



## Teaching Guide

Identifying Data					2020/21
Subject (*)	Air Conditioning and Refrigeration		Code	730496226	
Study programme	Mestrado Universitario en Enxeñaría Naval e Oceánica (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 IndustrialEnxeñaría Naval e Oceánica				
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 thermal environments for people in buildings. Specific topics include refrigeration cycles and systems, psychrometric principles, processes and applications, heating and cooling loads in buildings, thermal comfort, and air quality.				
Contingency plan	<ol style="list-style-type: none"> <li>Modifications to the contents</li> <li>Methodologies <ul style="list-style-type: none"> <li>*Teaching methodologies that are maintained</li> <li>*Teaching methodologies that are modified</li> </ul> </li> <li>Mechanisms for personalized attention to students</li> <li>Modifications in the evaluation <ul style="list-style-type: none"> <li>*Evaluation observations:</li> </ul> </li> <li>Modifications to the bibliography or webgraphy</li> </ol>				

## Study programme competences / results

Code	Study programme competences / results
A5	A04 - Capacidade para analizar solucións alternativas para a definición e optimización das plantas de enerxía e propulsión de buques.
B2	CB07 Que os estudantes saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en ámbitos novos ou pouco coñecidos dentro de contextos máis amplos (ou multidisciplinares) relacionados coa súa área de estudo
B3	CB08 Que os estudantes sexan capaces de integrar coñecementos e enfrontarse á complexidade de formular xuízos a partir dunha información que, sendo incompleta ou limitada, inclúa reflexións sobre as responsabilidades sociais e éticas vinculadas á aplicación dos seus coñecementos e xuízos
B5	CB10 Que os estudantes posúan as habilidades de aprendizaxe que lles permitan continuar estudando dun modo que haberá de ser en boa medida autodirixido ou autónomo.
C2	C1 Capacidade pra desenrolar a actividade profesional nun entorno multilingue
C3	ABET (a) An ability to apply knowledge of mathematics, science, and engineering.
C7	ABET (e) An ability to identify, formulate, and solve engineering problems.

## Learning outcomes



Learning outcomes	Study programme competences / results		
Psicrometry, Refrigeration systems, Air Conditioning systems	AJ4	BC2 BC3 BC5	CC2 CC3 CC7

Contents	
Topic	Sub-topic
0 The following sub-topics show the contents established in the Verifying Memory:	1. Introduction: Review of thermodynamic and heat transfer 2. Fundamentals of Psicrometry: Psicrometry, heat transfer from wet surfaces. Processes and equipments. 3. Air conditioning systems: types and design. 4. Cooling and dehumidification coils: Types and desing parameters. 5. Vapor compression cycle: ideal cycle, real cycle, COP, COP enhancement. Flash-gas. Refrigerants. Expansion devices. 6. Multipressure systems: industria refrigeration, Flash-gas removal, intercooling, one evaporator ? one compressor, two evaporators ? one compressor, one evaporador ? two compressors. 7. Compressors: Classification. Performance, power, refrigerant displacement. Performance curves. 8. Cooling tower and evaporative condensers. 9. Heat pumps.
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 / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A5 B2 B3 B5 C2 C3 C7	12	35	47
Problem solving	A5 B2 B3 B5 C2 C3 C7	15	46.5	61.5
Objective test	A5 B2 B3 B5 C2 C3 C7	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 aided with audiovisual material to expose the fundamentals of each chapter
Problem solving	Oral presentation audiovisually aided and the introduction of questions with the aim of transmitting knowledge and assisting the learning.
Objective test	Written learning progress test, characterised by pre-determined answers. Well-designed tests offer objectively quantifiable results in relation to student knowledge, capacities, skills, performance, aptitudes, attitude, intelligence, etc. Used for diagnostic, formative and summative assessment. May consist of all or any of the following types of questions: multiple choice, ordering and sequencing, short answer, binary, completion, multiple matching.

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

Assessment			
Methodologies	Competencies / Results	Description	Qualification
Problem solving	A5 B2 B3 B5 C2 C3 C7	Solved exercises	20
Objective test	A5 B2 B3 B5 C2 C3 C7	Written learning progress test, characterised by pre-determined answers. Well-designed tests offer objectively quantifiable results in relation to student knowledge, capacities, skills, performance, aptitudes, attitude, intelligence, etc. Used for diagnostic, formative and summative assessment. May consist of all or any of the following types of questions: multiple choice, ordering and sequencing, short answer, binary, completion, multiple matching.	80

Assessment comments
<p>Solved exercises is mandatory. If it is previously agreed with the teacher, the assesment can consist on the objective test only .</p> <p>Duration: 210 min</p> <p>The objective test will take place on the exam date. It 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.</p>

Sources of information	
<b>Basic</b>	<ul style="list-style-type: none"> <li>- Incropera, F. P. y DeWitt, D. P. (). Fundamentos de transferencia de calor.</li> <li>- Moran y Shapiro (). Fundamentos de termodinámica técnica.</li> <li>- Stoecker y Jones (). Refrigeration and air condictioning.</li> <li>- Eastop &amp; Maconky (). Applied thermodynamics for Engineering and Technologists.</li> </ul>
<b>Complementary</b>	

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously



## Subjects that continue the syllabus

Masters Thesis/730496216

### 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.

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.