COURSE PROGRAM

Academic Year: 2024/2025

Identification and characteristics of the course			
Code	402133	ECTS Credits	4,5
Course name (English)	Design of systems and thermal machines		
Course name (Spanish)	Diseño de sistemas y máquinas térmicas		
Degree programs	Master Universitario en Ingeniería Industrial		
Faculty/School	Escuela de Ingenierías Industriales		
Semester	2º	Type of course	Obligatory
Module	Industrial Technologies		
Matter	Thermal and Fluid Technologies		
Lecturer/s			
Name	Office	E-mail	Web page
Awf Al-Kassir	B1.15	aawf@unex.es	www.unex.es
Subject Area	Machines and Thermal Engines		
Department	Mechanical, Thermal and Materials Engineering		
Coordinating Lecturer (Ifmore than one)	Awf Al-Kassir		

Competencies (see table at http://bit.ly/competenciasMUII)

Basic Competences	Check With an "X"	General Competences	Check With an "X"	Transversal Competences	Check With an "X"	Specific Competences EC y ECM (I)	Check With an "X"	Specific Competences ET (II)	Check With an "X"	Specific Competences EG (III)	Check With an "X"	Specific Competences EI (IV)	Check With an "X"
CB6	X	CG1	X	CT1	X	CEC1		CET1		CEG1		CEI1	
CB7	X	CG2	X	CT2	X	CEFM1		CET2		CEG2		CEI2	
CB8	X	CG3		CT3	X			CET3		CEG3		CEI3	
CB9	X	CG4	X	CT4	X			CET4		CEG4		CEI4	X
CB10	X	CG5		CT5	X			CET5	X	CEG5		CEI5	
		CG6		CT6	X			CET6		CEG6		CEI6	
		CG7		CT7	X			CET7		CEG7		CEI7	
		CG8	XX	CT8	X			CET8		CEG8			
		CG9	X	CT9	X								
				CT10	X								
				CT11	X								
				CT12	X								
				CT13	X								

CEC: Competencias específicas complementarias
CET: Competencias específicas de tecnologías industriales
CEG: Competencias específicas de gestión

CEI: Competencias específicas de instalaciones, plantas y construcciones complementarias
CEFM: Competencias específicas de fin de máster

Competences EM1	Check With an "X"	Competences EM2	Check With an "X"	Competences EM3	Check With an "X"	Competences EM4	Check With an "X"	Competences EM5	Check With an "X"	Competences EM6	Check With an "X"
CEM1.1		CEM2.1		CEM3.1		CEM4.1		CEM5.1		CEM6.1	
CEM1.2		CEM2.2		CEM3.2		CEM4.2		CEM5.2		CEM6.2	
CEM1.3		CEM2.3		CEM3.3		CEM4.3		CEM5.3		CEM6.3	
CEM1.4		CEM2.4		CEM3.4		CEM4.4		CEM5.4		CEM6.4	
CEM1.5		CEM2.5		CEM3.5		CEM4.5		CEM5.5		CEM6.5	
		CEM2.6		CEM3.6				CEM5.6		CEM6.6	
								CEM5.7			
								CEM5.8			

CEM1: Competencias de especialidad: tecnologías de producción
CEM2: Competencias de especialidad: organización industrial
CEM3: Competencias de especialidad: energías renovables y eficiencia energética
CEM4: Competencias de especialidad: redes eléctricas inteligentes
CEM5: Competencias de especialidad: mecatrónica
CEM6: Competencias de especialidad: gestión integral de proyectos de innovación

Contents

Course outline

Compressible fluids. Thermal machine analysis. Thermal engine analysis. Industrial heating and cooling. Thermal systems: heat exchangers, boilers, furnaces and dryers. Design of refrigeration systems. Refrigerating installations. Design of air conditioning and ventilation systems.

Course syllabus

Name of lesson 1: Machines and thermal engines.
Contents of lesson 1: Compressible fluids. Analysis of thermal machines and engines. Characteristics of refrigerant fluids.
Description of the practical activities of lesson 1:
AP1: Refrigerant nomenclature exercises (1h) in Classroom.

Name of lesson 2: Industrial heating and cooling systems.
Contents of lesson 2: Systems and processes of cooling production and their industrial applications. Two-phase and mixing heat exchangers, boilers, ovens, and design of industrial dryers
Description of the practical activities of lesson 2:
AP1: Thermal design of two-phase heat exchangers (2h) in Classroom.
AP2: Identification of the main elements of a boiler and a dryer (2h) in Laboratory.

