UNIVERSIDADE DA CORUÑA

| Teaching Guide | | | | |
|---|---|---|---|---|
| Identifying Data | | | | 2016/17 |
| Subject (*) | Termodinámica técnica | | Code | 730G05015 |
| Study programme | Grao en Enxeñaría Naval e Oceánica | | | |
| Descriptors | | | | |
| Cycle | Period | Year | Type | Credits |
| Graduate | 1st four-month period | Second | Obligatoria | 6 |
| Language | Spanish | | | |
| Teaching method | Face-to-face | | | |
| Prerequisites | | | | |
| Department | Enxeñaría Naval e Oceánica | | | |
| Coordinador | Calvo Diaz, Jose Ramon | E-mail | jose.ramon.calvo@udc.es | |
| Lecturers | Calvo Diaz, Jose Ramon | E-mail | jose.ramon.calvo@udc.es | |
| | Lamas Galdo, Isabel | | isabel.lamas.galdo@udc.es | |
| | Lema Rodríguez, Marcos | | marcos.lema@udc.es | |
| Web | www.udc.es | | | |
| General description | | | | |

| Study programme competences | |
|---|---|
| Code | Study programme competences |

| Learning outcomes | | | |
|---|---|---|---|
| Learning outcomes | Study programme competences | | |
| Modelar matematicamente sistemas e procesos relacionados a la utilización y generación de la energía | A1<br>A2<br>A3<br>A7<br>A8 | B1<br>B2<br>B3<br>B4<br>B5<br>B6<br>B7<br>B8<br>B9 | C1<br>C2<br>C3<br>C4<br>C5<br>C6 |
| Aprender a aprender | A1<br>A2<br>A3<br>A7<br>A8 | B1<br>B2<br>B3<br>B4<br>B5<br>B6<br>B7<br>B8<br>B9 | C1<br>C2<br>C3<br>C4<br>C5<br>C6 |

| | | | |
|---|---|---|---|
| Resolver problemas de forma efectiva. | A1<br>A2<br>A3<br>A7<br>A8 | B1<br>B2<br>B3<br>B4<br>B5<br>B6<br>B7<br>B8<br>B9 | C1<br>C2<br>C3<br>C4<br>C5<br>C6 |
| Capacidad de abstracción, comprensión y simplificación de problemas complejos. | A1<br>A2<br>A3<br>A7<br>A8 | B1<br>B2<br>B3<br>B4<br>B5<br>B6<br>B7<br>B8<br>B9 | C1<br>C2<br>C3<br>C4<br>C5<br>C6 |

| Contents | |
|---|---|
| **Topic** | **Sub-topic** |
| 1. Introduction to Thermodynamics | Applications of Thermodynamics. Continuum medium. Basic concepts: system, surroundings, state, thermodynamical property, equilibrium. Characterization and measurement of primitive properties: pressure, volume, temperature. Temperature scale. Gas thermometer. |
| 2. Work, energy and the 1st law of Thermodynamics (conservation of energy) | Review of mechanical concepts of energy. Examples: energy balance. Concept of work. Electric work. Examples. Cuasi-equilibrium processes and work. Heat iteration. Examples of heat and work. Internal energy and total energy. Conservation of energy. Heat transfer at constant pressure and volume. Enthalpy. Internal energy and enthalpy of ideal gasses and compressible flows. Tables of ideal gasses. |
| 3. Propiedades de una sustancia pura | Ideal gas equation of state and characterization of the state using two independent properties. Incompressible flows. Phase diagrams and phases of a pure substance. Pure simple compressible substances. Characterization of pure simple compressible substances. Equation of state and thermodynamical surfaces. (p, v) and (T, v) diagrams of a pure simple compressible substance. Tables of thermodynamic properties and reference states for water refrigerants. Examples. |
| 4. Conservation of energy and 1st law of Thermodynamics | Vapor turbines, hydraulic turbines, compressors, nozzles, heat exchangers. Concept of control volume (open system). Conservation of mass. Examples. Conservation of energy and input/output works. Conservation of mass and energy applied to thermal machines. Steady and transient states. Filling and emptying of tanks. |
| 5. 2nd law of Thermodynamics and introduction to thermodynamic cycles | Concept of reversibility. Irreversible processes. Spontaneous processes. Internally reversible processes. Thermal reservoir. Power cycles and refrigerators. Efficiency and coefficient of performance (COP). 2nd law of Thermodynamics: Kelvin-Plank and Clausius statements. Equivalence between both statements. Carnot cycle of an ideal gas inside a cylinder-piston system. Efficiency of a reversible power cycle. Corollaries of the 2nd law of thermodynamics. Kelvin temperature scale. Clausius inequality. |

| | |
|---|---|
| 6. Entropy | Analogy between work-pressure and heat-temperature in reversible process. Entropy as thermodynamic property. Thermodynamic equations related to entropy. Equations for ideal gasses. Tables of properties for pure simple compressible substances. (T, s) and (h, s) diagrams. Generation of entropy in irreversible processes. Generation and transfer of entropy. Open system. Application to thermal machines. Efficiency in thermal machines: compressors, pumps, turbines, nozzles. Applications. |

| Planning | | | | |
|---|---|---|---|---|
| Methodologies / tests | Competencies | Ordinary class hours | Student?s personal work hours | Total hours |
| ICT practicals | A1 A2 A3 A7 A8 B1 B2 B3 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 C5 C6 | 30 | 40 | 70 |
| Guest lecture / keynote speech | A1 A2 A3 A7 A8 B1 B2 B3 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 C5 C6 | 40 | 28 | 68 |
| Long answer / essay questions | A1 A2 A3 A7 A8 B1 B2 B3 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 C5 C6 | 9 | 2 | 11 |
| 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 | Students learn the software EES (Engineering Equation Solver). Thermodynamical problems will be solved using EES. There will also be lab work. |
| Guest lecture / keynote speech | Conventional classes. |
| Long answer / essay questions | Two exams |

| Personalized attention | |
|---|---|
| Methodologies | Description |
| ICT practicals | Personal attention will be provided to the students. |

| Assessment | | | |
|---|---|---|---|
| Methodologies | Competencies | Description | Qualification |
| Long answer / essay questions | A1 A2 A3 A7 A8 B1 B2 B3 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 C5 C6 | Exam/s. In order to pass it is neccesary to obtain at least 3.5 at the final exam and 5 final score. | 80 |
| ICT practicals | A1 A2 A3 A7 A8 B1 B2 B3 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 C5 C6 | Students may deliver some exercises and lab work | 20 |

| | | | |
|---|---|---|---|
| Others | | | |

| Assessment comments |
|---|
| |

| Sources of information | |
|---|---|
| Basic | - J. Mª Sáiz Jabardo (2008). Introducción a la Termodinámica.<br>- M. Moran y H. N Shapiro (2004). Fundamentals of Engineering Thermodynamics. John Willey & Sons<br>- Y. A. Çengel y M. A. Boles. (2006). Thermodynamics. McGraw-Hill |
| Complementary | |

| Recommendations |
|---|
| Subjects that it is recommended to have taken before |
| CALCULUS/730G01101<br>PHYSICS I/730G01102<br>DIFFERENTIAL EQUATIONS/730G01110<br>MECHANICS/730G01118 |
| Subjects that are recommended to be taken simultaneously |
| |
| Subjects that continue the syllabus |
| FLUID MECHANICS/730G01119<br>CALOR E FRIO INDUSTRIAL/REFRIG/730G03020<br>MÁQUINAS TERMICAS E HIDRAULICAS/730G03023 |
| Other comments |
| |

(*)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.