Teaching Guide				
Identifying Data				2021/22
Subject (*)	Thermal Engineering		Code	730497205
Study programme	Mestrado Universitario en Enxeñaría Industrial (plan 2018)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	1st four-month period	First	Optional	4.5
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Ciencias da Navegación e Enxeñaría MariñaEnxeñaría Naval e Industrial			
Coordinador	Arce Ceinos, Alberto	E-mail	alberto.arce@udc.es	
Lecturers	Arce Ceinos, Alberto	E-mail	alberto.arce@udc.es	
Web				
General description	This subject provides a fundamental approach for designing thermal systems in industrial processes and termal enviroments for people in buildings. Specific topics include refirgeration cycles and systems, psychrometric principles, processes and applications, heating and cooling loads in buildings, themal confort, and air quality.			
Contingency plan	1. Modifications to the contents 2. Methodologies *Teaching methodologies that are maintained *Teaching methodologies that are modified 3. Mechanisms for personalized attention to students 4. Modifications in the evaluation *Evaluation observations: 5. Modifications to the bibliography or webgraphy			

Study programme competences	
Code	Study programme competences
A4	ETI4 - Capacity for the analysis and design of chemical processes.
A5	ETI5 - Knowledge and skills for the design and analysis of machines and thermal engines, hydraulic machines and industrial installations of heat and cold.
B2	CB7 - That students know how to apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of ??study.
B3	CB8 - That students are able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.
B5	CB10 - That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.
B6	G1 - Have adequate knowledge of the scientific and technological aspects in Industrial Engineering.
B7	G2 - Project, calculate and design products, processes, facilities and plants.
B13	G8 - Apply the knowledge acquired and solve problems in new or unfamiliar environments within broader and multidisciplinary contexts.
B14	G9 - Be able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.
B16	G11 - Possess the learning skills that allow to continue studying in a self-directed or autonomous way.

C1	ABET (a) - An ability to apply knowledge of mathematics, science, and engineering.
C3	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.
C5	ABET (e) - An ability to identify, formulate, and solve engineering problems.
C6	ABET (f) - An understanding of professional and ethical responsibility.
C8	ABET (h) - The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
C9	ABET (i) - A recognition of the need for, and an ability to engage in life-long learning.
C11	ABET (k) - An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Learning outcomes			
Learning outcomes	Study programme competences		
A materia ten por obxectivo proporcionar unha formación general, aunque de suficiente profundidade e complementar a adquirida polos alumnos dos graos en aspectos relacionados co deseño e análisis de máquinas e motores térmicos, máquinas hidráulicas e instalacions de calor e frío industrial	AJ4 AJ5	BJ2 BJ3 BJ5 BJ6 BJ7 BJ13 BJ14 BJ16	CJ1 CJ3 CJ5 CJ6 CJ8 CJ9 CJ11

Contents	
Topic	Sub-topic
0 Os temas seguintes desenrolan os contidos establecidos nas fichas da Memoria de Verificación que son:	Deseño e análise de: - Máquinas e motores térmicos. - Máquinas hidráulicas. - Instalacións de calor e frío industrial
1 Thermodynamic and heat transfer revision	Termodinámica Transferencia de calor
2 Introduction to the exergy analysis of thermal systems	Balance de exergía Sistemas abertos
3 Heat exchangers	3.1 Design 3.2 Simulation
4 Fundamentals of psicrometry and applications	4.1 Drying 4.2 Comfort and air condioning
5 Refrigeration systems	Refrixerantes Ciclo de compresión de calor Coeficiente de rendemento Bomba de calor
6 Air and vapor motor cycles	Ciclo Rankine Ciclo Brayton
7 Introduction to optimization techniques and simulation of thermal systems	Optimización Simulación

