

IDENTIFYING DATA				
Thermal Technology II				
Subject	Thermal Technology II			
Code	V04M141V01115			
Study programme	(*)Máster Universitario en Enxeñaría Industrial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1st	1st
Teaching language	Spanish English			
Department				
Coordinator	Sieres Atienza, Jaime			
Lecturers	Sieres Atienza, Jaime			
E-mail	jsieres@uvigo.es			
Web				
General description	At the end of this course students are expected to have the knowledges and skills for the selection, design and calculation of air conditining, or HVAC&R, systems (heating, ventilating, air conditioning and refrigeration).			

Skills	
Code	
A4	Students can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
A5	Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.
C1	CET1. Project, calculate and design products, processes, facilities and plants.
C9	CET9. Knowing how to communicate the conclusions -and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
C10	CET10. Possess learning skills that will allow further study of a self-directed or autonomous mode.
C16	CTI5. Knowledge and skills for the design and analysis of thermal machines and engines, hydraulic machines and facilities for heat and industrial refrigeration
D1	ABET-a. An ability to apply knowledge of mathematics, science, and engineering.
D3	ABET-c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
D5	ABET-e. An ability to identify, formulate, and solve engineering problems.
D11	ABET-k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Know and understand the different types of systems and equipments used in air conditioning systems, for both heating and refrigeration applications	C1 C16 D1 D3 D5 D11
Know and understand the components used in heating and refrigeration equipments of air conditioning systems	C1 C16 D1 D3 D5 D11

Ability to calculate heat engines and its main components	C1 C16 D1 D3 D5 D11
Ability to perform designs, calculations and tests of heat engines, heating and refrigeration systems	A4 A5 C1 C9 C10 D5

Contents	
Topic	
0. REVIEW OF THERMODYNAMICS AND HEAT TRANFSER CONCEPTS	1. Energy, work and heat 2. Mass and energy analyses of closed systems and control volumes 3. Reversible thermal engines, refrigerators and heat pumps 4. Heat transfer mechanisms 5. Thermal resistance concept
1. PSYCHROMETRICS	1. Moist air 2. Psychrometric properties 3. Psychrometric Charts
2. HEAT TRANSFER IN HVAC APPLICATIONS	1. Introduction 2. Conduction 3. Convection 4. Radiation 5. Transient heat transfer 6. Heat exchangers 6.1. Classification 6.2 Analysis
3. PSYCHROMETRIC PROCESSES	1. Introduction 2. Adiabatic mixing of two streams 3. Condition line and sensible heat ratio 4. Sensible heating or cooling 5. Cooling and dehumidification 6. Heating and humidification 7. Adiabatic humidification 8. Heating and dehumidification
4. AIR CONDITIONING SYSTEMS	1. Introduction 1.1 Concept of thermal load 1.2. Concepts of space, zone and building 1.3 Components of thermal loads 2. Types of systems 3. Air systems 3.1. Basics 3.2. Description of the system and components 3.3. Calculations 4. Water systems 4.1. Basics 4.2. Description of the system and components 4.3. Calculations 5. Air-water systems 5.1. Basics 5.2. Description of the system and components 5.3. Calculations 6. Direct expansion systems 6.1. Basics 6.2. Description of the system and components

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	18	27	45
Laboratory practical	6	6	12
Autonomous problem solving	0	14	14
Essay questions exam	3	0	3

Objective questions exam	1	0	1

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

Methodologies

	Description
Lecturing	Lecturer's introduction of the contents of the matter object of study
Laboratory practical	Real processes experimentations in the laboratory which complement the contents covered in the course. Use of software for modelling thermal systems.
Autonomous problem solving	Resolution of problems and/or exercises related with the course that the student will carry out following the classroom and/or laboratory guidelines. Examples of direct application of the contents studied as well as practical examples will be solved. The methodology will be focused on explaining how to solve the problems rather than on determining the final numerical solution.

Personalized assistance

Methodologies	Description
Laboratory practical	Students' questions or doubts about any of the course contents will be solved during the instructor's office hours.
Lecturing	Students' questions or doubts about any of the course contents will be solved during the instructor's office hours.

Assessment

	Description	Qualification	Training and Learning Results		
Essay questions exam	Final exam to evaluate the whole contents of the course	0-10	A4	C1 C9 C16	D1 D3 D5 D11
Objective questions exam	The corresponding note to the Continuous Assessment will be based on written tests or essays	0-2	A4 A5	C1 C9 C10 C16	D1 D3 D5 D11

Other comments on the Evaluation

Assesment: The final qualification (CF) is determined by adding the points obtained on the final exam (EF) and those obtained during the continuous assessment (EC). The continuous evaluation grade will be scored over 2 points and the final exam over 10 points. The final qualification is obtained from the following formula:

CF=EC+(10-EC)*EF/10

Examples:

-EC=2 y EF=3. The final qualification is CF=2+8*3/10=4.4 (Suspenso)

-EC=2 y EF=3.75. The final qualification is CF=2+8*3.75/10=5.0 (Aprobado)

-EC=1 y EF=7. The final qualification is CF=1+9*7/10=7.3 (Notable)

-EC=0 y EF=9. The final qualification is CF=9 (Sobresaliente)

The points achieved by continuous assessment will be valid in the first and the second calls. None of the qualifications obtained in the final exam of the the first call will be saved for the second call.

Ethical commitment: The student is expected to present an adequate ethical behavior. In the event that an unethical behavior is detected (copying, plagiarism, use of unauthorized electronic devices, for example), it will be considered that the student does not meet the necessary requirements for passing the subject. Depending on the type of unethical behavior detected, it could be concluded that the student has not reached the competencies of the course.

IMPORTANT NOTE: this is the english translation of the subject guide. In the event of any conflict between the English and Spanish versions, the Spanish version shall prevail.

Sources of information

Basic Bibliography

ASHRAE, **ASHRAE handbook. Fundamentals**, ASHRAE, 2013
ASHRAE, **ASHRAE handbook. Refrigeration**, ASHRAE, 2014
Yunus A. Çengel, Afshin J. Ghajar, **Heat and mass transfer : fundamentals & applications**, McGraw-Hill Education, 2015

Complementary Bibliography

ASHRAE, **ASHRAE handbook: heating, ventilating, and air-Conditioning systems and equipment**, ASHRAE, 2012
ASHRAE,, **ASHRAE handbook : heating, ventilating and air-conditioning applications**, ASHRAE, 2015
Wang S.K., **Handbook of air conditioning and refrigeration**, Mc Graw-Hill, 2001
Torrella Alcaraz E., Navarro Esbrí J., Cabello López R., Gómez Marqués F., **Manual de climatización**, AMV Ediciones, 2005
Carrier Air Conditioning Company, **Manual de aire acondicionado**, Marcombo,, 2009

Recommendations

Other comments

In order to take this course it is highly recommended that students have completed courses about thermodynamics, heat transfer and thermal engineering and technology.

In particular, a good background in psychrometrics and psychrometrics processes is strongly recommended.

IMPORTANT NOTE: this is the english translation of the subject guide. In the event of any conflict between the English and Spanish versions, the Spanish version shall prevail.