Energetic properties of a system.	Mechanical concept of the energy. Work. Energy of a system. Transfer of energy by heat. Balance of energy in enclosed systems. Energetic properties of a system. Internal energy and enthalpy. Calorific Capacities
Transformations of a gaseous system.	Transformations of an ideal gas. Politropic transformations.
Properties of a pure substance, simple and compressible.	Thermodynamic state. The relation p-v-T. Calculation of thermodynamic properties. Calculation of variations of internal energy and enthalpy.
First principle in open systems.	Conservation of the mass. Conservation of the energy. Analysis of volumes of control in sattionary state. Transitory states. Cycles.
Second principle of the thermodynamics.	Formulation of the Second Principle. Irreversibilities. Application to thermodynamic cycles. Scale Kelvin of temperatures. Maximum performances. Cycle of Carnot.
Entropy.	Inequality of Clausius. The thermodynamic property entropy. Variation of entropy. Calculation of entropy. Reversible processes. Balances of entropy in enclosed and open systems.
Technical thermodinamic Cycles.	Cycles of condensable substance. Cycles of Gas.
No reactive mixtures.	General concepts. Homogeneous multicomponent systems. Ideal mixtures.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	20	35	55
Problem solving	16	45	61
Laboratory practical	10	0	10
Seminars	4	17.5	21.5
Problem and/or exercise solving	2.5	0	2.5

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

Methodologies

	Description
Lecturing	Exhibition by part of the professor of the contents of the matter of study. Bases in which it is supported. Relation with other matters. Technological applications
Problem solving	Formulation, analysis and resolution of problems for the consolidation and application of the theoretical contents.
Laboratory practical	Experimentation of real processes in the laboratory that complement the contents of the matter.
Seminars	Resolution of doubts of the theoretical contents of the matter. Participatory discussion of the students in relation to the understanding of the concepts and ideas.

Personalized assistance	
Methodologies	**Description**
Lecturing	All these activities will be supervised by the professor; or during the lessons hours, or during the official hours of tutorials, or during the review of the proofs and examinations.
Problem solving	All these activities will be supervised by the professor; or during the lessons hours, or during the official hours of tutorials, or during the review of the proofs and examinations.
Laboratory practical	All these activities will be supervised by the professor; or during the lessons hours, or during the official hours of tutorials, or during the review of the proofs and examinations.
Seminars	All these activities will be supervised by the professor; or during the lessons hours, or during the official hours of tutorials, or during the review of the proofs and examinations.

Assessment							
	Description	Qualification	Training and Learning Results				
Lecturing	It values through three type test examinations of the theoretical lessons. Each one of these theoretical exams will mark 5% of the final note. EXPECTED RESULTS Know the technological base on which support the most recent investigations in applications of the thermodynamic engineering. Comprise the basic appearances of balance of mass and energy in thermal systems. Know the experimental process used when it works with transfer of energy. Dominate the available current technicians for the analysis of thermal systems. Deepen in the technicians of analysis of processes.	15	A1 A2 A3 A4 A5	B1 B3	C4	D1 D2 D3 D4 D7 D8	
Laboratory practical	It values through a type test examination when lab practices end. EXPECTED RESULTS Know the experimental process used when it works with transfer of energy. Deepen in the technicians of analysis of processes.	5	A1 A2 A3 A4	B1 B3 B4	C4	D2	
Problem and/or exercise solving	Written exam to solve problems and/or exercises. Two tests will be carried out, with a weight of 40% of the final grade. One will take place during the semester and the other on the official date established by the center. EXPECTED RESULTS: Know the technological base on which support the most recent investigations in applications of the thermodynamic engineering. Comprise the basic appearances of balance of mass and energy in thermal systems. Know the experimental process used when it works with transfer of energy. Dominate the available current technicians for the analysis of thermal systems. Deepen in the technicians of analysis of processes.	80	A1 A2 A3 A4 A5	B1 B2 B3 B4	C4	D2 D3	

Other comments on the Evaluation

Considerations on continuous evaluation:

The theory and practical exams prior to the first opportunity final exam (Final January) will allow you to obtain 2.0 points out of a total of 10 points. The problem exam prior to the first opportunity final exam (Final January) will allow you to obtain 4.0 points out of a total of 10 points. For those students in continuous evaluation, these exams are not recoverable at the first opportunity (End of January).

Second chance considerations

Students will be able to take an exam that will include questions on all the contents of the subject, being able to access 100% of the grade.

Global Assessment Considerations

The exams carried out on the official date will consist of three theory tests and one test-type practice, each scoring 0.5 points. The other eight points are problem solving.

Exam Timetable: Exam dates and rooms must be verified in the official webpage of the school:

http://minaseenerxia.uvigo.es/es/docencia/examenes

Sources of information

Basic Bibliography

Moran, M.J. y Shapiro, H. N., **Fundamentos de termodinámica técnica**, Reverté,

Çengel, Yunus A.,, **Termodinámica**, MacGraw-Hill,

Moran, M.J. y Shapiro, H. N., **Fundamentals of Engineering Thermodynamics**, John Wiley & Sons, Inc.,

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Heat transmission/V09G311V01207

Subjects that are recommended to be taken simultaneously

Fluid mechanics/V09G291V01204

Subjects that it is recommended to have taken before

Physics: Physics I/V09G311V01102
Physics: Physics II/V09G311V01107
Mathematics: Calculus I/V09G311V01104
Mathematics: Calculus II/V09G311V01109
Chemistry/V09G311V01105

IDENTIFYING DATA				
Xeoloxía: Xeoloxía				
Subject	Xeoloxía: Xeoloxía			
Code	V09G311V01206			
Study programme	Grao en Enxeñaría dos Recursos Mineiros e Enerxéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	2	2c
Teaching language	Castelán			
Department	Enxeñaría dos recursos naturais e medio ambiente Xeociencias mariñas e ordenación do territorio			
Coordinator	Díez Ferrer, José Bienvenido			
Lecturers	Caparrini Marín, Natalia Díez Ferrer, José Bienvenido			
E-mail	jbdiez@uvigo.es			
Web				
General description	Nesta materia preténdese que o alumnado adquira os coñecementos básicos sobre as diferentes ramas da Xeoloxía para incorporar estes coñecementos científicos e técnicos ao servizo das necesidades humanas, é dicir, para desenvolver solucións prácticas a fenómenos e situacións problemáticas relacionadas coa enxeñaría.			

Resultados de Formación e Aprendizaxe	
Code	
A1	Que os estudantes demostrasen posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral, e adóitase atopar a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo.
A2	Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo.
A3	Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética.
A4	Que os estudantes poidan transmitir información, ideas, problemas e solucións a un público tanto especializado coma non especializado.
A5	Que os estudantes desenvolvesen aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía.
C5	Coñecementos básicos de xeoloxía e morfoloxía do terreo e a súa aplicación en problemas relacionados coa enxeñería. Climatoloxía.
D1	Capacidade de interrelacionar todos os coñecementos adquiridos, interpretándoos como compoñentes dun corpo do saber cunha estrutura clara e unha forte coherencia interna.
D3	Propoñer e desenvolver solucións prácticas, utilizando os coñecementos teóricos, a fenómenos e situacións-problema da realidade cotiá propios da enxeñería, desenvolvendo as estratexias adecuadas.
D5	Coñecer as fontes necesarias para dispoñer dunha actualización permanente e continua de toda a información precisa para desenvolver o seu labor, accedendo a todas as ferramentas, actuais e futuras, de procura de información e adaptándose aos cambios tecnolóxicos e sociais
D7	Capacidade para organizar, interpretar, asimilar, elaborar e xestionar toda a información necesaria para desenvolver o seu labor, manexando as ferramentas informáticas, matemáticas, físicas, etc., necesarias para iso.