Name of lesson 3: Design of refrigerating systems.
Contents of lesson 3: Vapour compression cycle. Absorption cycle. Positive displacement machines. Expansion valves.
Description of the practical activities of lesson 3:
AP1: Calculation of the performance of cooling compression machines (2h) in Classroom.
AP2: Determination of operating temperatures of a cold production machine (2h) in Laboratory.

Name of lesson 4: Refrigeration installations and air conditioning and ventilation systems.
Contents of lesson 4: Thermal loads. Design of cold rooms. Design of air conditioning and ventilation systems.
Description of the practical activities of lesson 4:
AP1: Project for calculating a refrigerating installation (4h) in Classroom.
AP2: Calculation of an air conditioning and ventilation system (4h) in Classroom.

Educational activities

Student workload in hours by lesson		Lectures	Practical activities				Monitoring activity	Homework
Lesson	**Total**	**L**	**HI**	**L**	**C**	**S**	**SGT**	**PS**
1	17	6				1		10
2	26	7		2		2		15
3	23	7		2		2		12
4	29	8				6		15
Final Assessm.	17,5	2						15,5
TOTAL	112,5	30		4		11		67.5

L: Lectures (85 students)
HI: Hospital internships (7 students)
L: Laboratory or field practices (15 students)
C: Computer room or language laboratory practices (20 students)
S: Problem classes or seminars or case studies (40 students)
SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
PS: Personal study, individual or group work and reading of bibliography

Teaching Methodologies

Among the teaching methodologies included in the formative program, in this course the following are used:

Teaching methodology	Used methodologies labelled as "X"
1. Clase magistral. Exposición de contenidos por parte del profesor.	X
2. Sesiones de trabajo utilizando metodología del caso.	X
3. Sesiones de trabajo en el aula para la resolución de ejercicios.	X
4. Desarrollo de prácticas en espacios con equipamiento especializado (laboratorios, aulas de informática, trabajo de campo).	X
5. Visitas técnicas a instalaciones.	
6. Desarrollo, redacción y análisis, individualmente o en grupo, de trabajos, memorias, ejercicios, problemas, y estudios de caso, sobre contenidos y técnicas, teóricos y prácticos, relacionados con la materia.	X
7. Pruebas, exámenes, defensas de trabajos, prácticas, etc. Pudiendo ser orales o escritas e individuales o en grupo.	X
8. Estudio del alumno. Preparación y análisis individual de textos, casos, problemas, etc.	X
9. Formación en TICs y desarrollo de habilidades comunicativas (orales, escritas, multimedia).	X
10. Aprendizaje fuera del aula, basado en la vinculación entre formación académica y experiencias empresariales o profesionales.	
11. Aprendizaje supervisado y tutelado por el profesor para, a través de la interacción individual entre alumno y tutor, detector posibles problemas del proceso formativo, conocer los resultados del aprendizaje fuera del escenario del aula y programar los procesos de trabajo del alumno en actividades no presenciales como memorias, trabajo fin de master, preparación de la defensa delmismo, etc.	X

Learning outcomes

Carry out the analysis and design of thermal machines.
Carry out the analysis and design of alternative thermal engines.
Carry out the design of industrial heating and cooling systems.
Carry out the design of air conditioning and ventilation systems.

Assessment systems

Assessment criteria:
Evaluation criteria
The evaluation of learning will be carried out according to the following criteria:

C1. Demonstrate understanding of the concepts involved in the subject. The weighting of this evaluation criterion in the final quantitative grade is 40%. Related to the skills CG1, CG2, CG4, CG8, CG9, CB6-CB10, CT1-CT13.

C2. Know the most important data and results related to the subject (10%). Related to the competition CT5, CT13.

C3. Solve problems by applying theoretical knowledge or based on experimental results (40%). Related to the CET5, CEI4, CB6-CB10, CT1-CT13 competencies.

C4. Clearly present the results obtained (10%). Related to skills CB6-CB10, CT1-CT13.

Assessment activities:
Among the assessment activities included in the formative program, in this course the following are used:

	Range fixed	Ordinary call	Extraordinary call	Global assessment
1. Exam (final exam and/or partial examinations, cumulative and / or eliminatory).	0%–100%(1) 0%–80%(2)	80%	80%	80%
2. Solution and submission of activities (cases, exercises, assignments, projects, etc.), individually and/or in groups	0%–80%	10%	10%	20%
3. Attendance and use in practical classes and other learning activities	0%–20%	10%	10%	0%
4. Presentation and defense of proposed papers and reports	0%(1) 0%–30%(2)	0%	0%	0%

(1) Module courses: Complementary Technologies.
(2) Other courses.

