Teaching Guide					
Identifying Data					2020/21
Subject (*)	TERMODINÁMICA			Code	730G04014
Study programme	Grao en enxeñaría en Tecnoloxías Industriais				
Descriptors					
Cycle	Period		Year	Type	Credits
Graduate	1st four-month period		Second	Obligatory	6
Language	Spanish				
Teaching method	Hybrid				
Prerequisites					
Department	Ciencias da Navegación e Enxeñaría MariñaEnxeñaría Naval e Industrial				
Coordinador	Calvo Diaz, Jose Ramon		E-mail	jose.ramon.calvo@udc.es	
Lecturers	Calvo Diaz, Jose Ramon Lamas Galdo, Isabel		E-mail	jose.ramon.calvo@udc.es isabel.lamas.galdo@udc.es	
Web	www.udc.es				
General description	Heat, work, and energy.				
Contingency plan	1. Modifications to the contents No modifications. 2. Methodologies *Teaching methodologies that are maintained No modifications. *Teaching methodologies that are modified No modifications. 3. Mechanisms for personalized attention to students E-mail, moodle and teams. These will be consulted every dary. 4. Modifications in the evaluation No modifications. *Evaluation observations: The exams will take place online. 5. Modifications to the bibliography or webgraphy No modifications.				

Study programme competences / results	
Code	Study programme competences / results
A7	CR1 Coñecementos de termodinámica aplicada e transmisión de calor. Principios básicos e a súa aplicación á resolución de problemas de enxeñaría.
B1	CB1 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
B3	CB3 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
B5	CB5 Que os estudantes desenvolvan aquelas habilidades de aprendizaxe necesarias para emprenderen estudos posteriores cun alto grao de autonomía
B7	B5 Ser capaz de realizar unha análise crítica, avaliación e síntese de ideas novas e complexas

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
C4	C6 Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
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		
Learn thermodynamics and heat transfer. Fundamentals and application to engineering.	A7	B1 B3 B5 B7 B9	C4 C6

Contents	
Topic	Sub-topic
The following blocks or chapters develop the contents established in the verification memory, which are:	Fundamentals Energy and conservation of energy Entropy Exergy Problems applied to engineering
1. Introduction to thermodynamics	Thermodynamics and energy Systems and control volumes Properties States Processes Energy and enthalpy Specific heat and thermal capacity Phases Ideal gases Temperature and zeroth law of thermodynamics Density Pressure
2. Work, energy and the 1st Law of Thermodynamics (conservation of energy)	Energy Energy transfer by heat Energy transfer by work The first law of thermodynamics for closed systems, energy balance
3. Propiedades de una sustancia pura	Introduction Phase-change processes of pure substances Property diagrams Property tables Properties of incompressible substances Properties of ideal gases Reference states
4. Conservation of energy and 1st law of Thermodynamics	Introduction Conservation of mass in control volumes Conservation of energy in control volumes Examples

5. Thermodynamic cycles and introduction to the 2nd law of thermodynamics	Introduction Thermal energy reservoirs Thermodynamic cyclic devices: heat engines, refrigerators and heat pumps Kelvin-Planck and Clausius statements for the second law of thermodynamics Maximum thermal efficiency of thermodynamic cyclic devices
6. Entropy	AClausius inequality Entropy Entropy tables Entropy diagrams Tds relations Entropy change of thermal energy reservoirs Entropy change of incompressible substances Entropy change of ideal gases Entropy generation Isentropic processes Entropy balance for closed systems and control volumes Entropy of the universe Isentropic efficiency of pumps, compressors, turbines and nozzles

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
ICT practicals	A7 B1 B3 B5 B7 B9 C4 C6	24	48	72
Guest lecture / keynote speech	A7 B1 B3 B5 B7 B9 C4 C6	23	46	69
Mixed objective/subjective test	A7 B1 B3 B5 B7 B9 C4 C6	4	4	8
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
ICT practicals	Software
Guest lecture / keynote speech	Classes
Mixed objective/subjective test	Exam/s

Personalized attention	
Methodologies	Description
Mixed objective/subjective test ICT practicals	Attention will be provided by personalized attention, tutorials and e-mail. Academic dispense is allowed. Students who request it must contact teacher to realize additional homework.

Assessment			
Methodologies	Competencies / Results	Description	**Qualification**

Mixed objective/subjective test	A7 B1 B3 B5 B7 B9 C4 C6	Exam/s.	70
ICT practicals	A7 B1 B3 B5 B7 B9 C4 C6	Students may deliver some exercises.	30
Others			

Assessment comments
Students who request academic dispense must realize other activities proposed by the teacher. The qualification is the same as the practice. 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 is necessary to obtain at least 4 in the final exam and 5 in the global score.

Sources of information	
Basic	- Y. A. Çengel; M. A. Boles. (). Thermodynamics. McGraw-Hill - M. Moran y H. N Shapiro (). Fundamentos de Termodinámica Técnica. John Willey & Sons - J. Mª Sáiz Jabardo (). Introducción a la Termodinámica. - Y. A. Cengel (). Ecuaciones Diferenciales para Ingeniería y Ciencias. McGraw-Hill
Complementary	

Recommendations
Subjects that it is recommended to have taken before
CALCULUS/730G01101 PHYSICS I/730G01102 DIFFERENTIAL EQUATIONS/730G01110 MECHANICS/730G01118
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
FLUID MECHANICS/730G01119 Industrial Heat Transfer/730G03020 Fluid and Thermal Machines/730G03023
Other comments

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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":</p><p>
            The
delivery of the documentary works that are made in this matter:</p><p>
                ?
Will be requested in virtual format and / or computer support</p><p>
                ?
It will be done through Moodle, in digital format without the need to print
them</p><p>
                ?
If it is necessary to make them on paper:</p><p>
                    -
Plastics will not be used</p><p>
                    -
Double-sided prints will be made.</p><p>
                    -
Recycled paper will be used.</p><p>
                    -
Printing of drafts will be avoided.</p><p>
                   ?
A sustainable use of resources and the prevention of negative impacts on the
natural environment must be made</p><p>
                    ?
The importance of ethical principles related to the values ??of sustainability in personal and professional
behaviors must be taken into account</p><p>
                    ?
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 ...)</p><p>
                    ?
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.</p><p>
                    ?
Discrimination situations must be detected and actions and measures will be

proposed to correct them.

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(*)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.