Resultados previstos na materia			
Expected results from this subject	Training and Learning Results		
Comprender os aspectos básicos da dinámica da Terra	A1	C5	D1
Coñecer os aspectos básicos da xeoloxía histórica e rexional	A1	C5	D1
Desenvolver solucións prácticas a fenómenos e situacións-problema da realidade cotiá en xeral e en particular os propios da xeoloxía e hidroxeoloxía.	A1 A2 A3 A4 A5	C5	D1 D3 D5 D7
Adquirir habilidades no manexo, interpretación e elaboración de cartografía xeral e temática	A2 A3 A4 A5	C5	D5 D7

Contidos

Topic	
TEMA 1: ESTRUTURA E COMPOSICIÓN DA TERRA	A Terra como obxecto de estudo. Estrutura da da Terra. Deriva continental de Wegener. A expansión do fondo oceánico. Tectónica de placas.
TEMA 2: DEFORMACIÓN DA CORTIZA TERRESTRE	Tectónica - Xeoloxía Estrutural. Esforzo-Deformación. Estruturas tectónicas.
TEMA 3: MATERIA E MINERAIS	Definición de Mineral. Composición química dos minerais. Estrutura dos minerais. O Cristal. Propiedades físicas dos minerais. Clasificación dos minerais. Xacementos e recursos minerais.
TEMA 4: PROCESOS E ROCHAS ÍGNEAS	Magmas. Clasificación das formas ígneas. Clasificación Rochas ígneas. Xacementos minerais ligados a procesos ígneos. Enerxía Xeotérmica.
TEMA 5: PROCESOS E ROCHAS SEDIMENTARIAS (I)	Descrición xeral. Meteorización e chan. Procesos gravitacionales. Sistemas morfoclimáticos.
TEMA 6: PROCESOS E ROCHAS SEDIMENTARIAS (II)	Cuncas sedimentarias. Diaxénese. Clasificación Rochas Sedimentarias. Ambientes sedimentarios e Facies. Estratos e estruturas sedimentarias. Xacementos minerais ligados a procesos sedimentarios.
TEMA 7: PROCESOS E ROCHAS METAMÓRFICAS	Metamorfismo. Factores do metamorfismo. Texturas metamórficas. Clasificación Rocas Metamórficas Ambientes metamórficos. Xacementos minerais ligados a procesos metamórficos.
TEMA 8: O TEMPO EN XEOLOXÍA	Concepto de Tempo en Xeoloxía. A Escala Xeolóxica A medida do tempo xeolóxico. Métodos de Datación. - A Datación Relativa. Principios fundamentais en Xeoloxía. - A Datación Absoluta.
TEMA 9: CONCEPTOS BÁSICOS DE ESTRATIGRAFÍA	Definición de Estratigrafía. Unidades Estratigráficas. Estratotipo. Correlacións estratigráficas.
TEMA 10: AUGAS SUBTERRÁNEAS	Importancia da auga Subterránea. Distribución das Augas Subterráneas. Circulación das Augas Subterráneas. Pozos, mananciais. fontes termais e géiseres. Problemas asociados coa extracción de auga subterránea. Sistema Cársico.
TEMA 11: XEOLOXÍA DA PENÍNSULA IBÉRICA E CANARIAS	Contexto xeolóxico xeneral. O Macizo Hespérico. As Cordilleiras Alpinas. Illas Baleares. Cuncas Terciarias. Actividade Volcánica Cenozoica. Cartografía Xeolóxica (IGME).

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	26	58	84
Seminario	4	8	12
Saídas de estudo	4	8	12
Obradoiro	16	19.5	35.5
Exame de preguntas de desenvolvemento	1	0	1
Exame de preguntas obxectivas	0.5	0	0.5

Resolución de problemas e/ou exercicios	1	0	1
Informe de prácticas, prácticum e prácticas externas	0	4	4

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

Metodoloxía docente

	Description
Lección maxistral	Exposición por parte do profesorado dos contidos sobre a materia obxecto de estudo, bases teóricas e/ou directrices dun traballo, exercicio que o/a estudante ten que desenvolver
Seminario	Actividade enfocada ao traballo sobre un tema específico, que permite profundar ou complementar os contidos da materia. Pódense empregar como complemento das clases teóricas.
Saídas de estudo	Actividades de aplicación, contraste e observación dos coñecementos nun contexto determinado nun espazo externo.
Obradoiro	Actividades enfocadas á adquisición de coñecementos procedimentais, habilidades manipulativas e instrumentais sobre unha temática concreta, con asistencia específica por parte do profesorado ás actividades individuais e/ou grupais que desenvolven os estudantes.

Atención personalizada

Methodologies	Description
Seminario	Actividade académica desenvolvida polo profesorado para atender as necesidades e consultas do alumnado relacionadas co estudo e/ou temas vinculados coa materia, proporcionándolle orientación, apoio e motivación no proceso de aprendizaxe. Esta actividade desenvolverase de forma presencial (directamente na aula), nos horarios que o profesorado ten asignadas a tutorías de despacho ou de forma non presencial (a través do correo electrónico ou do campus virtual).
Saídas de estudo	Actividade académica desenvolvida polo profesorado para atender as necesidades e consultas do alumnado relacionadas co estudo e/ou temas vinculados coa materia, proporcionándolle orientación, apoio e motivación no proceso de aprendizaxe. Esta actividade desenvolverase de forma presencial, nos horarios que o profesorado ten asignadas a tutorías de despacho ou de forma non presencial (a través do correo electrónico ou do campus virtual).
Obradoiro	Actividade académica desenvolvida polo profesorado para atender as necesidades e consultas do alumnado relacionadas co estudo e/ou temas vinculados coa materia, proporcionándolle orientación, apoio e motivación no proceso de aprendizaxe. Esta actividade desenvolverase de forma presencial (directamente na aula), nos horarios que o profesorado ten asignadas a tutorías de despacho ou de forma non presencial (a través do correo electrónico ou do campus virtual).

Avaliación

	Description	Qualification	Training and Learning Results		
Exame de preguntas de desenvolvemento	Exame escrito de cuestións de resposta longa, de desenvolvemento. Resultados previstos na materia: - Comprender os aspectos básicos da dinámica da Terra - Coñecer os aspectos básicos da xeoloxía histórica e rexional.	27	A1	C5	D1
Exame de preguntas obxectivas	Exame escrito de cuestións de resposta curta. Resultados previstos na materia: - Comprender os aspectos básicos da dinámica da Terra - Coñecer os aspectos básicos da xeoloxía histórica e rexional.	27	A1	C5	D1
Resolución de problemas e/ou exercicios	Proba na que o alumnado debe solucionar unha serie de problemas e/ou exercicios. Resultados previstos na materia: - Desenvolver solucións prácticas a fenómenos e situacións-problema da realidade cotiá en xeral e en particular os propios da xeoloxía e hidroxeoloxía.	40	A1 A2 A3 A4 A5	C5	D1 D3 D5 D7
Informe de prácticas, prácticum e prácticas externas	Elaboración dun documento por parte do alumnado no que se recollen os resultados de prácticas expostas e sobre a saída de campo realizada. Resultados previstos na materia: - Desenvolver solucións prácticas a fenómenos e situacións-problema da realidade cotiá en xeral e en particular os propios da xeoloxía e hidrogeoloxía - Adquirir habilidades no manexo, interpretación e elaboración de cartografía xeral e temática.	6	A1 A2 A3 A4 A5	C5	D1 D3 D5 D7

Other comments on the Evaluation

A orde establecida no temario da materia pode sufrir modificacións ao longo do curso para favorecer o proceso de aprendizaxe do alumnado.

Avaliación Continua primeira oportunidade

En ningún caso o alumnado terá que enfrentarse nunha única sesión a unha proba que supoña máis do 40 % da materia.

Exames de teoría, 54% da nota final (50% preguntas desenvolvemento + 50% preguntas curtas).

Exame de prácticas, 28% da nota final.

Exame de recoñecemento de minerais e rochas, 12% da nota final.

Memoria dos talleres de cartografía, cortes xeolóxicos e saída de campo, 6% da nota final.

A fin de facilitar unha avaliación continua faranse tres probas parciais da parte teórica que terán validez do 18 % da nota final. Si obtense unha nota inferiora 5, o alumnado debera examinarse das partes no superadas no exame teórico da primeira oportunidade. Si a nota e superior a 5 o alumnado poderá presentarse asubir nota no exame teórico da primeira oportunidade, conservándose la nota superior de ambas opcións.

Na primeira oportunidade o alumnado se examinará do exame de prácticas e recoñecemento de minerais e rochas. Ademais, o alumnado poderá presentarse as partes teóricas non superadas ou as que desexe subir nota.

Nota: Para presentarse a subir nota, o alumnado deberá comunicar ao profesorado da materia a súa intención antes do comezo do período de exames.

Na primeira oportunidade, para superar a materia é necesario obter no exame final unha nota superior a 3,5 sobre 10 en calquera dos apartados avaliados.

Tanto nas sesións de seminario como de laboratorio realizarase un seguimento do nivel de asistencia. Aquel alumnado que non alcance un nivel de asistencia mínimo do 80%, non superará a materia por avaliación continua.

Avaliación Continua segunda oportunidade

As condicións son similares a primeira oportunidade. As notas parciais manteñense, pero non existe a posibilidade de subir nota ao alumnado que superou a materia na primeira oportunidade.

Avaliación Global primeira e segunda oportunidade

Unha soa proba teórico-práctica polo 100% da nota. A proba incluirá preguntas de desenvolvemento e curtas, identificación de Minerais e Rochas, exercicios de cartografía e cortes xeolóxicos.