Description of the assessment activities:

The evaluation will be carried out through the following activities:

A1. Final Exam (8 points).
A written test will be carried out on the syllabus of the subject, in which some practical laboratory questions could be included, in the period destined for exams. To pass this part of the subject it will be necessary to obtain a grade of at least 4 points of 8 in this evaluation activity. This activity is RECOVERABLE in the extraordinary call.

A2. Laboratory and classroom practical activities (2 points).
Participation in laboratory practices is mandatory, the seminars and individual and group work will be evaluated continuously and through some practical questions included in the written test. This activity is considered NON-RECOVERABLE, that is, it cannot be carried out in the extraordinary call, but the questions related to the practices carried out will be included in the extraordinary written test. The points of this activity (A2) will NOT be added to the points of the activity (A1) if it would not be approved in the activity (A1).

Final grade (10 points):

The final CF grade for the course will be calculated using the formula:

CF=A1+A2

To pass the subject it will be necessary to obtain a total CF score of at least 5 points of 10.

Overall evaluation:
The global evaluation will take place on the same day assigned to the final exam of each call by the Sub-directorate of Academic Organization of the E.II.II. It will consist of the following tests:

A1. Final Exam (8 points).
A written test will be carried out on the syllabus of the subject, which could include some practical laboratory questions, in the period set aside for exams. To pass this part of the subject it will be necessary to obtain a grade of at least 4 points out of 8 in this evaluation activity. This activity is RECOVERABLE in the extraordinary call.

A2. Laboratory and classroom practical activities (2 points).
Resolution and delivery of activities related to the theoretical and practical agenda of the signature. This activity is carried out during the course, but it is delivered, at most, one month prior to the final exam. This activity is considered NON-RECOVERABLE, that is, it cannot be carried out in the extraordinary call. The points of this activity (A2) will NOT be added to the points of the activity (A1) if it would not be approved in the activity (A1).

Final grade (10 points):
The final CF grade for the course will be calculated using the formula:

CF=A1+A2

To pass the subject it will be necessary to obtain a total CF score of at least 5 points of 10.

Bibliography (basic and complementary)

Basic Bibliography:

Awf Al-Kassir, Apuntes de clase de la asignatura, archivos puestos en el campus virtual.

DIXON, S.L. Y HALL, C. A. "Fluid Mechanics and Thermodynamics of Turbomachinery". Sixth Edition. Prentice Hall, 2010.
ASHRAE Handbook, "*HVAC Systems and Equipment*", American Society of Heating Refrigerating and Air-Conditioning Engineers, Atlanta, 2000.
ASINEL, "*Generadores de vapor*", Asociación de Investigación Industrial Eléctrica, 2ª ed. Barcelona, 1982.
FERNÁNDEZ, I. P., "*Turbomáquinas Térmicas*", Oviedo, 1993.

Complementary Bibliography:

ASHRAE Handbook, "*Fundamentals*", American Society of Heating Refrigerating and Air-Conditioning Engineers, Atlanta, 2001.
BATHIE, W.W., "*Fundamentals of Gas Turbines*", 2ª Ed. John Wiley & Sons, 1996.
BEJAN, A., TSATASRONIS, G. & MORAN, M., "*Thermal Design and Optimization*", John Wiley & Sons, 1996.
BELSA, R., "*Conocimientos fundamentales sobre climatización*", CEAC, Barcelona, 1994.
ALARCÓN, J. M., GRANADA, E. y VÁZQUEZ, M. E., "*SISCECT, simulación y cálculo de Ciclos Termodinámicos*", Bellisco Ediciones Técnicas Científicas. Madrid, 1999.
BOEHM, R.F., "*Design Analysis of Thermal Systems*", John Wiley & Sons, 1987.
CARNICER ROYO, E., "*Aire acondicionado*", Paraninfo, 1999.

Other resources and complementary educational materials

http://campusvirtual.unex.es
http://eii.unex.es/profesores/

Characteristics of pumps:
http://www.itur.es/frames.htm
http://www.bombas-ideal.com/Bombas-Ideal-Index.asp

Heating and cooling installations:
https://www.cofrico.com
https://roquesola.es/instalaciones/refrigeracion/
https://www.fenercom.com