UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: INDUSTRIAL COOLING
Code: 310626
Type: CORE COURSE
ECTS credits: 6
Degree: 2328 - MASTERS DEGREE PROGRAMME IN INDUSTRIAL ENGINEERING
Academic year: 2021-22
Center: 602 - E.T.S. INDUSTRIAL ENGINEERING OF C. REAL
Group(s): 10 20 11 21
Year: 1
Duration: First semester
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: N
Web site:
Bilingual: Y

Lecturer: **MAGIN LAPUERTA AMIGO** - Group(s): **20 21**

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Lecturer: **JOSE RODRIGUEZ FERNANDEZ** - Group(s): **20 21**

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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 psychrometic 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	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	
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	
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 (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Laboratory sessions	30.00%	0.00%	
Final test	70.00%	100.00%	
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

The module has two blocks: the first about refrigerants and refrigeration systems and the second about air conditioning. A first exam will be made by the middle of the semester corresponding to the first block. The final exam will be composed of two parts, corresponding to the aforementioned blocks. Both parts will be weighted equally in the final score. A minimum mark of 4 (out of 10) is required in each part. The final score must be equal or above 5 (out of 10).

Non-continuous evaluation:

The module has two blocks: the first about refrigerants and refrigeration systems and the second about air conditionin. The final exam will be composed of two parts, corresponding to the aforementioned blocks. Each part will include questions about theory, problems and practicum. Both parts will be weighted equally in the final score. The final score must be equal or above 5 (out of 10).

Specifications for the resit/retake exam:

The same criteria as in the final exam will be applied

Specifications for the second resit / retake exam:

A single exam including all the contents will be made

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
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
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

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	