Alumnado repetidor

Non se gardarán cualificacións dun ano para outro

Calendario de exames. Verificar/consultar de forma actualizada na páxina web do centro:

http://minaseenerxia.uvigo.es/gl/docencia/exames

Bibliografía. Fontes de información

Basic Bibliography

Tarbuck, E. J.; Lutgens, F. K., y Tasa, D., **CIENCIAS DE LA TIERRA**, PEARSON PRENTICE HALL,

J. L. Giner Robles;Javier González Yelamos;Manuel Pozo Rodríguez, **Geología práctica : introducción al reconocimiento de materiales y análisis de mapas**, Alhambra,

Complementary Bibliography

BONEWITZ, R.L., **ROCAS Y MINERALES.**, Omega,

Luis I. González de Vallejo, Mercedes Ferrer, Luis Ortuño, Carlos Oteo, **INGENIERÍA GEOLÓGICA**, PEARSON EDUCACIÓN,

Recomendacións

IDENTIFYING DATA				
Transmisión de calor				
Subject	Transmisión de calor			
Code	V09G311V01207			
Study programme	Grao en Enxeñaría dos Recursos Mineiros e Enerxéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	2c
Teaching language	Castelán			
Department	Enxeñaría mecánica, máquinas e motores térmicos e fluídos			
Coordinator	Fernández Seara, Jose			
Lecturers	Fernández Seara, Jose			
E-mail	jseara@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	Profundar no coñecemento dos procesos e equipos industriais máis relevantes que impliquen transferencia de calor.			

Resultados de Formación e Aprendizaxe	
Code	
A1	Que os estudantes demostrasen posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral, e adóitase atopar a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo.
A2	Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo.
A3	Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética.
A4	Que os estudantes poidan transmitir información, ideas, problemas e solucións a un público tanto especializado coma non especializado.
A5	Que os estudantes desenvolvesen aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía.
B1	Capacitación científico-técnica para o exercicio da profesión de Enxeñeiro Técnico de Minas e coñecemento das funcións de asesoría, análise, deseño, cálculo, proxecto, construción, mantemento, conservación e explotación.
B2	Comprensión dos múltiples condicionamentos de carácter técnico e legal que se expoñen no desenvolvemento, no ámbito da enxeñería de minas, que teñan por obxecto, de acordo cos coñecementos adquiridos segundo o establecido no apartado 5 da orde CIN/306/2009, a prospección e investigación xeolóxica-mineira, as explotacións de todo tipo de recursos xeolóxicos, incluídas as augas subterráneas, as obras subterráneas, os almacenamentos subterráneos, as plantas de tratamento e beneficio, as plantas enerxéticas, as plantas mineralúrxicas e siderúrxicas, as plantas de materiais para a construción, as plantas de carboquímica, petroquímica e gas, as plantas de tratamentos de residuos e efluentes e as fábricas de explosivos e capacidade para empregar métodos contrastados e tecnoloxías acreditadas, coa finalidade de conseguir a maior eficacia dentro do respecto polo Medio Ambiente e a protección da seguridade e saúde dos traballadores e usuarios das mesmas.
B3	Capacidade para deseñar, redactar e planificar proxectos parciais ou específicos das unidades definidas no apartado anterior, tales como instalacións mecánicas e eléctricas e co seu mantemento, redes de transporte de enerxía, instalacións de transporte e almacenamento para materiais sólidos, líquidos ou gaseosos, vertedoiros, balsas ou presas, sostemento e cimentación, demolición, restauración, voaduras e loxística de explosivos.
B4	Capacidade para deseñar, planificar, operar, inspeccionar, asinar e dirixir proxectos, plantas ou instalacións, no seu ámbito.
C10	Comprensión e dominio dos conceptos básicos sobre as leis xerais da mecánica e da termodinámica e a súa aplicación para a resolución dos problemas propios da enxeñería. Transferencia de calor e materia e máquinas térmicas.
D1	Capacidade de interrelacionar todos os coñecementos adquiridos, interpretándoos como compoñentes dun corpo do saber cunha estrutura clara e unha forte coherencia interna.
D2	Capacidade de desenvolver un proxecto completo en calquera campo desta enxeñería, combinando de forma adecuada os coñecementos adquiridos, accedendo ás fontes de información necesarias, realizando as consultas precisas e integrándose en equipos de traballo interdisciplinar.
D3	Propoñer e desenvolver solucións prácticas, utilizando os coñecementos teóricos, a fenómenos e situacións-problema da realidade cotiá propios da enxeñería, desenvolvendo as estratexias adecuadas.
D4	Favorecer o traballo cooperativo, as capacidades de comunicación, organización, planificación e aceptación de responsabilidades nun ambiente de traballo multilingüe e multidisciplinar, que favoreza a educación para a igualdade, para a paz e para o respecto dos dereitos fundamentais.

D7	Capacidade para organizar, interpretar, asimilar, elaborar e xestionar toda a información necesaria para desenvolver o seu labor, manexando as ferramentas informáticas, matemáticas, físicas, etc., necesarias para iso.
D8	Concibir a enxeñería nun marco de desenvolvemento sustentable con sensibilidade cara a temas ambientais.

Resultados previstos na materia

Expected results from this subject	Training and Learning Results			
Identificación dos modos de transferencia de calor así como a formulación e resolución de problemas de enxeñaría relacionados.	A2		C10	D1 D3 D7
Coñecer o proceso experimental utilizado cando se traballa con transferencia de enerxía.	A1 A2 A3 A5	B2 B3	C10	D3 D4 D7 D8
Capacidade para coñecer e entender os principios e fundamentos da transmisión de calor.	A1 A2 A3 A5	B1 B3 B4	C10	D1 D2 D3 D4 D7
Capacidade para coñecer, entender e utilizar os principios e fundamentos da termodinámica aplicada.	A1 A2 A3 A5	B1	C10	D1 D2
Calcular instalacións de transferencia de calor.	A1 A2 A3 A5	B1 B2 B3 B4	C10	D1 D2 D3 D8
Dominar as técnicas actuais dispoñibles para a análise da enxeñaría térmica	A2 A3 A4 A5	B1 B3 B4	C10	D1 D2 D3 D7 D8

Contidos

Topic	
1. INTRODUCIÓN Á TRANSMISIÓN DE CALOR	1.1. A transmisión de calor e a termodinámica 1.2. Mecanismos de transmisión da calor 1.3. Complexidade do fenómeno de transmisión da calor 1.4. Importancia do estudo da transmisión de calor. Aplicacións
2. CONCEPTOS E PRINCIPIOS FUNDAMENTAIS EN CONDUCIÓN	2.1. Campo de temperaturas, liñas e superficies isotermas 2.2. Gradiente de temperatura 2.3. Calor, fluxo de calor e densidade de fluxo de calor 2.4. Lei de Fourier 2.5. Ecuación xeral de transmisión de calor por condución 2.6. Condicións de unicidad: xeométricas, físicas, iniciais, de contorno 2.7. Proceso xeral de solución dos problemas en condución 2.8. Conductividade térmica e mecanismos de condución 2.9. Conductividade térmica en sólidos, líquidos e gases 2.10. Difusividade térmica
3. CONDUCIÓN EN RÉXIME PERMANENTE UNIDIRECCIONAL	3.1. Parede plana infinita 3.2. Parede plana composta 3.3 Cilindro infinito 3.4. Cilindro composto 3.5. Espesor crítico de illamento en tubaxes 3.6. Esfera 3.7. Esfera composta 3.8. Espesor crítico de illamento nunha esfera 3.9. Ecuación xeral para casos particulares 3.10 Resistencia térmica de contacto 3.11. Analoxía termo-eléctrica.

