Teaching Guide				
Identifying Data				2022/23
Subject (*)	Thermodynamics		Code	730G03014
Study programme	Grao en Enxeñaría Mecánica			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Second	Obligatory	6
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Ciencias da Navegación e Enxeñaría MariñaEnxeñaría Naval e Industrial			
Coordinador	Lamas Galdo, Isabel		E-mail	isabel.lamas.galdo@udc.es
Lecturers	Cartelle Barros, Juan José Lamas Galdo, Isabel		E-mail	juan.cartelle1@udc.es isabel.lamas.galdo@udc.es
Web	www.udc.es			
General description	Heat, work, and energy.			

Study programme competences	
Code	Study programme competences
A7	CR1 - Coñecementos de termodinámica aplicada e transmisión de calor. Principios básicos e a súa aplicación á resolución de problemas de enxeñaría.
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
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
B5	CB05 - 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		
Learn thermodynamics 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. Properties of pure substances	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	Ordinary class hours	Student?s personal work hours	Total hours
ICT practicals	A7 B1 B3 B5 B7 B9 C4 C6	28	48	76
Guest lecture / keynote speech	A7 B1 B3 B5 B7 B9 C4 C6	28	35	63
Mixed objective/subjective test	A7 B1 B3 B5 B7 B9 C4 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
ICT practicals	Software
Guest lecture / keynote speech	Classes
Mixed objective/subjective test	Exam/s

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

Assessment comments
Students who request academic dispense will be evaluated as the other students. The evaluation criteria of the 2nd and extra opportunity are the same as those of the 1st 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	- J. Mª Sáiz Jabardo (). Introducción a la Termodinámica. - M. Moran y H. N Shapiro (). Fundamentos de Termodinámica Técnica. John Willey &amp;amp; Sons - Y. A. Çengel; M. A. Boles. (). Thermodynamics. McGraw-Hill - 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

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.