



## IDENTIFYING DATA

### Thermal Energy Management

Subject	Thermal Energy Management			
Code	V09G291V01401			
Study programme	Grado en Ingeniería de la Energía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Eguía Oller, Pablo			
Lecturers	Eguía Oller, Pablo Pérez Orozco, Raquel			
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Web	<a href="http://moovi.uvigo.gal">http://moovi.uvigo.gal</a>			
General description	<p>Introduction to energy management for the acquisition of basic knowledge necessary for energy audit. It includes from the economic analysis of an investment to the thermal simulation of a building. The student will obtain fluency in the use of techniques such as cogeneration, the use of different fuels or energy efficiency, as well as an overview of current regulations.</p> <p>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.</p>			

## 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.
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.
B5	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.
C39	Ability to manage audits of energy facilities.
C40	Understanding and ability to use concepts pertaining to energy efficiency and saving, as well as their management and application for solving problems specific to the field of energy engineering.
C41	Ability to innovate in the development of new lines, projects and products in the field of energy engineering.
D1	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.
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.

- D4 Understanding the importance of safety issues and being able to foster awareness about safety among people within their environment.
- D5 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			
Know the technological base on which support the most recent investigations in energy savings	A1 A3 A5	B1	C39 C41	D1 D3 D4 D5
Comprise the basic appearances of CHP	A1 A2	B5	C40	D1 D3 D4
Dominate the available current techniques for the analysis of energetic audits	A4 A5	B1 B3 B5	C39 C40 C41	D5
Deepen in the techniques of energetic efficiency	A1 A2 A3 A4 A5	B3	C39	D2 D3 D4 D5
Dominate the available current techniques for the analysis of systems and thermal devices	A4 A5	B1 B3 B5	C40	D1 D2 D3
Know the rule and the regulations needed in the thermal installations	A3 A5	B3 B5	C39 C40 C41	D1 D3 D5
Project a system of energy savings by means of the integration of processes and technologies	A2 A3 A4 A5	B1 B3 B5	C39 C40 C41	D1 D2 D3 D4 D5

### Contents

Topic	
1. THE SOCIETY AND THE USE OF THE ENERGY	Introduction. Basic concepts. Energy and society. Sources of energy: renewable and no renewable. Energy Utilisation and Management. Energetic efficiency. Energy and environment
2. THE ENERGY AUDIT	Energy management. Energetic approach. Phases of an audit. Justification of investments. Building Energy Simulation.
3. ECONOMIC ANALYSIS	Introduction to economic analysis. Capital in time. investment evaluation criteria.
4. FUELS	Energy and fuels. Storage, transport and manipulation of fuels. Regulation.
5. INDUSTRIAL AUDITS	Introduction. Main differences with the tertiary sector. Boilers and systems of thermal generation. Simulation of Thermal Instalations.
6. LEGISLATION AND TARIFF STRUCTURE OF FUELS	Introduction. Prices of Electricity. Prices of Natural Gas. Prices of LPG. Prices of Diesel. Prices of Biomass. Prices of Coal.
7. SAVING AND IMPROVEMENTS PROJECTS	Natural resources. Waste energy resources. Improvements in the construction. Losses in engines. Saving Programs. Use of simulations in energy saving projects.
8. REGULATION OF THERMAL INSTALLATIONS	RD 1027/2007. Annex 1: general disposals. Annex 2: technical instructions.
9. INSTRUMENTATION	Demand Parameters. Inner thermal conditions. Envelope Conditions. Energetic efficiency measures.
10. COMBINED HEAT AND POWER	Introduction: definitions and parameters. Classification of CHP Systems. CHP Systems. CHP in the industry and in the tertiary sector. CHP Projects and savings. Legislation.

### Planning

	Class hours	Hours outside the classroom	Total hours
Problem solving	12	12	24

Practices through ICT	20	20	40
Presentation	2	2	4
Lecturing	12	15	27
Mentored work	4	4	8
Essay questions exam	2.5	20	22.5
Essay	0	24.5	24.5

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

<b>Methodologies</b>	
	Description
Problem solving	Formulation of problems, analysis, resolution and debate about the results. Consolidation of content treated in the lectures.
Practices through ICT	Development of computer software for the resolution of real complex problems. Introduction to advanced concepts of simulation and data processing. The student will report the weekly work that will be evaluated for the final grade.
Presentation	During the last weeks the work carried out during the course will be explained individually.
Lecturing	Presentation of the contents of the subject by teachers . Prior to the explanation in a lecture, the reading of the topic to be discussed will be recommended.
Mentored work	Delivery of a report on simulation of indoor environmental conditions in buildings and compliance with the regulations that exist in this regard.