4. SUPERFICIES ADICIONAIS Ou ALETAS	4.1. Introdución 4.2. Tipos de aletas 4.3. Ecuación xeral das aletas e condicións de contorno 4.4. Aletas de sección transversal constante 4.5. Fluxo de calor disipada por unha aleta 4.6. Aletas de sección transversal variable 4.7. Eficiencia das aletas 4.8. Eficiencia dunha superficie aleteada 4.9. Fluxo de calor disipada por unha superficie aleteada 4.10. Efecto da colocación de aletas rectas
5. CONDUCIÓN EN RÉXIME PERMANENTE MULTIDIRECCIONAL	5.1. Réxime permanente en máis dunha dirección 5.2. Placas rectangulares 5.3. Principio de superposición 5.4. Cilindro de lonxitude finita 5.5 Factor de forma
6. CONDUCIÓN EN RÉXIME TRANSITORIO	6.1. Réxime transitorio e parámetros adimensionais 6.2. Condución transitoria nunha placa infinita 6.3. Condución transitoria en cilindros infinitos 6.4. Condución en réxime transitorio en máis dunha dirección. Método do produto de solucións 6.5. Método da capacidade térmica global
7. MÉTODOS NUMÉRICOS	7.1. Introdución 7.2. Método de diferenzas finitas. Discretización do dominio e do tempo 7.3. Método das diferenzas finitas en réxime permanente 7.4. Método das diferenzas finitas en réxime transitorio
8. CONCEPTOS E PRINCIPIOS FUNDAMENTAIS EN CONVECCIÓN	8.1. Introdución 8.2. Tipos de convección 8.3. Formulación xeral do problema de convección 8.4. Conceptos básicos 8.5. Análise dimensional, magnitudes fundamentais e derivadas 8.6. Teorema PI de Buckingham. Método dos Índices 8.7. Parámetros adimensionais. 8.8. Coeficientes de convección: local, medio
9. CONVECCIÓN FORZADA E CONVECCIÓN NATURAL	9.1. Parámetros adimensionais en convección forzada 9.2. Temperatura de cálculo das propiedades do fluído 9.3. Convección forzada externa 9.4. Convección forzada interna 9.5. Parámetros adimensionais en convección natural 9.6. Convección natural en espazos ilimitados 9.7. Convección natural en espazos limitados 9.8. Convección mixta
10. CONVECCIÓN CON CAMBIO DE FASE. CONDENSACIÓN E EBULICIÓN	10.1. Introdución 10.2. Condensación. Tipos 10.3. Condensación en película sobre unha parede vertical plana 10.4. Condensación sobre tubos horizontais 10.5. Condensación sobre un feixe de tubos 10.6. Condensación sobre superficies e tubos inclinados 10.7. Condensación sobre esferas 10.8. Condensación en convección forzada 10.9. Ebulición. Tipos 10.10. Ebulición en recipientes. 10.11. Ebulición en convección forzada
11. INTERCAMBIADORES DE CALOR	11.1. Introdución 11.2. Clasificación xeral 11.3. Principais tipos de intercambiadores 11.4. Tipos de análises de intercambiadores 11.5. Coeficiente global de transmisión de calor 11.6. Resistencia térmica controlante 11.7. Distribución de temperaturas nos intercambiadores 11.8. Cálculo do fluxo de calor intercambiada 11.9. Método da diferenza de temperaturas 11.10. Método da eficiencia-número de unidades de transferencia (Ef-N.T.U.) 11.11. Comparación entre os métodos DTLM e Ef-N.T.U. Formulación xeral dos problemas 11.12. Cálculo do coeficiente global de transmisión de calor 11.13. Método xeral de cálculo dun intercambiador por procesos iterativos

12. CONCEPTOS E PRINCIPIOS FUNDAMENTAIS EN RADIACIÓN	12.1. Introdución 12.2. Conceptos básicos no proceso de intercambio de enerxía radiante: lei de Prevost, intensidade de radiación, emitancia, radiosidad e irradiación 12.3. Proceso de intercambio de enerxía radiante 12.4. Corpo negro: intensidade de radiación, lei de Stefan-Bolztmann, lei de Planck, lei de Wien, lei do desprazamento de Wien 12.5. Lei de Lambert. Superficies mates ou difusas. 12.6. Emisividade, absortividade, reflectividade e transmitividade. 2.7. Superficie gris. Xeneralización da Lei de Stefan-Boltzman 12.8. Lei de Kirchoff
13. INTERCAMBIO DE CALOR POR RADIACIÓN NO MEDIO NON PARTICIPANTE	13.1. Introdución 13.2. Concepto de factor de forma 13.3. Factor de forma entre dúas superficies 13.4. Factores de forma nun recinto pechado 13.5. Cálculo dos factores de forma 13.6. Balance de enerxía radiante nunha superficie calquera 13.7. Intercambio de calor entre superficies negras 13.8. Métodos de cálculo do intercambio de calor nun recinto pechado
14. INTERCAMBIO DE CALOR POR RADIACIÓN NO MEDIO PARTICIPANTE	14.1. Introdución 14.2. Absorción volumétrica monocromática nun gas. Lei de Beer 14.3. Comportamento real dun medio participante. 14.4. Fluxo de calor intercambiada nun recinto con N superficies negras e un gas participante. Radiación en fornos e caldeiras 14.5. Radiación solar

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	36	72.5	108.5
Prácticas de laboratorio	10	20	30
Seminario	4	5	9
Exame de preguntas obxectivas	2.5	0	2.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente

	Description
Lección maxistral	Exposición dos contidos da materia en clase por parte do profesorado
Prácticas de laboratorio	Realización de prácticas no laboratorio utilizando diversos equipos e técnicas experimentais.
Seminario	Uso de programas informáticos de cálculo.

Atención personalizada

Methodologies	Description
Lección maxistral	O profesorado atenderá persoalmente as dúbidas e consultas do alumnado durante a clase e no horario de tutorías. Durante a clase só se atenderán as dúbidas que se refiran a conceptos que se están explicando nese momento. Para todas as modalidades de docencia, as sesións de tutorización poderán realizarse por medios telemáticos (correo electrónico, videoconferencia, foros de Moovi, ...) baixo a modalidade de concertación previa.
Seminario	O profesorado atenderá persoalmente as dúbidas e consultas do alumnado durante a clase e no horario de tutorías. Durante a clase só se atenderán as dúbidas que se refiran a conceptos que se están explicando nese momento. Para todas as modalidades de docencia, as sesións de tutorización poderán realizarse por medios telemáticos (correo electrónico, videoconferencia, foros de Moovi, ...) baixo a modalidade de concertación previa.
Prácticas de laboratorio	O profesorado atenderá persoalmente as dúbidas e consultas do alumnado durante a clase e no horario de tutorías. Durante a clase só se atenderán as dúbidas que se refiran a conceptos que se están explicando nese momento. Para todas as modalidades de docencia, as sesións de tutorización poderán realizarse por medios telemáticos (correo electrónico, videoconferencia, foros de Moovi, ...) baixo a modalidade de concertación previa.

Avaliación

	Description	Qualification	Training and Learning Results

Lección maxistral	Durante o cuadrimestre, en data diferente á do exame oficial, realizarase unha proba que poderá incluír preguntas de teoría e/ou problemas relacionados cos contidos impartidos. Nesta metodoloxía trabállanse todos os resultados previstos na materia	40	A1 A2 A3 A4 A5	B1 B2 B3 B4	C10	D1 D2 D3 D4 D7 D8
Prácticas de laboratorio	Valorarase a asistencia ás sesións tipo B e o informe de prácticas. Nesta metodoloxía trabállanse todos os resultados previstos na materia	20	A1 A2 A3 A4 A5	B1 B3	C10	D2
Exame de preguntas obxectivas	Resultados de aprendizaxe avaliados: Identificación dos modos de transferencia de calor así como a formulación e resolución de problemas de enxeñaría relacionados. Coñecer o proceso experimental utilizado cando se traballa con transferencia de enerxía. Capacidade para coñecer e entender os principios e fundamentos da transmisión da calor. Capacidade para coñecer, entender e utilizar os principios e fundamentos da termodinámica aplicada. Calcular instalacións de transferencia de calor. Dominar as técnicas actuais dispoñibles para a análise da enxeñaría térmica.	40	A1 A2 A3 A4 A5	B1 B2 B3 B4	C10	D1 D2 D3 D4 D7 D8

Other comments on the Evaluation

Consideracións sobre a avaliación continua:

O alumnado deberá obter unha puntuación igual ou superior a 5 sobre 10 na suma das puntuacións obtidas en cadametodoloxía avaliada.

Consideracións sobre a avaliación global:

O alumnado terá dereito a renunciar á avaliación continua unha vez transcorrido un mes desde o inicio da actividadedocente (según a normativa da Escola de Enxeñaría de Minas e Enerxía) e a súa cualificación obterase a partir do examerealizado no data oficial, debendo Obter unha cualificación igual ou superior a 5 sobre 10 na dita proba.

Consideracións sobre a segunda oportunidade:

O alumnado que non superase a materia pola modalidade de avaliación continua ou avaliación global na primeiraoportunidade terá dereito a unha segunda oportunidade mediante a realización dunha proba na data oficial que figure nocalendario do centro, onde deberá obter unha cualificación igual ou superior. cualificación ata 5 sobre 10.

