Teaching Guide				
Identifying Data				2024/25
Subject (*)	Thermodynamics		Code	730G05015
Study programme	Grao en Enxeñaría Naval e Oceánica			
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	Lamas Galdo, Isabel	E-mail	isabel.lamas.galdo@udc.es	
Lecturers	Cartelle Barros, Juan José Lamas Galdo, Isabel Naveiro Parga, Manuel	E-mail	juan.cartelle1@udc.es isabel.lamas.galdo@udc.es manuel.naveiro@udc.es	
Web	www.udc.es			
General description	Heat, work, and energy.			

Study programme competences / results	
Code	Study programme competences / results
A14	Knowledge of the applied thermodynamics and of the transmission of the heat.
B2	That the students know how to apply its knowledge to its work or vocation in a professional way and possess the competences that tend to prove itself by the elaboration and defense of arguments and the resolution of problems in its area of study
B3	That the students have the ability to bring together and to interpret relevant data (normally in its area of study) to emit judgments that include a reflection on relevant subjects of social, scientific or ethical kind
B4	That the students can transmit information, ideas, problems and solutions to a public as much specialized as not specialized
B5	That the students developed those skills of learning necessary to start subsequent studies with a high degree of autonomy
B6	Be able to carrying out a critical analysis, evaluation and synthesis of new and complex ideas.
C1	Using the basic tools of the technologies of the information and the communications (TIC) necessary for the exercise of its profession and for the learning throughout its life.
C4	Recognizing critically the knowledge, the technology and the available information to solve the problems that they must face.

Learning outcomes			
Learning outcomes	Study programme competences / results		
Model and calculate systems and processes related to the employment and generation of energy	A14	B2 B3 B4 B5 B6	C1 C4

Contents	
Topic	Sub-topic
The following blocks or chapters develop the contents established in the verification memory, which are:	Introduction Conservation of energy Properties of pure substances 2nd law Practical applications

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	Clausius inequality Entropy Entropy tables Entropy diagrams T-ds 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	A14 B2 B3 B4 B5 B6 C1 C4	20	20	40
Guest lecture / keynote speech	A14 B2 B3 B4 B5 B6 C1 C4	30	30	60
Problem solving	A14 B2 B3 B4 B5 B6 C1 C4	20	20	40
Mixed objective/subjective test	A14 B2 B3 B4 B5 B6 C1 C4	9	0	9
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	Classes using software
Guest lecture / keynote speech	Classes
Problem solving	Classes about problem solving
Mixed objective/subjective test	Exam/s

Personalized attention	
Methodologies	Description
Mixed objective/subjective test Problem solving ICT practicals	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**
Mixed objective/subjective test	A14 B2 B3 B4 B5 B6 C1 C4	Exam/s.	70
ICT practicals	A14 B2 B3 B4 B5 B6 C1 C4	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 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	- Y. A. Çengel; M. A. Boles. (). Thermodynamics. McGraw-Hill - M. Moran y H. N Shapiro (). Fundamentos de Termodinámica Técnica. Reverte - J. Mª Sáiz Jabardo (). Introducción a la Termodinámica. Servicio de Publicaciones de la Universidade da Coruña
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Mathematics 2/730G05005 Physics 2/730G05006
Subjects that are recommended to be taken simultaneously
Differential equations/730G05011
Subjects that continue the syllabus
Heat transfer/730G05022 Marine propulsion systems 1/730G05027 Marine propulsion systems 2/730G05034
Other comments
To help achieve an immediate sustainable environment and fulfill the objective of action number 5: "Healthy and sustainable environmental and social education and research" of the "Ferrol Green Campus Action Plan":The delivery of the documentary work done in this matter:- It will be requested in virtual format and/or computer support- It will be done through Moodle, in digital format without the need to print- If it is necessary to do them on paper:Plastics will not be used.Double sided printing will be done.Recycled paper will be used.Printing drafts will be avoided.- The sustainable use of resources and prevention of negative impacts on the natural environment must be carried out- The importance of ethical principles related to sustainability values ??in personal and professional behavior must be taken into account- The gender perspective is incorporated into the teaching of this subject (non-sexist language will be used, the bibliography of authors of both sexes will be used, the intervention of students in class will be encouraged...)- Work will be carried out to identify and modify prejudices and sexist attitudes and the environment will be influenced to modify and promote values ??of respect and equality.- Situations of discrimination must be detected and actions and measures will be proposed to correct them.- The full integration of students who, for physical, sensory, psychological or socio-cultural reasons, experience difficulties in accessing appropriate, equal and profitable university life will be facilitated.As stated in the different application regulations for university teaching, the gender perspective must be incorporated in this subject (non-sexist language will be used, bibliography by authors of both sexes will be used, male and female students will be encouraged to participate in class...). Work will be done to identify and modify prejudices and sexist attitudes and influence the environment to modify them and promote values ??of respect and equality. Situations of discrimination based on gender must be detected and actions and measures will be proposed to correct them.In accordance with art.11.4.c of the UDC Student Disciplinary Regulations, in the event of plagiarism in the exam or evaluation test, the grade will be suspended in the call in which the offense is committed: the student will be graded with "Failed" (numerical grade 0) in the corresponding call of the academic year, whether the commission of the offense occurs on the first opportunity or on the second. For this, their qualification in the minutes will be modified, if necessary.