UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: INDUSTRIAL COOLING
Code: 310626
Type: CORE COURSE
ECTS credits: 6
Degree: 2338 - MASTERS DEGREE PROGRAMME IN INDUSTRIAL ENGINEERING (AB)
Academic year: 2022-23
Center: 605 - SCHOOL OF INDUSTRIAL ENGINEERS. AB
Group(s): 10 11
Year: 1
Duration: First semester
Main language: English
Second language: Spanish
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **JUAN FRANCISCO BELMONTE TOLEDO** - Group(s): **10 11**

Building/Office	Department	Phone number	Email	Office hours
0.D.10	MECÁNICA ADA. E ING. PROYECTOS	926053326	juanf.belmonte@uclm.es	To be advised in Campus Virtual

Lecturer: **ANTONIO ENRIQUE MOLINA NAVARRO** - Group(s): **10 11**

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0.D.4	MECÁNICA ADA. E ING. PROYECTOS		antonio.mnavarro@uclm.es	To be advised in Campus Virtual

2. Pre-Requisites

Students are expected to have adequate knowledge in the concepts taught in Thermodynamics and Heat Transfer

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

Life today is not conceived without Refrigeration and/or Air Conditioning systems at any level of human use, i.e., in the residential, industrial (read industry and transport) and tertiary sectors. At the same time, these systems require of their conceptual knowledge, operation, and optimization with the objective to be used efficiently due to the energy consumption involved in their use and the consequent emission of pollutants. This course requires of previous academic training in Thermodynamics and Heat Transfer. To a lesser extent, but it also has related to energy technology. All these subjects serve as a knowledge base to address Refrigeration and HVAC projects. Life today is not conceived without Refrigeration and/or Air Conditioning systems at any level of human use, i.e., in the residential, industrial (read industry and transport) and tertiary sectors. At the same time, these systems require of their conceptual knowledge, operation, and optimization with the objective to be used efficiently due to the energy consumption involved in their use and the consequent emission of pollutants. This course requires of previous academic training in Thermodynamics and Heat Transfer. To a lesser extent, but it also has related to energy technology. All these subjects serve as a knowledge base to address Refrigeration and HVAC projects

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

Additional outcomes

Know the different cooling methods and the constructive parts of the different systems
Application of refrigeration and air conditioning systems to specific industrial problems

6. Units / Contents

Unit 1: DESIGN CONDITIONS
- **Unit 1.1** Indoor design conditions
- **Unit 1.2** Outdoor design conditions
- **Unit 1.3** Indoor air quality

Unit 2: HEAT TRANSMISSION IN BUILDING STRUCTURES
- **Unit 2.1** Building insulation
- **Unit 2.2** Facilities insulation

Unit 3: AIR CONDITIONING SYSTEMS
- **Unit 3.1** Space heating and cooling loads
- **Unit 3.2** Types of Air Conditioning systems
- **Unit 3.3** System selection and arrangement
- **Unit 3.4** Air and/or water systems
- **Unit 3.5** Accessories

Unit 4: PSYCHROMETRICS
- **Unit 4.1** Psychrometric properties of moist air
- **Unit 4.2** Psychrometric charts
- **Unit 4.3** Typical Air Conditioning processes
- **Unit 4.4** Psychrometric software

Unit 5: REFRIGERATION
- **Unit 5.1** Refrigeration systems and practices
- **Unit 5.2** Refrigerants and secondary coolants
- **Unit 5.3** Vapor-compression refrigeration systems
- **Unit 5.4** Absorption refrigeration systems
- **Unit 5.5** Refrigeration load calculations

Unit 6: PRACTICES
- **Unit 6.1** Building simulation: Building envelope design
- **Unit 6.2** Building simulation: Heating and cooling peak loads
- **Unit 6.3** Building simulation: System and equipment sizing
- **Unit 6.4** Heat pump: Test bench and energy variables measurement

ADDITIONAL COMMENTS, REMARKS

A detailed weekly lecture plan will be issued during the first class and it can also be downloaded from Campus Virtual