Calendario de examens. Verificar/consultar de forma actualizada na páxina web do centro:

http://minaseenerxia.uvigo.es/é/docencia/examenes

Bibliografía. Fontes de información

Basic Bibliography

Incropera F.P., Dewitt D.P., **Fundamentals of heat and mass transfer**, 4ª Edición, Editorial John Wiley & Sons, 1996

Complementary Bibliography

Fernández Seara J., Rodríguez Alonso C., Uhía Vizoso F. J., Sieres Atienza J., **Coeficientes de convección en casos prácticos. Correlaciones y programa de cálculo.**, 1ª Edición, Ciencia 3, 2005

Fernández Seara J., Sieres Atienza J. Uhía Vizoso F.J., **Manual de prácticas de transmisión de calor**, 1ª Edición, Gamesal, 2006

Chapman A.J., **Transmisión de calor**, 3ª Edición, Librería Editorial Bellisco, 1990

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

Holman J.P., **Transferencia de calor**, 8ª Edición, Mc Graw Hill, 1998

Bejan, **Heat transfer**, John Wiley & Sons, 1993

Recomendacións

Subjects that it is recommended to have taken before

Física: Física I/V09G311V01102
Física: Física II/V09G311V01107
Matemáticas: Cálculo I/V09G311V01104
Matemáticas: Cálculo II/V09G311V01109
Mecánica de fluídos/V09G311V01204
Sistemas térmicos/V09G311V01205

IDENTIFYING DATA				
Tecnoloxía ambiental				
Subject	Tecnoloxía ambiental			
Code	V09G311V01208			
Study programme	Grao en Enxeñaría dos Recursos Mineiros e Enerxéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	2c
Teaching language	Castelán			
Department	Enxeñaría dos recursos naturais e medio ambiente			
Coordinator	Barrionuevo Giménez, Rafael			
Lecturers	Barrionuevo Giménez, Rafael			
E-mail	rbarrio@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	Nesta materia preténdese mostrar cales son as principais fontes de contaminación así como as metodoloxías dispoñibles para avaliar o seu impacto.			

Resultados de Formación e Aprendizaxe	
Code	
A1	Que os estudantes demostrasen posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral, e adóitase atopar a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo.
A2	Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo.
A3	Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética.
A4	Que os estudantes poidan transmitir información, ideas, problemas e solucións a un público tanto especializado coma non especializado.
A5	Que os estudantes desenvolvesen aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía.
C18	Capacidade para aplicar metodoloxías de estudos e avaliacións de impacto ambiental e, en xeral, de tecnoloxías ambientais, sustentabilidade e tratamento de residuos.
D2	Capacidade de desenvolver un proxecto completo en calquera campo desta enxeñería, combinando de forma adecuada os coñecementos adquiridos, accedendo ás fontes de información necesarias, realizando as consultas precisas e integrándose en equipos de traballo interdisciplinar.
D4	Favorecer o traballo cooperativo, as capacidades de comunicación, organización, planificación e aceptación de responsabilidades nun ambiente de traballo multilingüe e multidisciplinar, que favoreza a educación para a igualdade, para a paz e para o respecto dos dereitos fundamentais.
D7	Capacidade para organizar, interpretar, asimilar, elaborar e xestionar toda a información necesaria para desenvolver o seu labor, manexando as ferramentas informáticas, matemáticas, físicas, etc., necesarias para iso.
D8	Concibir a enxeñería nun marco de desenvolvemento sustentable con sensibilidade cara a temas ambientais.
D9	Entender a transcendencia dos aspectos relacionados coa seguridade e saber transmitir esta sensibilidade ás persoas da súa contorna.
D10	Tomar conciencia da necesidade dunha formación e mellora continua de calidade, desenvolvendo valores propios da dinámica do pensamento científico, mostrando unha actitude flexible, aberta e ética ante opinións ou situacións diversas, en particular en materia de non discriminación por sexo, raza ou relixión, respecto aos dereitos fundamentais, accesibilidade, etc.

Resultados previstos na materia		
Expected results from this subject	Training and Learning Results	
Coñecer o medio físico e a súa caracterización.	A1 A2 A3 A4 A5	C18 D2 D4 D7 D8 D9 D10

Identificar e avaliar as fontes e impacto da contaminación.	A1 A2 A3 A4 A5	C18	D2 D4 D7 D8 D9 D10
Aplicar métodos de avaliación de impacto ambiental.	A1 A2 A3 A4 A5	C18	D2 D4 D7 D8 D9 D10
Coñecer as tecnoloxías básicas de prevención e control da contaminación atmosférica e augas	A1 A2 A3 A4 A5	C18	D2 D4 D7 D8 D9 D10

Contidos	
Topic	
Caracterización do medio físico e recursos para a súa caracterización	Clima, paisaxe, topografía, medio hídrico, solos, xeoloxía, patrimonio, cultural, fauna, flora, medio socioeconómico.
Fontes de contaminación, impacto e medida do seu impacto.	Contaminación atmosférica e calidade do aire Contaminación hídrica e calidade da auga Contaminación de solos e augas subterráneas Contaminación acústica Residuos sólidos e efluentes
Avaliación de Impacto Ambiental. Metodoloxía e lexislación	Lexislación Metodoloxías
Tecnoloxías para o control da contaminación ambiental	Tecnoloxías para tratamento de residuos Tecnoloxías para a prevención da contaminación atmosférica Tecnoloxías para a prevención da contaminación das augas

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	17	30	47
Estudo de casos	7.5	15	22.5
Resolución de problemas	7.5	30	37.5
Prácticas de laboratorio	14	14	28
Seminario	4	8.5	12.5
Exame de preguntas obxectivas	2.5	0	2.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Lección maxistral	Exposición por parte do profesorado dos contidos sobre a materia obxecto de estudo, bases teóricas e/ou directrices dun traballo, exercicio ou proxecto a desenvolver polo/a estudante
Estudo de casos	Análise dun feito, problema ou suceso real coa finalidade de coñecelo, interpretalo, resolvelo, xerar hipótese, contrastar datos, reflexionar, completar coñecementos, diagnosticalo e adestrarse en procedementos alternativos de solución
Resolución de problemas	En moitos dos estudos de casos de análise que se abordarán durante o curso, o alumnado deberá desenvolver as solucións adecuadas ou correctas mediante o excercicio de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación da información dispoñible e a interpretación dos resultados.
Prácticas de laboratorio	Actividades de aplicación dos coñecementos a situacións concretas e de adquisición de habilidades básicas e procedimentales relacionadas coa materia obxecto de estudo. Desenvólvense en espazos especiais con equipamento especializado (laboratorios, aulas informáticas, etc.).
Seminario	Actividade tutelada enfocada ao traballo sobre un tema específico, que permite afondar ou complementar os contidos da materia.

Atención personalizada

Methodologies	Description
Lección maxistral	Atenderanse as necesidades e consultas do alumnado relacionadas co estudo e/ou temas vinculados coa materia, proporcionándolle orientación, apoio e motivación no proceso de aprendizaxe. Esta actividade pode desenvolverse de forma presencial (directamente na aula e nos horarios de titorías de despacho) ou de forma non presencial (a través do correo electrónico ou da plataforma docente MooVi).
Estudo de casos	Atenderanse as necesidades e consultas do alumnado relacionadas co estudo e/ou temas vinculados coa materia, proporcionándolle orientación, apoio e motivación no proceso de aprendizaxe. Esta actividade pode desenvolverse de forma presencial (directamente na aula e nos horarios de titorías de despacho) ou de forma non presencial (a través do correo electrónico ou da plataforma docente MooVi).
Resolución de problemas	Atenderanse as necesidades e consultas do alumnado relacionadas co estudo e/ou temas vinculados coa materia, proporcionándolle orientación, apoio e motivación no proceso de aprendizaxe. Esta actividade pode desenvolverse de forma presencial (directamente na aula e nos horarios de titorías de despacho) ou de forma non presencial (a través do correo electrónico ou da plataforma docente MooVi).
Seminario	Atenderanse as necesidades e consultas do alumnado relacionadas co estudo e/ou temas vinculados coa materia, proporcionándolle orientación, apoio e motivación no proceso de aprendizaxe. Esta actividade pode desenvolverse de forma presencial (directamente na aula e nos horarios de titorías de despacho) ou de forma non presencial (a través do correo electrónico ou da plataforma docente MooVi).

Avaliación

	Description	Qualification	Training and Learning Results		
Resolución de problemas	O alumnado deberá resolver problemas de desenvolvemento práctico que se traballan previamente na aula. Avalíanse os resultados previstos na materia seguintes: Identificar e avaliar as fontes e impacto da contaminación. Aplicar métodos de avaliación de impacto ambiental.	40	A1 A2 A3 A4 A5	C18	D2 D4 D7 D8 D9 D10
Prácticas de laboratorio	Terase en conta na avaliación a asistencia ás prácticas de laboratorio. Avalíanse os resultados previstos na materia seguintes: Identificar e avaliar as fontes e impacto da contaminación. Coñecer as tecnoloxías básicas de prevención e control da contaminación atmosférica e augas.	20	A1 A2 A3 A4 A5	C18	D2 D4 D7 D8 D9 D10
Seminario	Terase en conta a realización dun ou dous problemas relacionados cos seminarios. Mediante esta metodoloxía avalíanse todos os resultados previstos na materia.	10	A1 A2 A3 A4 A5	C18	D2 D4 D7 D8 D9 D10
Exame de preguntas obxectivas	Proba de avaliación que expón cuestións teórico-prácticas de resposta obxectiva, relacionada cos contidos impartidos na aula. Avalíanse os resultados previstos na materia seguintes: Coñecer o medio físico e a súa caracterización. Identificar e avaliar as fontes e impacto da contaminación. Coñecer as tecnoloxías básicas de prevención e control da contaminación atmosférica e augas.	30	A1 A2 A3 A4 A5	C18	D2 D4 D7 D8 D9 D10

Other comments on the Evaluation

CONSIDERACIONS SOBRE A AVALIACIÓN CONTINUA

A avaliación continua incluirá os seguintes apartados:

 (40%) Exame escrito sobre problemas (4 problemas).

