



## Teaching Guide

Identifying Data					2020/21
Subject (*)	Industrial Heat Transfer	Code	730G03020		
Study programme	Grao en Enxeñaría Mecánica				
Descriptors					
Cycle	Period	Year	Type	Credits	
Graduate	2nd four-month period	Third	Obligatory	6	
Language	Spanish				
Teaching method	Hybrid				
Prerequisites					
Department	Ciencias da Navegación e Enxeñaría Mariña Construcións Navais Enxeñaría Naval e Industrial				
Coordinador	Lamas Galdo, Isabel	E-mail	isabel.lamas.galdo@udc.es		
Lecturers	Lamas Galdo, Isabel	E-mail	isabel.lamas.galdo@udc.es		
Web					
General description	Heat transfer mechanisms (conduction, convection and radiation) and practical applications in engineering.				
Contingency plan	<p>1. Modifications to the contents No modifications.</p> <p>2. Methodologies *Teaching methodologies that are maintained No modifications.  *Teaching methodologies that are modified No modifications.</p> <p>3. Mechanisms for personalized attention to students E-mail, moodle and teams. These will be consulted every day.</p> <p>4. Modifications in the evaluation No modifications.  *Evaluation observations: The exams will take place online.</p> <p>5. Modifications to the bibliography or webgraphy No modifications.</p>				

## Study programme competences / results

Code	Study programme competences / results
A21	TEM3 - Coñecementos aplicados de enxeñaría térmica.
B1	CB01 - Que os estudantes demostren posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral e adoita encontrarse a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo
B2	CB02 - Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo
B3	CB03 - Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitiren xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética
B4	CB04 - Que os estudantes poidan transmitir información, ideas, problemas e solucións a un público tanto especializado como leigo



B5	CB05 - Que os estudantes desenvolvan aquelas habilidades de aprendizaxe necesarias para emprenderen estudos posteriores cun alto grao de autonomía
B6	B3 - Ser capaz de concibir, deseñar ou poñer en práctica e adoptar un proceso substancial de investigación con rigor científico para resolver calquera problema formulado, así como de comunicar as súas conclusións ?e os coñecementos e razóns últimas que as sustentan? a un público tanto especializados como leigo dun xeito claro e sen ambigüidades
B7	B5 - Ser capaz de realizar unha análise crítica, avaliación e síntese de ideas novas e complexas
B8	B7 - Deseñar e realizar investigacións en ámbitos novos ou pouco coñecidos, con aplicación de técnicas de investigación (con metodoloxías tanto cuantitativas como cualitativas) en distintos contextos (ámbito público ou privado, con equipos homoxéneos ou multidisciplinares etc.) para identificar problemas e necesidades
B9	B8 - Adquirir unha formación metodolóxica que garanta o desenvolvemento de proxectos de investigación (de carácter cuantitativo e/ou cualitativo) cunha finalidade estratéxica e que contribúan a situarnos na vangarda do coñecemento
C1	C3 - Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.
C2	C4 - Desenvolverse para o exercicio dunha cidadanía aberta, culta, crítica, comprometida, democrática e solidaria, capaz de analizar a realidade, diagnosticar problemas, formular e implantar solucións baseadas no coñecemento e orientadas ao ben común.
C3	C5 - Entender a importancia da cultura emprendedora e coñecer os medios ao alcance das persoas emprendedoras.
C4	C6 - Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben afrontarse.
C5	C7 - Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.
C6	C8 - Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.

Learning outcomes			
Learning outcomes	Study programme competences / results		
Applications of thermal engineering.	A21	B1	C1
		B2	C2
		B3	C3
		B4	C4
		B5	C5
		B6	C6
		B7	
		B8	
		B9	

Contents	
Topic	Sub-topic
The following topics develop the contents indicated in the Verification Memory (Memoria de Verificación), which are:	Thermal engineering. Heat transfer Industrial refrigeration Air conditioning
1. Introduction	Introduction Heat transfer modes Conservation of energy
2. One-dimensional steady heat conduction	Introduction General heat conduction equation Cartesian coordinates Thermal contact resistance Cylindrical coordinates Spherical coordinates Fins