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours

Guest lecture / keynote speech	A4 A5 B2 B3 B5 B13 B14 B16 B7 B6 C1 C3 C5 C6 C8 C9 C11	10	25.5	35.5
Problem solving	A4 A5 B2 B3 B5 B13 B14 B16 B7 B6 C1 C3 C5 C6 C8 C9 C11	17	56	73
Objective test	A4 A5 B2 B3 B5 B13 B14 B16 B7 B6 C1 C3 C5 C6 C8 C9 C11	3	0	3
Personalized attention		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	
Methodologies	**Description**
Guest lecture / keynote speech	Oral presentation audiovisually aided and the introduction of questions with the aim of transmiting knowledge and assisting the learning.
Problem solving	Oral presentation audiovisually aided and the introduction of questions with the aim of transmiting knowledge and assisting the learning.
Objective test	Proba escrita utilizada para a avaliación da aprendizaxe, cuxo trazo distintivo é a posibilidade de determinar se as respostas dadas son ou non correctas. Constitúe un instrumento de medida, elaborado rigorosamente, que permite avaliar coñecementos, capacidades, destrezas, rendemento, aptitudes, actitudes, intelixencia, etc. É de aplicación tanto para a avaliación diagnóstica, formativa como sumativa.

Personalized attention	
Methodologies	**Description**
Guest lecture / keynote speech Problem solving	Tutoring and email assistance

Assessment			
Methodologies	**Competencies**	**Description**	**Qualification**
Objective test	A4 A5 B2 B3 B5 B13 B14 B16 B7 B6 C1 C3 C5 C6 C8 C9 C11	Proba escrita utilizada para a avaliación da aprendizaxe, cuxo trazo distintivo é a posibilidade de determinar se as respostas dadas son ou non correctas. Constitúe un instrumento de medida, elaborado rigorosamente, que permite avaliar coñecementos, capacidades, destrezas, rendemento, aptitudes, actitudes, intelixencia, etc. É de aplicación tanto para a avaliación diagnóstica, formativa como sumativa.	70
Problem solving	A4 A5 B2 B3 B5 B13 B14 B16 B7 B6 C1 C3 C5 C6 C8 C9 C11	Exam	30

Assessment comments
Exam: 100% of the qualification 210 min Consists on solving 3 or 4 problems similar to those proposed in each chapter. The use of textbook and solved exercises could be allowed during the exam.

Sources of information	
Basic	- Incropera, F. P. y DeWitt, D. P. (). Fundamentos de transferencia de calor. - Moran y Shapiro (). Fundamentos de termodinámica técnica. - Stoecker y Jones (). Refrigeration and air condictioning. - Eastop & Maconky (). Applied thermodynamics for Engineering and Technologists.
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Final Year Dissertation /730497219
Other comments
?Para ayudar a conseguir un entorno inmediato sostenido y cumplir con el objetivo de la acción número 5: ?Docencia e investigación saludable y sustentable ambiental y social? del "Plan de Acción Green Campus Ferrol": La entrega de los trabajos documentales que se realicen en esta materia: ? Se solicitarán en formato virtual y/o soporte informático ? Se realizará a través de Moodle, en formato digital sin necesidad de imprimirlos ? En caso de ser necesario realizarlos en papel: - No se emplearán plásticos - Se realizarán impresiones a doble cara. - Se empleará papel reciclado. - Se evitará la impresión de borradores. ? Se debe de hacer un uso sostenible de los recursos y la prevención de impactos negativos sobre el medio natural ? Se debe tener en cuenta la importancia de los principios éticos relacionados con los valores de la sostenibilidad en los comportamientos personales y profesionales ? Se incorpora perspectiva de género en la docencia de esta materia (se usará lenguaje no sexista, se utilizará bibliografía de autores de ambos sexos, se propiciará la intervención en clase de alumnos y alumnas?) ? Se trabajará para identificar y modificar prejuicios y actitudes sexistas, y se influirá en el entorno para modificarlos y fomentar valores de respeto e igualdad. ? Se deberán detectar situaciones de discriminación y se propondrán acciones y medidas para corregirlas.