 (30%) Exame de exercicios teóricos e prácticos. Conteñen teoría ou algún exercicio práctico de aplicación directa. (3 exercicios).

 (20%) Exame práctico. (2 follas de cálculo).

 (10%) Problema ou problemas relacionados co seminario (1 ou 2 problemas).

Na modalidade de avaliación continua establécese en porcentaxe (20%) o número máximo de faltas de asistencia a laboratorios máis seminarios, que corresponde a 2 faltas en total.

Na primeira oportunidade, o alumnado será examinado polo sistema de avaliación continua, salvo renuncia expresa. A data mínima para solicitar a renuncia á avaliación continua non será inferior a un mes desde o inicio da impartición da materia.

En ningún caso, o alumnado terá que enfrentarse por primeira vez a unha proba que supoña máis do 40% da cualificación da asignatura.

CONSIDERACIONS SOBRE A AVALIACIÓN GLOBAL

No caso de que os/as estudantes decidiran facer un exame global, o sistema porcentual sería o seguinte:

 (40%) Exame escrito de problemas (4 problemas)

 (40%) Exame de exercicios teóricos e prácticos. Conteñen teoría ou algún exercicio práctico de aplicación directa. (4 exercicios)

 (20%) Problema ou problemas relacionados co seminario (2 problemas)

CONSIDERACIONES DE SEGUNDA OPORTUNIDADE

Na segunda oportunidade, o alumnado será examinado polo sistema de avaliación continua, salvo que deixara constancia expresa en tempo e forma regulamentariamente. Este exame terá a mesma configuración que a avaliación global de primeira oportunidade.

Calendario de exames: poden consultarse na páxina web do centro

http://minaseenerxia.uvigo.es/es/docencia/examenes/

Bibliografía. Fontes de información

Basic Bibliography

Burel F. y Baudry J., **Ecología del Paisaje**, Mundi Prensa Lirbos SA, 2002

Canter L.W., **Maual de la Evaluación del Impacto Ambiental**, McGraw-Hill, 1998

Kiely G., **Ingeniería Ambiental: Fundamentos, entornos, tecnologías y sistemas de gestión**, McGraw-Hill, 1999

Complementary Bibliography

Ayala Carcedo F.J. y Vadillo Fernández L., **Manual de restauración de terrenos y evaluación de impactos ambientales en minería**, Instituto Geológico y Minero de España, 2005

López Gimeno C., **Manual de estabilización y revegetación de taludes**, Carlos López Gimeno, 1999

Vaquero Díaz I., **Manual de diseño y construcción de vertederos de residuos sólidos urbanos**, 1ª, Carlos López Gimeno, 2004

Polprasert C., **Organic Waste Recycling: Technology and Management**, IWA Publishing, 2007

Tchobanoglous G, **Gestión Integral de Residuos Sólidos**, McGraw-Hill, 1996

Nemerow N.L., Dasgupta A., **Tratamiento de Vertidos Industriales y peligrosos**, Díaz de Santos, 1998

López Jimeno C., Aduvire Patacas O., Escribano González A., **Manual de Construcción y restauración de escombreras**, Escuela Técnica Superior de Ingenieros de Minas, 2006

LaGrega M.D., Buckingham P.L., Evans J.C., **Hazardous Waste Management**, 2nd, Waveland Press, Inc., 1994

Recomendacións

IDENTIFYING DATA				
Electrical Technology				
Subject	Electrical Technology			
Code	V09G311V01209			
Study programme	Grado en Ingeniería de los Recursos Mineros y Energéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Valdés Peña, María Dolores			
Lecturers	Valdés Peña, María Dolores			
E-mail	mvaldes@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The objective of this course is to provide the students with the theoretical and practical fundamental knowledge in electronics' five main areas: analog electronics, digital electronics, industrial sensors, power electronics and communications electronics. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
A1	That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study
A2	That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study
A3	That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues
A4	That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized audience
A5	That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.
B1	Scientific and technical training and qualification as a Mining Engineer and knowledge of the functions of consultancy, analysis, design, calculus, project, construction, maintenance, preservation and exploitation.
B3	Ability to design, write and plan partial or specific projects within the units specified in the previous section, such as mechanical and electric plants and their maintenance, networks of energy transportation, facilities for transportation and storage of solid, liquid and gaseous materials, waste sites, tailing dams, foundation and support, demolition, restoration, controlled explosions and explosives logistics.
C17	Knowledge of the fundamentals of the electrical power system: generation of energy, transportation, distribution and delivery networks, as well as the types of lines and conductors. Knowledge of the regulations of high and low tension. Basic knowledge of electronics and control systems.
D1	Ability to draw links between the different elements of all the knowledge they acquired, understanding them as components of a body of knowledge with a clear structure and strong internal cohesion.
D2	Ability to develop a project to completion in any field of this branch of engineering, combining appropriately the knowledge acquired, consulting the relevant sources of information, carrying out any required inquiries, and joining interdisciplinary work teams.
D8	Understanding engineering within a framework of sustainable development with environmental awareness.
D9	Understanding the importance of safety issues and being able to foster awareness about safety among people within their environment.

Expected results from this subject	Training and Learning Results		
Know the basic operation of the electronic devices.	A4 A5	C17	D2 D9
Know the operation of basic digital circuits	A3 A4 A5	C17	D2

Know the structures of data acquisition systems.	A3 A4 A5		C17	D2
Understand the basics of different types of sensors and their applications.	A1 A2 A3 A4 A5	B1 B3	C17	D2 D8
Select and use computer tools for the analysis, visualization and storage of the value of variables.	A3 A4 A5		C17	D1 D2
Know the basic principles of the programmable instrumentation and its use	A4		C17	D1 D2
Know the structure of basic power electronic converters.	A1 A2 A3 A4	B1	C17	D1 D2 D9

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

Power Electronics	- Circuits for Power Conversion - Rectifiers - Lineal and Switched Power Sources
Laboratory practices	- Management of circuit design and simulation software tools. - Management of electrical signals measurement instrumentation. - Assembly and test of electric circuits based on diodes, transistors, operational amplifiers, analog/digital and digital/analog converters.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	28	0	28
Problem solving	8	0	8
Previous studies	0	49	49
Autonomous problem solving	0	48.5	48.5
Laboratory practical	14	0	14
Essay questions exam	2.5	0	2.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

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

Personalized assistance	
Methodologies	**Description**
Problem solving	Professor will answer questions and queries of the students. Students will have the opportunity to attend individual or group tutorials. Email: Students will also be able to request guidance and support via email from the subject teachers, either for specific questions or to request a tutorial through Remote Campus.
Lecturing	Professor will personally answer questions and queries of the students about course issues. Students will have the opportunity to attend individual or group tutorials. Email: Students will also be able to request guidance and support via email from the subject teachers, either for specific questions or to request a tutorial through Remote Campus.

Laboratory practical	Professors will answer questions and queries of the students about laboratory practices and issues. Students will have the opportunity to attend individual or group tutorials. Email: Students will also be able to request guidance and support via email from the subject teachers, either for specific questions or to request a tutorial through Remote Campus.

Assessment

	Description	Qualification	Training and Learning Results			
Laboratory practical	Assessment of the laboratory sessions: The laboratory sessions will be evaluated in a continuous way, on each session. The applied criteria are: - Previous task preparation of the sessions - Make the most of the session The documents of the practices will be available prior to the sessions. Previous preparation of the practice will be evaluated through scored activities previous to the face-to-face session. The students will fill report, that will be delivered when the session ends. This report serves to justify both the attendance and how they have done the work asked for. This methodology assesses expected results from this subject related to the basic functioning of electronic devices, the use of computer tools for the analysis and visualization of the value of variables and the correct use of instrumentation.	30	A1 A2 A4 A5	B1 B3	C17	D1 D2
Essay questions exam	Partial evaluations that are carried out throughout the semester in which part of the theoretical contents of the subject are evaluated. They will consist of individual objective tests related to a set of topics of the subject. This methodology assesses expected results from this subject related to the basic functioning of electronic devices, basic digital circuits, structures of data acquisition systems, basic aspects of different types of sensors and basic electronic power converters.	70	A1 A2 A3 A4 A5	B1 B3	C17	D1 D2 D8 D9

Other comments on the Evaluation

EVALUATION.

1.-Continuous assessment

FirstCall:

Thecontinuous evaluation will be carried out throughout the semester. Both thetheoretical contents (70% of the final mark) and the laboratory practices (30%of the final mark) will be evaluated.