### **Personalized assistance**

<b>Methodologies</b>	<b>Description</b>
Practices through ICT	The student will be able to expose his doubts and advance in the domain of energy audits every week in computer practices. For all the modalities of teaching, the tutorial sessions may be carried out by telematic means (email, videoconference, Moovi forums, ...) with prior agreement.

### **Assessment**

	Description	Qualification	Training and Learning Results			
Practices through ICT	Weekly preparation of the parts of an energy audit. All the expected results from this subject are evaluated.	30	A1 A2 A3 A4 A5	B1 B3 B5	C39 C40 C41	D1 D2 D3 D5
Presentation	Oral presentation of the work done weekly during practice hours and out of class. All the expected results from this subject are evaluated.	5	A1 A2 A3 A4 A5	B1 B3 B5	C39 C40 C41	D1 D2 D3 D4 D5
Mentored work	Simulation of a HVAC instalation using Energyplus. All the expected results from this subject are evaluated.	10	A1 A2 A4	B5	C40 C41	D2 D3 D5
Essay questions exam	Necessary test to be able to pass the subject where questions will be asked about concepts developed in master classes and in computer classroom practices. AAll the expected results from this subject are evaluated.	20	A1 A2 A3 A4 A5	B1 B3 B5	C39 C40 C41	D1 D2 D3 D4 D5
Essay	Realization of a work / energy audit project: presentation of a real case, analysis of the possible measures to be taken, economic evaluation of the measures, realization of a report, plans and budgets. All the expected results from this subject are evaluated.	35	A1 A2 A3 A4 A5	B1 B3 B5	C39 C40 C41	D1 D2 D3 D4 D5

### **Other comments on the Evaluation**

#### **Continuous assessment-First Opportunity:**

The students have to obtain a minimum qualification of 5 points on 10 in all the items/proofs of the subject. In the official date of the exam only the essay questions exam will be made.

#### **Continuous assessment-Second Opportunity:**

The students have to obtain a minimum qualification of 5 points on 10 in all the items/proofs of the subject. In the official date of the exam only the essay questions exam will be made.

## Global assessment-First and second opportunity:

The students that has renounced to the continuous assesment, will deliver the energy audit work before the official date for the exam, and will be valued with 50% of the final grade and, also, will have to pass the Essay questions exam that will be valued with 50% of the final grade.

The student who does not attend the class must take a test on the contents of the subject in which he/she demonstrates that he/she has mastered the tools used by the students in the computer practices, as well as an exam on knowledge imparted in the theory classrooms where he/she will answer questions about issues to develop and problems.

Exams timetable:

<http://minasyenergia.uvigo.es/gl/docencia>

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### Sources of information

#### Basic Bibliography

J.M. Rey Hernández, F.J. Rey Martínez, E. Velasco Gómez, : **Eficiencia energética de los edificios. Certificación energética**, 1ª Edición, Paraninfo, S.A., 2018

J.M. Rey Hernández, F.J. Rey Martínez, E. Velasco Gómez, **Eficiencia energética de los edificios. Auditorías energéticas**, Paraninfo, S.A., 2018

A.M. Díez Suárez, A. González Martínez, L. de Sousa Díaz, A. de la Puente Gil, B. Vega Barrallo, M., **Eficiencia energética en las instalaciones de climatización en los edificios**, 1ª Edición, Ediciones Paraninfo, S.A, 2017

Ian Beausoleil-Morrison, **Fundamentals of Building Performance Simulation**, 1ª Edición, Routledge (Taylor & Francis Group), 2020

Antonio Madrid Vicente, **Cogeneración, trigeneración y microcogeneración**, 8412095456, Antonio Madrid Vicente, Editor, 2019

Pablo Eguía Oller, **Apuntes de la asignatura**, 2017

#### Complementary Bibliography

U.S. Department of Energy, **EnergyPlus: Energy simulation software**, 9.4.0, 2021

National Renewable Energy Laboratory, **OpenStudio Application**, 1.1.0, 2021

Clark, William H., **Análisis y gestión energética de edificios**, 1ª Edición, McGrawHill, 1998

Sala Lizarraga, José M<sup>a</sup>., **Cogeneración. Aspectos termodinámicos, tecnológicos y económicos**, 1ª Edición, Servicio Editorial de la Universidad del País Vas, 1994

Ministerio de Energía, Turismo y Agenda Digital, **Publicaciones**, 2011

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### Recommendations

#### Other comments

The student is recommended to attend the theoretical and practical classes to be able to acquire the necessary ease for the realization of documents on energy efficiency and energy audit. Thus, in a progressive manner, the student will carry out the work that will be presented at the end of the semester, being reviewed and commented by the professors of the subject, who will be able to advise the student as he deepens in the subject related to the management of thermal energy.