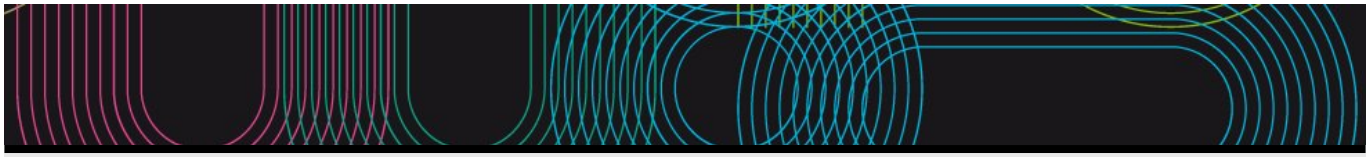

IDENTIFYING DATA				
Thermal Systems				
Subject	Thermal Systems			
Code	V09G291V01205			
Study programme	Grado en Ingeniería de la Energía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Granada Álvarez, Enrique			
Lecturers	Granada Álvarez, Enrique Lopez Mera, David			
E-mail	egranada@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The aim of the subject is that the students get the necessary knowledge 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	Ability to draw links between the different elements of all the knowledge acquired, understanding them as components of a body of knowledge with a clear structure and strong internal cohesion.
B2	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.
B3	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.
B4	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.
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 problems that are specific to the field of engineering.
D2	Ability to organize, understand, assimilate, produce and handle all the relevant information to develop their professional work, using appropriate computing, mathematics, physics tools, etc. when these are required.
D3	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 know the technological foundations on which the most recent research works in thermodynamic engineering applications are based	A1 A2 A3 A4 A5	B1 B2 B3 B4	C4	D2 D3
To understand the basic aspects on mass and energy balances in thermal systems	A3 A5	B1	C4	D2 D3
To know the experimental process used when working with energy transfer	A3	B1 B3	C4	D2 D3
To master the current available techniques for the analysis of thermal systems.	A5	B2 B4	C4	D2 D3
To look into process analysis techniques	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 is evaluated through three type test examinations of the theoretical lessons. Each one of these theoretical exams will mark 5% of the final note. EXPECTED RESULTS FROM THIS SUBJECT. To know the technological foundations on which the most recent research works in thermodynamic engineering applications are based. To understand the basic aspects on mass and energy balances in thermal systems. To know the experimental process used when working with energy transfer. To master the current available techniques for the analysis of thermal systems. To look into process analysis techniques	15	A1 B1 C4 D2 A2 B3 D3 A3 A4 A5
Laboratory practical	It is evaluated through a type test examination after having finished lab practices. EXPECTED RESULTS FROM THIS SUBJECT. To know the experimental process used when working with energy transfer. To look into process analysis techniques	5	A1 B1 C4 D2 A2 B3 A3 B4 A4
Problem and/or exercise solving	Two tests will be carried out, each one with a weight of 40% of the final grade: one during the semester and another on the official date established in the center's calendar. They will be written problem solving and/or exercises. EXPECTED RESULTS FROM THIS SUBJECT. To know the technological foundations on which the most recent research works in thermodynamic engineering applications are based. To understand the basic aspects on mass and energy balances in thermal systems. To know the experimental process used when working with energy transfer. To master the current available techniques for the analysis of thermal systems. To look into process analysis techniques.	80	A1 B1 C4 D2 A2 B2 D3 A3 B3 A4 B4 A5

Other comments on the Evaluation

CONSIDERATIONS ON CONTINUOUS ASSESSMENT

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 chance 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.

CONSIDERATIONS ON THE GLOBAL EVALUATION

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

Exam calendar. Check/consult the center's web page for updates:

http://minaseenerxia.uvigo.es/é/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/V09G291V01206

Subjects that are recommended to be taken simultaneously

Fluid mechanics/V09G291V01204

Subjects that it is recommended to have taken before

Physics: Physics I/V09G291V01102
Physics: Physics II/V09G291V01107
Mathematics: Calculus I/V09G291V01104
Mathematics: Calculus II/V09G291V01109
Chemistry: Chemistry/V09G291V01105