3. Numerical methods	Introduction Solution of the governing equations
4. Transient heat conduction	Lumped system analysis Semi-infinite solids Other cases
5. External forced convection	Introduction Flow across flat plates Flow across cylinders Flow across spheres Flow across tube banks Other cases
6. Internal forced convection	The entrance region Laminar flow Turbulent flow Non-circular tubes Distribution of temperature
7. Free convection	Introduction Vertical plates Inclined and horizontal plates Cylinders Spheres
8. Boiling and condensation	Boiling Condensation
9. Heat exchangers	Introduction DTML method Epsilon-NUT method
10. Radiation heat transfer	Fundamentals Radiation heat transfer
11. Refrigeration	Fundamentals Refrigeration procedures

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student's personal work hours	Total hours
Guest lecture / keynote speech	A21 B9 B8 B7 B6 B5 B4 B3 B2 B1 C1 C2 C3 C4 C5 C6	18	36	54
Problem solving	A21 B9 B8 B7 B6 B5 B4 B3 B2 B1 C1 C2 C3 C4 C5 C6	17	68	85
Mixed objective/subjective test	A21 B9 B8 B7 B6 B5 B4 B3 B2 B1 C1 C2 C3 C4 C5 C6	4	6	10
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	Classes.



Problem solving	Problem solving. Students must deliver exercises.
Mixed objective/subjective test	Exam/s

Personalized attention	
Methodologies	Description
Guest lecture / keynote speech Problem solving Mixed objective/subjective test	Attention will be provided by personalized attention, e-mail and Teams.  Academic dispense is allowed. Students who request it must contact teacher to realize additional homework.

Assessment			
Methodologies	Competencies / Results	Description	Qualification
Problem solving	A21 B9 B8 B7 B6 B5 B4 B3 B2 B1 C1 C2 C3 C4 C5 C6	Students must deliver exercises	30
Mixed objective/subjective test	A21 B9 B8 B7 B6 B5 B4 B3 B2 B1 C1 C2 C3 C4 C5 C6	Exam/s	70
Others			

Assessment comments
The evaluation criteria of the 2nd opportunity are the same as those of the 1st opportunity except that, in case of partial exams, the mark obtained in these will not be taken into account in the 2nd opportunity. In order to pass it will be necessary to obtain at least 4 in the final exam and 5 in the global score.

Sources of information	
<b>Basic</b>	- Incropera, F. P.; DeWitt, D. P., (). Fundamentos de Transferencia de Calor y Materia 5ª Ed. Pearson Educación - Cengel, Y.A. (). Heat Transfer. A Practical Approach. McGraw-Hill - Sáiz Jabardo, J.M., Arce Ceinos, A., Lamas Galdo, M.I. (). Transferencia de Calor. Universidade da Coruña - Holman, H.P. (). Transferencia de Calor. McGraw-Hill - Mills, A.F. (). Transferencia de Calor. Irwin  
<b>Complementary</b>	

Recommendations
<b>Subjects that it is recommended to have taken before</b>
Thermodynamics /730G03014
<b>Subjects that are recommended to be taken simultaneously</b>
Fluid Mechanisc /730G03018
<b>Subjects that continue the syllabus</b>
Graduation Project/730G03068
<b>Other comments</b>



To help achieve a sustained immediate environment and meet the objective of action number 5:

"Healthy and sustainable environmental and social teaching and research" of the "Green Campus Ferrol Action Plan":

The delivery of the documentary works that are made in this matter:

Will be requested in virtual format and / or computer support

It will be done through Moodle, in digital format without the need to print them

If it is necessary to make them on paper:

Plastics will not be used

Double-sided prints will be made.

Recycled paper will be used.

Printing of drafts will be avoided.

A sustainable use of resources and the prevention of negative impacts on the natural environment must be made

The importance of ethical principles related to the values of sustainability in personal and professional behaviors must be taken into account

Gender perspective is incorporated into the teaching of this subject (non-sexist language will be used, bibliography of authors of both sexes will be used, intervention in class of students will be encouraged ...)

Work will be done to identify and modify prejudices and sexist attitudes, and the environment will be influenced to modify them and promote values of respect and equality.

Discrimination situations must be detected and actions and measures will be proposed to correct them.

(\*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.