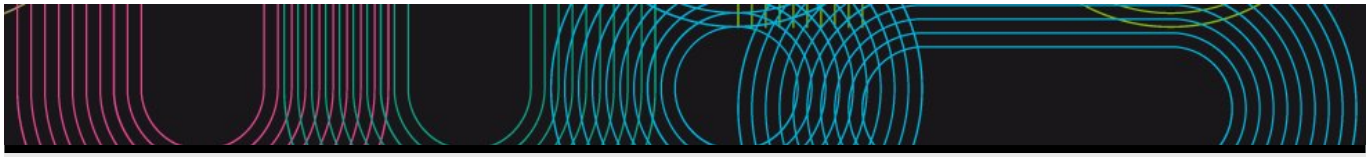

IDENTIFYING DATA				
Thermal systems				
Subject	Thermal systems			
Code	V09G311V01205			
Study programme	Grado en Ingeniería de los Recursos Mineros y Energéticos			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Granada Álvarez, 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