



Teaching Guide

| Identifying Data | | | | | 2020/21 |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------------------------------------|---------|---------|
| 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 | Spanish | | | | |
| Teaching method | Hybrid | | | | |
| Prerequisites | | | | | |
| Department | Ciencias da Navegación e Enxeñaría MariñaEnxeñaría Naval e Industrial | | | | |
| Coordinador | Calvo Díaz, Jose Ramon | E-mail | jose.ramon.calvo@udc.es | | |
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| Web | www.udc.es | | | | |
| General description | Heat, work, and energy. | | | | |
| 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 dary.</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 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 |



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



Assessment

| Methodologies | Competencies / Results | 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 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

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|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic | <ul style="list-style-type: none"> - J. M^a Sáiz Jabardo (). Introducción a la Termodinámica. - M. Moran y H. N Shapiro (). Fundamentos de Termodinámica Técnica. John Willey & Sons - Y. A. Çengel; M. A. Boles. (). Thermodynamics. McGraw-Hill - Y. A. Çengel (). 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.

(*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.