Thetheoretical part of the subject is evaluated through three partial exams thatwill be carried out within the hours assigned to the subject classrooms. Theweight of each exam is 23.3% of the final grade. The grade for the theory part(T) will be obtained from the average of the grades of the three partial exams.

Regardinglaboratory practices, students will be evaluated in all practical sessions andwill obtain a grade for each practice. Sessions without assistance will bescored with a zero. The laboratory grade (L) will be obtained from the averageof the practical sessions grades. If the student does not pass the subject inthe current course, the NL grade will be retained for two academic years.

Thecontinuous assessment (C) rating will be calculated as:

C= 0.7 x T + 0.3 x L

Topass the subject by continuous assessment, both L and C must be greater than orequal to 5 points out of 10. When L is less than 5, the maximum continuousassessment grade (C) will be 4.5.

Studentswho have not passed the continuous assessment during the semester, will be ableto recover the theoretical part on the date established for the first callfinal exam. In this case, the students will take an exam on all the theoreticalcontents of the subject. The mark obtained in this exam will replace the Tgrade obtained during the semester.

Secondcall:

Studentswho have not passed the continuous assessment on the first call may take anexam of all the theoretical contents of the subject on the date of the secondcall. The grade obtained in this exam will replace the T grade obtained at thefirst call.

Thefinal continuous assessment (C) grade will be calculated as:

C= 0.7 x T + 0.3 x L

2.-Global assessment

Studentswho opt for the global evaluation method must request it by email to theteaching staff within a maximum period of one month before the end of thesemester.

Thosewho opt for global assessment will also have two opportunities, first andsecond call. In both cases the assessment will consist of two exams, one of thetheoretical part of the subject with a weight of 70% of the final grade, andanother of the laboratory practices with a weight of 30%.

Thetheoretical exam will be a written test lasting two hours. The laboratorypractice exam will last one hour and will take place in the practice laboratoryassigned to the subject.

Topass the subject by global evaluation it will be necessary to obtain a minimumgrade of 5 points out of 10, both in the theoretical and practical exam.

Exam Timetable: Exam dates and rooms must be verified in the official webpage of the school:

http://minaseenerxia.uvigo.es/es/docencia/examenes

Sources of information

Basic Bibliography

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

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

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

TOCCI, RONALD J., NEAL S. WIDMER , GREGORY L. MOSS, **Sistemas digitales. Principios y aplicaciones**, 10ª,

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

Complementary Bibliography

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

Wait, J.; Huelsman, L.; Korn, G., **INTRODUCCION AL AMPLIFICADOR OPERACIONAL**, 4ª,

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

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics I/V09G311V01102
Physics: Physics II/V09G311V01107
Mathematics: Linear algebra/V09G311V01103
Mathematics: Calculus I/V09G311V01104
Mathematics: Calculus II/V09G311V01109
Circuits and electrical machines/V09G311V01201

IDENTIFYING DATA				
Seguridade e saúde				
Subject	Seguridade e saúde			
Code	V09G311V01210			
Study programme	Grao en Enxeñaría dos Recursos Mineiros e Enerxéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	2c
Teaching language	Castelán			
Department	Enxeñaría dos recursos naturais e medio ambiente			
Coordinator	Giráldez Pérez, Eduardo			
Lecturers	Giráldez Pérez, Eduardo			
E-mail	egiraldez@uvigo.es			
Web	http://https://moovi.uvigo.gal/			
General description	Nesta materia introdúcense conceptos básicos sobre a Prevención de Riscos Laborais. Estúdase a lexislación vixente neste ámbito e adquírense metodoloxías de traballo para levar esta lexislación á práctica como técnicos na prevención de riscos laborais.			

Resultados de Formación e Aprendizaxe	
Code	
A1	Que os estudantes demostrasen posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral, e adóitase atopar a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo.
A2	Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo.
A3	Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética.
A4	Que os estudantes poidan transmitir información, ideas, problemas e solucións a un público tanto especializado coma non especializado.
A5	Que os estudantes desenvolvesen aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía.
B1	Capacitación científico-técnica para o exercicio da profesión de Enxeñeiro Técnico de Minas e coñecemento das funcións de asesoría, análise, deseño, cálculo, proxecto, construción, mantemento, conservación e explotación.
B2	Comprensión dos múltiples condicionamentos de carácter técnico e legal que se expoñen no desenvolvemento, no ámbito da enxeñería de minas, que teñan por obxecto, de acordo cos coñecementos adquiridos segundo o establecido no apartado 5 da orde CIN/306/2009, a prospección e investigación xeolóxica-mineira, as explotacións de todo tipo de recursos xeolóxicos, incluídas as augas subterráneas, as obras subterráneas, os almacenamentos subterráneos, as plantas de tratamento e beneficio, as plantas enerxéticas, as plantas mineralúrxicas e siderúrxicas, as plantas de materiais para a construción, as plantas de carboquímica, petroquímica e gas, as plantas de tratamentos de residuos e efluentes e as fábricas de explosivos e capacidade para empregar métodos contrastados e tecnoloxías acreditadas, coa finalidade de conseguir a maior eficacia dentro do respecto polo Medio Ambiente e a protección da seguridade e saúde dos traballadores e usuarios das mesmas.
B7	Coñecemento para realizar, no ámbito da enxeñería de minas, de acordo cos coñecementos adquiridos segundo o establecido no apartado 5 da orde CIN/306/2009, medicións, replanteos, planos e mapas, cálculos, valoracións, análises de riscos, peritacións, estudos e informes, plans de labores, estudos de impacto ambiental e social, plans de restauración, sistema de control de calidade, sistema de prevención, análise e valoración das propiedades dos materiais metálicos, cerámicos, refractarios, sintéticos e outros materiais, caracterización de chans e macizos rochosos e outros traballos análogos.
B8	Coñecemento, comprensión e capacidade para aplicar a lexislación necesaria no exercicio da profesión de Enxeñeiro Técnico de Minas.
C16	Capacidade de análise da problemática da seguridade e saúde nos proxectos, plantas ou instalacións.
D3	Propoñer e desenvolver solucións prácticas, utilizando os coñecementos teóricos, a fenómenos e situacións-problema da realidade cotiá propios da enxeñería, desenvolvendo as estratexias adecuadas.
D5	Coñecer as fontes necesarias para dispoñer dunha actualización permanente e continua de toda a información precisa para desenvolver o seu labor, accedendo a todas as ferramentas, actuais e futuras, de procura de información e adaptándose aos cambios tecnolóxicos e sociais
D6	Coñecer e manexar a lexislación aplicable ao sector, coñecer a contorna social e empresarial e saber relacionarse coa administración competente integrando este coñecemento na elaboración de proxectos de enxeñería e no desenvolvemento de calquera dos aspectos do seu labor profesional.
D9	Entender a transcendencia dos aspectos relacionados coa seguridade e saber transmitir esta sensibilidade ás persoas da súa contorna.

D11 Capacidade para comprender o significado e aplicación da perspectiva de xénero nos distintos ámbitos de coñecemento e na práctica profesional co obxectivo de alcanzar unha sociedade máis xusta e igualitaria.

Resultados previstos na materia				
Expected results from this subject	Training and Learning Results			
Ser consciente, como futuro traballador/a ou directivo/a, da necesidade de fomentar o interese e cooperación dos traballadores nunha acción preventiva integrada.	A2 A4	B1 B8	C16	D6 D9 D11
Ser capaz, como futuro traballador/a ou directivo/a, de promover comportamentos seguros no ámbito laboral e a correcta utilización dos equipos de traballo e protección.	A2 A3 A4	B1 B2 B8	C16	D6 D9 D11
Ser consciente, como futuro traballador/a ou directivo/a, da necesidade de promover, en particular, as actuacións preventivas básicas, tales como a orde, a limpeza, a sinalización e o mantemento xeral, e efectuar o seu seguimento e control.	A2 A3 A4	B1	C16	D5 D6 D9 D11
Ser capaz de realizar avaliacións elementais de riscos e, no seu caso, establecer medidas preventivas do mesmo carácter compatibles co seu grao de formación.	A1 A2 A3 A4	B1 B2 B7 B8	C16	D3 D5 D6 D9 D11
Aprender como colaborar na avaliación e o control dos riscos xerais e específicos dunha empresa, efectuando visitas ao efecto, atendendo queixas e suxestións e rexistrando de datos.	A1 A2 A3 A4 A5	B8	C16	D3 D5 D6 D9
Saber como actuar en caso de emerxencia e primeiros auxilios xestionando as primeiras intervencións ao efecto.	A2 A4	B8	C16	D6 D9 D11

