

## 29713 - Technical Thermodynamics and Fundamentals of Heat Transfer

### Syllabus Information

**Academic year:** 2023/24

**Subject:** 29713 - Technical Thermodynamics and Fundamentals of Heat Transfer

**Faculty / School:** 110 - Escuela de Ingeniería y Arquitectura

**Degree:** 330 - Complementos de formación Máster/Doctorado  
434 - Bachelor's Degree in Mechanical Engineering

**ECTS:** 6.0

**Year:** 434 - Bachelor's Degree in Mechanical Engineering: 2

330 - Complementos de formación Máster/Doctorado: XX

**Semester:** First semester

**Subject type:** 434 - Compulsory

330 - ENG/Complementos de Formación

**Module:**

### 1. General information

This subject is the basis of some of the most important subjects of the Mechanical Engineering studies, as it covers not only the analysis of thermal processes - production and absorption of mechanical energy (engines and turbomachines, compressors, pumps, etc.), and the production of cold/heat (heat exchange equipment, boilers, evaporators, condensers, etc.), but also a large part of the fluid-mechanical and chemical processes.

With this subject, students become familiar with the thermodynamic methodology necessary to approach, simplify, model and simulate different energy installations, both economically and socially important: chemical processed industries, food processing, ceramics, paper, transportation, aviation, etc., as well as thermal power plants for electricity production, gas turbines, alternative internal combustion engines for the automotive industry, refrigeration and air conditioning systems, etc.

The subject is essential to take the following courses: Thermal Machines and Engines (compulsory), and Thermal Engineering (compulsory).

These approaches and objectives are aligned with the Sustainable Development Goals (SDGs) of the 2030 Agenda of United Nations (<https://www.un.org/sustainabledevelopment/es/>) and certain specific targets, such that the acquisition of the learning results of the subject will contribute to some extent to the achievement of targets 7.2 and 7.3 of Goal 7, 9.4 of Goal 9, 11.6 of Goal 11 and 12.2 of Goal 12.

### 2. Learning results

- To know the thermophysical properties of industrial interest and to be able to use and select appropriate procedures and tools for their calculation.
- To know and apply the laws of thermodynamics to the energetic analysis of basic engineering equipment and processes.
- To acquire the basic criteria for the analysis of thermodynamic cycles.
- To know the basic mechanisms of heat transfer for the analysis of thermal equipment.
- Solve in a reasoned way basic problems of technical thermodynamics applied to engineering.

### 3. Syllabus

TOPIC 1: Basic concepts: thermodynamic system, properties and state of a substance, state principle, equilibrium, thermodynamic processes, energy transfers (heat and work).

TOPIC 2: Behavior of pure substances: Heterogeneous systems, PVT surface, thermodynamic diagrams, tables of thermodynamic properties.

TOPIC 3: Treatment of pure substances: equations of state, ideal and real gas model, incompressible substance model.

TOPIC 4: First principle of thermodynamics: energy balance in closed systems.

TOPIC 5: First principle of thermodynamics: energy balance in open systems.

TOPIC 6: Second Principle of Thermodynamics.

TOPIC 7: Entropy.

TOPIC 8: Gas power cycles: Joule-Brayton cycle.

TOPIC 9: Steam turbine power cycles: Rankine power cycle.

TOPIC 10: Vapor compression refrigeration cycles.

TOPIC 11: Fundamentals of psychrometry.

#### 4. Academic activities

In order for students to achieve the learning outcomes described above and to acquire the competences designed for this subject, the following training activities are proposed:

- Participative lectures: 45 hours Exposition of the fundamental contents of the subject and the methodology for problem solving is established.
- **Laboratory practices (15 hours):** Practical application of the concepts developed in theory classes and problems by means of practical work with computer and/or laboratory.
- **Personal study and work (90 hours):** Study of the subject matter and the presentation of exercises, questions and problems in addition to those solved in class. This encourages autonomous work, studying the subject matter and applying it to problem solving. This directed activity, but of autonomous execution, is fundamental for the student's learning process and for overcoming the evaluation activities.
- **Assessment tests (3 hours)**

The hours indicated are only illustrative and will be adjusted depending on the academic calendar.

#### 5. Assessment system

**1st Call:** The procedure consists of a set of tests that allow passing the subject with an overall grade equal to or higher than 5 points out of 10. The practical sessions will take place during the teaching period, while the written exam (global assessment test) will take place during the exam period.

**Second call:** The procedure is identical to that of the 1st call.

The final grade will be calculated by weighting the grades of each of the parts according to the activities carried out, as shown in the following table, being necessary an **overall grade equal or higher than 5** to pass the subject.

	Option 1	Option 2
<b>Conditions</b>	Practical classes: <b>YES (and grade &gt; 5)</b>	Practical classes: <b>NO (or grade &lt; 5)</b>
<b>Exam a</b>	<b>80%</b> (minimum grade of 4 in each part of the exam: theory and problems)	<b>20%</b> (minimum grade of 4 in each part of the exam: theory and problems)
<b>Practicesb</b>	<b>20%</b>	---

**aExam:**

- The exam is composed of two parts, one of theory (50%) and the other of problems (50%).
- In order to pass the exam and pass the subject it is mandatory to obtain a minimum grade of 4 in each of the parts (theory and problems).
- The explanation of the methodology followed for the resolution of the problems, the correct use of the units, and the analysis of the results will be especially valued.

**bPractices:**

- The practices not carried out or not handed in are considered zero in the calculation of the final grade of this part.
- In case of not obtaining an overall grade of more than 5, the practice will be considered failed.