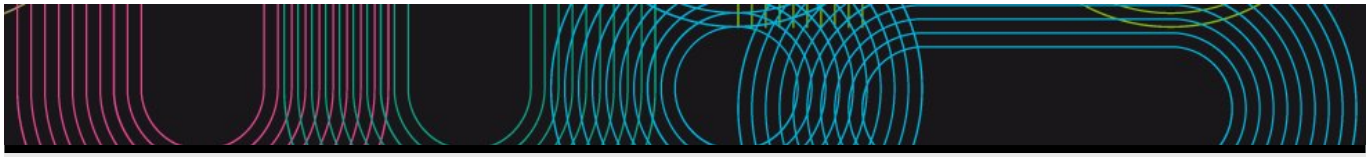

IDENTIFYING DATA				
Thermal Technology II				
Subject	Thermal Technology II			
Code	V04M141V01115			
Study programme	(*)Máster Universitario en Enxeñaría Industrial			
Descriptors	ECTS Credits	Type	Year	Quadmester
	3	Mandatory	1st	1st
Teaching language	Spanish English			
Department				
Coordinator	Sieres 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).			

Competencies	
Code	
CB4	Students can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
CB5	Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.
CE1	CET1. Project, calculate and design products, processes, facilities and plants.
CE9	CET9. Knowing how to communicate the conclusions -and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
CE10	CET10. Possess learning skills that will allow further study of a self-directed or autonomous mode.
CE16	CTI5. Knowledge and skills for the design and analysis of thermal machines and engines, hydraulic machines and facilities for heat and industrial refrigeration
CT1	ABET-a. An ability to apply knowledge of mathematics, science, and engineering.
CT3	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.
CT5	ABET-e. An ability to identify, formulate, and solve engineering problems.
CT11	ABET-k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Learning outcomes	
Learning outcomes	Competences
Know the thermodynamic properties and thermodynamic processes of moist air and how to apply them to the anlaysis of common air-conditioning systems	CE1 CE16 CT1 CT5 CT11
Know and understand the different types of systems and equipments used in air conditioning systems, for both heating and refrigeration applications	CE1 CE16 CT1 CT3 CT5 CT11

Know and understand the components used in heating and refrigeration equipments of air conditioning systems	CE1 CE16 CT1 CT3 CT5 CT11
Ability to calculate heat engines and its main components	CE1 CE16 CT1 CT3 CT5 CT11
Ability to perform designs, calculations and tests of heat engines, heating and refrigeration systems	CB4 CB5 CE1 CE9 CE10 CT5

Contents

Topic	
1. PSYCHROMETRICS	1. Moist air 2. Psychrometric properties 3. Psychrometric Charts
2. 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
3. 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
4. VAPOR COMPRESSION REFRIGERATION SYSTEMS	1. Introduction. Refrigerators and heat pumps 2. The reversed Carnot cycle 3. Thermodynamic diagrams 4. Ideal cycle or dry cycle 5. Basic components of a refrigeration system 5.1 Compressor 5.2 Evaporator 5.3 Condenser 5.4. Expansion device 6. Calculation parameters 7. Actual refrigeration cycle 8. Influence of the thermal conditions 9. Liquid-vapor heat exchanger

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	18	27	45
Laboratory practises	6	6	12
Autonomous troubleshooting and / or exercises	0	14	14
Long answer tests and development	3	0	3
Other	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
Master Session	Lecturer's introduction of the contents of the matter object of study
Laboratory practises	Real processes experimentations in the laboratory which complement the contents covered in the course. Use of software for modelling thermal systems.
Autonomous troubleshooting and / or exercises	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 attention

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

Assessment

	Description	Qualification	Evaluated Competencess		
Long answer tests and development	Final exam to evaluate the whole contents of the course	80	CB4	CE1 CE9 CE16	CT1 CT3 CT5 CT11
Other	The corresponding note to the Continuous Assessment will be based on written tests or essays	20	CB4 CB5	CE1 CE9 CE10 CE16	CT1 CT3 CT5 CT11

Other comments on the Evaluation

Assesment:

The final qualification is determined by adding the points obtained on the final exam (80%) and those obtained during the continuous assessment (20%).

The points achieved by continuous assessment (20%) will be valid in the first and 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.

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