Contidos	
Topic	
Conceptos básicos sobre seguridade e saúde no traballo.	- O traballo e a saúde: os riscos profesionais. Factores de risco. - Danos derivados do traballo. Os accidentes de traballo e as enfermidades profesionais. Outras patoloxías derivadas do traballo. - Marco normativo en materia de prevención de riscos laborais. Dereitos e deberes nesta materia.
Riscos xerais e a súa prevención.	- Riscos ligados ás condicións de seguridade. - Riscos ligados ao medio-ambiente de traballo. - A carga de traballo, fatígaa e a insastifacción laboral. - Conceptos de ergonomía. - Métodos e técnicas de avaliación de riscos - Sistemas elementais de control de riscos. Protección colectiva e individual. - Plans de emerxencia e evacuación. - O control da saúde dos traballadores.
Riscos específicos e a súa prevención en actividades incluídas no ANEXO I do REAL DECRETO 39/1997 relacionadas co ámbito profesional da Enxeñaría de Enerxía e Explotación de Recursos Mineiros.	- Riscos específicos e a súa prevención no sector da Industria. - Riscos específicos e a súa prevención no sector da Construción. - Riscos específicos e a súa prevención no sector da Minería
Elementos básicos de xestión da prevención de riscos.	- Organismos públicos relacionados coa seguridade e saúde no traballo. - Organización do traballo preventivo: «rutinas» básicas. - Documentación: recollida, elaboración e arquivo. - Técnicas de investigación de accidentes laborais.
Primeiros auxilios	- Procedementos de actuación ante a continxencia por accidente laboral.

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	26	43	69
Prácticas con apoio das TIC	10	15	25
Traballo tutelado	5	18	23
Debate	5	5	10
Saídas de estudo	4	2	6

Exame de preguntas de desenvolvemento	1	5	6
Estudo de casos	0.5	4.5	5
Observación sistemática	1	5	6

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

Metodoloxía docente	
	Description
Lección maxistral	Exposición por parte do profesorado dos contidos sobre a materia obxecto de estudo
Prácticas con apoio das TIC	Actividades de aplicación do coñecemento nun contexto determinado e de adquisición de habilidades básicas e procedementos en relación coa materia a través do TIC
Traballo tutelado	Exposición por parte do profesorado dos contidos sobre as directrices dos traballos expostos, que o estudante terá que desenvolver
Debate	Análise de feitos, problemas e sucesos reais ou supostos coa finalidade de coñecelos, interpretalos, resolvelos, xerar hipótese, contrastar datos, reflexionar, completar coñecementos, diagnosticalo e adestrarse en procedementos alternativos de solución.
Saídas de estudo	Visita a empresa ou centro formativo específico en PRL, para coñecer de primeira man a aplicación dous sistemas de prevención no ámbito laboral

Atención personalizada	
Methodologies	**Description**
Traballo tutelado	Atenderase as dúbidas do alumnado durante o curso académico xa sexa presencialmente ou a través do correo electrónico ou plataforma docente. Para todas as modalidades de docencia, as sesións de titorización poderán realizarse por medios en liña (correo electrónico, videoconferencia en Campus Remoto, foros de Moovi, ...) baixo a modalidade de concertación previa.
Debate	As dúbidas e cuestións que xurdan na aula durante o debate atenderanse no momento e tamén se atenderán en formato de titorías durante o curso académico xa sexa presencialmente ou a través do correo electrónico ou plataforma docente. Para todas as modalidades de docencia, as sesións de titorización poderán realizarse por medios telemáticos (correo electrónico, videoconferencia en Campus Remoto, foros de Moovi, ...) baixo a modalidade de concertación previa.
Tests	**Description**
Estudo de casos	Atenderase as dúbidas do alumnado durante o curso académico xa sexa presencialmente ou a través do correo electrónico ou plataforma docente. Para todas as modalidades de docencia, as sesións de titorización poderán realizarse por medios telemáticos (correo electrónico, videoconferencia en Campus Remoto, foros de Moovi, ...) baixo a modalidade de concertación previa.

Avaliación			
	Description	Qualification	Training and Learning Results
Traballo tutelado	Nos seminarios proporanse supostos sobre a xestión de prevención de riscos laborais na industria, a minería e do sector da construción. Abordaranse os problemas do día a día dunha empresa en materia de prevención de riscos laborais, centrándose nas metodoloxías de avaliación de riscos e investigación de accidentes laborais. RESULTADOS PREVISTOS NA MATERIA: Ser capaz de realizar avaliacións elementais de riscos e, no seu caso, establecer medidas preventivas do mesmo carácter compatibles co seu grao de formación. Aprender como colaborar na avaliación e o control dos riscos xerais e específicos dunha empresa, efectuando visitas ao efecto, atendendo queixas e suxestións e rexistrando de datos.	40	A1 B1 C16 D3 A2 B2 D5 A3 B7 D6 A4 B8 D9 A5 D11

Exame de preguntas de desenvolvemento	Probas para avaliación das competencias que inclúen preguntas abertas sobre un tema. O alumnado deben desenvolver, relacionar, organizar e presentar os coñecementos que teñen sobre a materia nunha resposta extensa. RESULTADOS PREVISTOS NA MATERIA: Ser consciente, como futuro traballador/a ou directivo/a, da necesidade de fomentar o interese e cooperación dos traballadores nunha acción preventiva integrada. Ser capaz, como futuro traballador/a ou directivo/a, de promover comportamentos seguros no ámbito laboral e a correcta utilización dos equipos de traballo e protección. Ser consciente, como futuro traballador/a ou directivo/a, da necesidade de promover, en particular, as actuacións preventivas básicas, tales como a orde, a limpeza, a sinalización e o mantemento xeral, e efectuar o seu seguimento e control. Ser capaz de realizar avaliacións elementais de riscos e, no seu caso, establecer medidas preventivas do mesmo carácter compatibles co seu grao de formación. Aprender como colaborar na avaliación e o control dos riscos xerais e específicos dunha empresa, efectuando visitas ao efecto, atendendo queixas e suxestións e rexistrando de datos. Saber como actuar en caso de emerxencia e primeiros auxilios xestionando as primeiras intervencións ao efecto.	25	A1 A2 A3 A4 A5	B8	C16	D3 D5 D6 D9 D11
Estudo de casos	Outro campo importante dentro do a Seguridade e a Saúde no Traballo é o da ergonomía. Analizarase un caso práctico de avaliación de riscos neste campo. RESULTADOS PREVISTOS NA MATERIA: Ser capaz de realizar avaliacións elementais de riscos e, no seu caso, establecer medidas preventivas do mesmo carácter compatibles co seu grao de formación. Saber como actuar en caso de emerxencia e primeiros auxilios xestionando as primeiras intervencións ao efecto.	20	A1 A2 A3 A4	B1 B2 B7 B8	C16	D3 D5 D6 D9 D11
Observación sistemática	Probas para avaliación das competencias adquiridas que inclúen preguntas pechadas con diferentes alternativas de resposta (verdadeiro/falso, elección múltiple, emparellamento de elementos...). O alumnado selecciona unha resposta entre un número limitado de posibilidades. RESULTADOS PREVISTOS NA MATERIA: Ser consciente, como futuro traballador/a ou directivo/a, da necesidade de fomentar o interese e cooperación dos traballadores nunha acción preventiva integrada. Ser capaz, como futuro traballador/a ou directivo/a, de promover comportamentos seguros no ámbito laboral e a correcta utilización dos equipos de traballo e protección. Ser consciente, como futuro traballador/a ou directivo/a, da necesidade de promover, en particular, as actuacións preventivas básicas, tales como a orde, a limpeza, a sinalización e o mantemento xeral, e efectuar o seu seguimento e control.	15	A2 A3 A4	B1 B2 B8	C16	D5 D6 D9 D11

Other comments on the Evaluation

AVALIACIÓN CONTINUA

Para aprobar globalmente a materia é condición imprescindible obter o 50% da nota máxima do exame de preguntas de desenvolvemento (12,5 sobre 25).

AVALIACIÓN GLOBAL

No caso de que o alumnado renuncie á avaliación continua, deberá realizar unha proba tipo test equivalente á observación sistemática. Ademais, debes realizar o exame de preguntas de desenvolvemento e entregar os traballos de puntuación (Traballo tutelado e estudo de caso). Do mesmo xeito, para aprobar globalmente a materia, é condición imprescindible obter o 50% da nota máxima do exame, dividido nunha parte de preguntas de desenvolvemento e unha parte de preguntas tipo test.

CONVOCATORIA SEGUNDA OPORTUNIDADE

Todas as probas/metodoloxías contempladas na convocatoria ordinaria serán de novo avaliadas. Nesta edición extraordinaria, é condición imprescindible obter o 50% da nota máxima do exame, dividida nunha parte de preguntas de desenvolvemento e outra de preguntas tipo test.

Calendario de exames. Verificar/consultar actualizado na páxina web do centro:

http://minaseenerxia.uvigo.es/es/docencia/examenes

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Complementary Bibliography

Recomendacións