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		0.04	1	Y	Y	
Class Attendance (theory) [ON-SITE]	Lectures		0.16	4	Y	Y	
Problem solving and/or case studies [ON-SITE]	Project/Problem Based Learning (PBL)		0.12	3	Y	Y	
Writing of reports or projects [OFF-SITE]	Self-study		0.28	7	Y	N	
Class Attendance (theory) [ON-SITE]	Lectures		0.16	4	Y	Y	
Class Attendance (theory) [ON-SITE]	Project/Problem Based Learning (PBL)		0.16	4	Y	Y	
Writing of reports or projects [OFF-SITE]	Self-study		0.28	7	Y	N	
Writing of reports or projects [OFF-SITE]	Self-study		0.36	9	Y	N	
In-class Debates and forums [ON-SITE]	Debates		0.08	2	Y	Y	
Class Attendance (theory) [ON-SITE]	Lectures		0.16	4	Y	Y	
Problem solving and/or case studies [ON-SITE]	Project/Problem Based Learning (PBL)		0.16	4	Y	Y	
Writing of reports or projects [OFF-SITE]	Self-study		0.28	7	Y	N	
Class Attendance (theory) [ON-	Lectures		0.16	4	Y	Y	

SITE]							
Problem solving and/or case studies [ON-SITE]	Project/Problem Based Learning (PBL)		0.16	4	Y	Y	
Writing of reports or projects [OFF-SITE]	Self-study		0.28	7	Y	N	
Class Attendance (theory) [ON-SITE]	Lectures		0.16	4	Y	Y	
Problem solving and/or case studies [ON-SITE]	Project/Problem Based Learning (PBL)		0.16	4	Y	Y	
Writing of reports or projects [OFF-SITE]	Self-study		0.28	7	Y	N	
Writing of reports or projects [OFF-SITE]	Self-study		0.36	9	Y	N	
In-class Debates and forums [ON-SITE]	Debates		0.08	2	Y	Y	
Class Attendance (practical) [ON-SITE]	Practical or hands-on activities		0.16	4	Y	Y	
Writing of reports or projects [OFF-SITE]	Practical or hands-on activities		0.24	6	Y	Y	
Class Attendance (practical) [ON-SITE]	Practical or hands-on activities		0.16	4	Y	Y	
Writing of reports or projects [OFF-SITE]	Practical or hands-on activities		0.24	6	Y	Y	
Class Attendance (practical) [ON-SITE]	Practical or hands-on activities		0.16	4	Y	Y	
Writing of reports or projects [OFF-SITE]	Practical or hands-on activities		0.24	6	Y	Y	
Class Attendance (practical) [ON-SITE]	Practical or hands-on activities		0.16	4	Y	Y	
Writing of reports or projects [OFF-SITE]	Practical or hands-on activities		0.24	6	Y	Y	
Study and Exam Preparation [OFF-SITE]	Self-study		0.52	13	Y	Y	
		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
Theoretical papers assessment	10.00%	10.00%	It consists of the resolution of different design and/or calculation problems throughout the subject, which can be exposed and explained. It could require the completion of a written test for the verification of the personal resolution of the works.
Final test	70.00%	70.00%	It consists of different parts of theory and problems.It is necessary to pass this part of the subject
Laboratory sessions	10.00%	10.00%	At the end of each practice session a protocol of the practice will be fulfilled. It is necessary to pass this part of the subject
Practicum and practical activities reports assessment	10.00%	10.00%	At the end of each practice session, a memory of the practice will be carried out, which will be delivered within the time period specified.It is necessary to pass this part of the subject
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:

Those students who do not accomplish the laboratory practices (sessions and/or reports) will have to perform a recovery exam of this part of the subject, with practical reports and laboratory sessions. The final test consists of different parts of theory and problems. You are required to achieve an average mark of 5 points in the individual assessment tasks (final test and practicals) to pass this course, if you achieve a mark less than 5 points in any of the individual assessments tasks (theory, problems and practicals), only a 4 points mark will be entered as your final overall mark
No marks for further calls are preserved

Non-continuous evaluation:

Those students who do not accomplish the laboratory practices (sessions and/or reports) will have to perform a recovery exam of this part of the subject, with practical reports and laboratory sessions. The final test consists of different parts of theory and problems. You are required to achieve an average mark of 5 points in the individual assessment tasks (final test and practicals) to pass this course, if you achieve a mark less than 5 points in any of the individual assessments tasks (theory, problems and practicals), only a 4 points mark will be entered as your final overall mark
No marks for further calls are preserved

Specifications for the resit/retake exam:

Those students who failed or do not accomplish the laboratory practices (sessions and/or reports) will have to perform a recovery exam of this part of the subject, with practical reports and laboratory sessions. The final test consists of different parts of theory and problems. You are required to achieve an average mark of 5

points in the individual assessment tasks (final test and practicals) to pass this course, if you achieve a mark less than 5 points in any of the individual assessments tasks (theory, problems and practicals), only a 4 points mark will be entered as your final overall mark
No marks for further calls are preserved

Specifications for the second resit / retake exam:

Read the above specifications

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	**hours**
Unit 1 (de 6): DESIGN CONDITIONS	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Project/Problem Based Learning (PBL)]	3
Writing of reports or projects [AUTÓNOMA][Self-study]	7
Unit 2 (de 6): HEAT TRANSMISSION IN BUILDING STRUCTURES	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Project/Problem Based Learning (PBL)]	4
Writing of reports or projects [AUTÓNOMA][Self-study]	7
Writing of reports or projects [AUTÓNOMA][Self-study]	9
In-class Debates and forums [PRESENCIAL][Debates]	2
Unit 3 (de 6): AIR CONDITIONING SYSTEMS	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Project/Problem Based Learning (PBL)]	4
Writing of reports or projects [AUTÓNOMA][Self-study]	7
Unit 4 (de 6): PSYCHROMETRICS	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (theory) [PRESENCIAL][Project/Problem Based Learning (PBL)]	4
Writing of reports or projects [AUTÓNOMA][Self-study]	7
Unit 5 (de 6): REFRIGERATION	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Project/Problem Based Learning (PBL)]	4
Writing of reports or projects [AUTÓNOMA][Self-study]	7
Writing of reports or projects [AUTÓNOMA][Self-study]	9
In-class Debates and forums [PRESENCIAL][Debates]	2
Unit 6 (de 6): PRACTICES	
Activities	**Hours**
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	4
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	6
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	4
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	6
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	4
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	6
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	4
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	6
Global activity	
Activities	**hours**
Writing of reports or projects [AUTÓNOMA][Self-study]	7
In-class Debates and forums [PRESENCIAL][Debates]	2
Problem solving and/or case studies [PRESENCIAL][Project/Problem Based Learning (PBL)]	4
Writing of reports or projects [AUTÓNOMA][Self-study]	14
In-class Debates and forums [PRESENCIAL][Debates]	2
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	4
Writing of reports or projects [AUTÓNOMA][Self-study]	9
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	6
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	4
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	6
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	4
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	6
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	4
Writing of reports or projects [AUTÓNOMA][Practical or hands-on activities]	6
Class Attendance (theory) [PRESENCIAL][Lectures]	20
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Problem solving and/or case studies [PRESENCIAL][Project/Problem Based Learning (PBL)]	11
Writing of reports or projects [AUTÓNOMA][Self-study]	14
Class Attendance (theory) [PRESENCIAL][Project/Problem Based Learning (PBL)]	4

Writing of reports or projects [AUTÓNOMA][Self-study]	9
	Total horas: 137

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Mitchell, John W.	Principles of heating, ventilation, and air conditioning in Buildings	John Wiley & Sons,		978-0-470-62457-9	2013	
	2009 ASHRAE handbook : fundamentals	ASHRAE		978-1-933742-55-7	2009	
	Manual de aire acondicionado : (handbook of air conditioning	Marcombo		978-84-267-1499-2	2008	
	Manual de climatización	A. Madrid Vicente Ediciones		84-89922-46-2	2005	
	www.atecyr.org					Programas de calculo CTE, RITE y psicrometría
	www.fchart.com					Programa EES (licencia para estudiantes en Campus Virtual)
	www.cne.es					Comision Nacional de la Energia
Alarcón Creus, José	Tratado práctico de refrigeración automática	Marcombo		978-84-267-1140-3	2008	
American Society of Heating, Refrigerating and Air-Condition	Refrigeration : 2010 ASHRAE handbook	American Society of Heating, Refrigerating and		978-1-933742-81-6	2010	
Jutglar, Lluís	Técnicas de refrigeración	Marcombo		978-84-267-1440-4	2008	
McQuiston, Faye C.	Heating, ventilating, and air conditioning : analysis and de	John Wiley & Sons		978-0-471-47015-1	2005	