

**1. General information****Course:** INDUSTRIAL COOLING**Type:** CORE COURSE**Degree:** 2328 - MASTERS DEGREE PROGRAMME IN INDUSTRIAL ENGINEERING**Center:** 605 - SCHOOL OF INDUSTRIAL ENGINEERS. AB**Year:** 1**Main language:** Spanish**Use of additional languages:****Web site:****Code:** 310626**ECTS credits:** 6**Academic year:** 2019-20**Group(s):** 10 11 20 21**Duration:** First semester**Second language:** English**English Friendly:** N**Bilingual:** Y**Lecturer:** MAGIN LAPUERTA AMIGO - Group(s): 20

Building/Office	Department	Phone number	Email	Office hours
Politécnico/2-D17	MECÁNICA ADA. E ING. PROYECTOS	926295431	magin.lapuerta@uclm.es	Presencial: Se publicará al comienzo del curso Telemática: Permanentemente en la dirección de email y en campus virtual (plataforma Moodle)

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Politécnico/2-C12	MECÁNICA ADA. E ING. PROYECTOS	926052319	jose.rfernandez@uclm.es	Presencial: a decidir con los alumnos al comienzo del curso Telemática: Permanentemente en la dirección de email y en campus virtual (plataforma Moodle)

2. Pre-Requisites

Not established

3. Justification in the curriculum, relation to other subjects and to the profession

Not established

4. Degree competences achieved in this course**Course competences**

Code	Description
A01	To have appropriate knowledge of the scientific and technological aspects of mathematical, analytical and numerical methods in engineering, electrical engineering, energy engineering, chemical engineering, mechanical engineering, continuous medium mechanics industrial electronics, automation, manufacturing, materials, quantitative management methods, industrial computing, town planning, infrastructures, etc.
A02	To plan, calculate and design products, processes, facilities and plants.
A04	To conduct research, development and innovation in products, processes and methods.
A05	To perform strategic planning and apply it to construction, production and environmental quality and management systems.
A06	To manage the technical and economic aspects of projects, installations, plants, companies and technology centres.
A12	Knowledge, understanding and capacity to apply the required legislation in the industrial engineering profession
B05	Knowledge and skills for the design and analysis of machines and heat engines, hydraulic machinery, and industrial heating and cooling installations
CB06	Knowledge and skills to organise and manage enterprises.
CB09	Knowledge of financial and costs accounting.
CB10	Knowledge of information systems for management, industrial organisation, production, logistics and quality management systems.
D01	Ability to design, construct and exploit industrial plants.
D04	Knowledge and abilities to plan and design electrical and fluid installations, lighting, heating and ventilation, energy saving and efficiency, acoustics, communications, domotics, Smart buildings and security installations.
D06	Knowledge and ability to perform verification and supervision of installations, processes and products.
D07	Knowledge and ability to conduct certifications, audits, verifications, trials and reports.

5. Objectives or Learning Outcomes**Course learning outcomes**

Description

Acquire knowledge of the classification and design criteria of air conditioning systems.

Acquire knowledge of the selection criteria for cooling fluids.

Be able to calculate thermal loads in industrial facilities and air conditioning tubes

Know how to make mass and energy balances in different cooling systems.

Be able to solve problems to determine psychrometric properties.

Additional outcomes

6. Units / Contents

Unit 1: Cooling: history and classification
Unit 2: Refrigerants
Unit 3: Simple-compression refrigeration systems
Unit 4: Multiple-compression refrigeration systems
Unit 5: Absorption refrigeration systems
Unit 6: Ejection refrigeration systems
Unit 7: Expansion refrigeration systems
Unit 8: Refrigeration with specific effects
Unit 9: Components of refrigeration systems
Unit 10: Air conditioning systems
Unit 11: Psychrometric variables and charts
Unit 12: Psychrometric transformations
Unit 13: Thermal loads
Unit 14: Design of air ducts

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	R	Description
Class Attendance (theory) [ON-SITE]	Lectures	A01 A02 A04 A05 A06 A12 B05 D01 D04 D06 D07	1	25	N	-	-	
Class Attendance (practical) [ON-SITE]	Problem solving and exercises	A02 A05 A06 A12 B05 CB09 D01 D04 D06	0.2	5	N	-	-	
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	A01 A02 B05 CB06 CB09 CB10 D04 D06 D07	0.8	20	Y	Y	N	
Workshops or seminars [ON-SITE]	Workshops and Seminars	A12 D01 D06 D07	0.2	5	N	-	-	
Individual tutoring sessions [ON-SITE]	Combination of methods	CB06 CB09 CB10	0.1	2.5	N	-	-	
Final test [ON-SITE]	Assessment tests	A01 A02 A04 A05 A06 A12 B05 CB06 CB09 CB10 D01 D04 D06 D07	0.1	2.5	Y	Y	Y	
Study and Exam Preparation [OFF-SITE]	Self-study	A01 A02 A04 A05 A06 A12 B05 CB06 CB09 CB10 D01 D04 D06 D07	3.6	90	N	-	-	
Total:			6	150				
Total credits of in-class work: 2.4			Total class time hours: 60					
Total credits of out of class work: 3.6			Total hours of out of class work: 90					

As: Assessable training activity

Com: Training activity of compulsory overcoming

R: Rescheduling training activity

8. Evaluation criteria and Grading System

Evaluation System	Grading System		Description
	Face-to-Face	Self-Study Student	
Final test	70.00%	0.00%	
Laboratory sessions	30.00%	0.00%	
Total:	100.00%	0.00%	

9. Assignments, course calendar and important dates

Not related to the syllabus/contents	
Hours	hours
Unit 1 (de 14): Cooling: history and classification	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.1
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	4
Unit 2 (de 14): Refrigerants	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	.5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.2
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	7
Unit 3 (de 14): Simple-compression refrigeration systems	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1

Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.3
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	4
Unit 4 (de 14): Multiple-compression refrigeration systems	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	1
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.3
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Unit 5 (de 14): Absorption refrigeration systems	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	.9
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.3
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	9
Unit 6 (de 14): Ejection refrigeration systems	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	.4
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.2
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Unit 7 (de 14): Expansion refrigeration systems	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	.5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.2
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	8
Unit 8 (de 14): Refrigeration with specific effects	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.2
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	7
Unit 9 (de 14): Components of refrigeration systems	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	5
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	5
Unit 10 (de 14): Air conditioning systems	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	5
Final test [PRESENCIAL][Assessment tests]	.1
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Unit 11 (de 14): Psychrometric variables and charts	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.3
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	9
Unit 12 (de 14): Psychrometric transformations	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	.2
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.1
Final test [PRESENCIAL][Assessment tests]	.1
Study and Exam Preparation [AUTÓNOMA][Self-study]	5
Unit 13 (de 14): Thermal loads	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2

Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	.5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.2
Final test [PRESENCIAL][Assessment tests]	.2
Study and Exam Preparation [AUTÓNOMA][Self-study]	8
Unit 14 (de 14): Design of air ducts	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	.1
Final test [PRESENCIAL][Assessment tests]	.1
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
Global activity	
Activities	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	25
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	5.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	20
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	2.5
Final test [PRESENCIAL][Assessment tests]	2.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	90
Total horas: 150.5	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Magin Lapuerta Amigo, Octavio Armas Vergel	Frío Industrial y Aire Acondicionado	Librería-papelería eÑe	Ciudad Real	84-608-0464-X	2010	