1. OVERVIEW

Subject area	Thermodynamics and Fluid Mechanics
Degree	Bachelor's Degree in Industrial Organisation Engineering
School/Faculty	Faculty of Science, Engineering and Design
Year	Third-party
ECTS	6 CTS
Type	Compulsory
Language(s)	Spanish
Delivery Mode	On campus
Semester	Second semester

2. INTRODUCTION

Thermodynamics and Fluid Mechanics is taught in the third year (second semester) of the Degree in Industrial Organisation Engineering. This subject has two separate parts: one dealing with knowledge of thermodynamics, while the other focuses on fluid mechanics.

Thermodynamics is a word with Greek origin and means the study of force originating from heat. It teaches us how heat is transformed into energy. It originated in the 18th Century as a result of the need to describe and optimise how steam engines ran. Current thermodynamics is therefore the result of more than 250 years of experimental research and theory. Thermodynamics today does not just deal with heat but all forms of energy and its transformations. This is why it is often referred to as the Science of Energy. Classic thermodynamics is taught in this basic course and looks at states of equilibrium rather than dynamic systems. Therefore, we can define thermodynamics as: *the field of physics which describes and relates the physical properties of macroscopic systems (bulk matter which can be spatially isolated and which co-exist with an infinite and undisturbed environment) of matter and energy.*

Fluid Mechanics deals with the basics of fluid mechanics and how they are applied to solving problems in the field of engineering. These processes are constant in most industries seen in the following systems: hydraulic, oleo-hydraulic, compressed gas, heat transfer or energy production, among others. We introduce basic concepts to understand the properties of fluids and describe the kinematic and dynamic properties of fluid systems through fundamental equations based on the laws of conservation of mass, quantity of momentum and energy.

3. SKILLS AND LEARNING OUTCOMES

Basic skills (CB, by the acronym in Spanish):

- CB2. Students can apply their knowledge to their work or vocation in a professional manner and possess the skills which are usually evident through the forming and defending of opinions and resolving problems within their study area.

- CB3. Students have the ability to gather and interpret relevant data (usually within their study area) to form opinions which include reflecting on relevant social, scientific or ethical matters.

Cross-curricular skills (CT, by the acronym in Spanish):

- CT2. Independent learning: skills for choosing strategies to search, analyse, evaluate and manage information from different sources, as well as to independently learn and put into practice what has been learnt.
- CT3. Teamwork: ability to integrate and collaborate actively with other people, areas and/or organisations to reach common goals.
- CT4. Written/spoken communication: ability to communicate and gather information, ideas, opinions and viewpoints to understand and be able to act, spoken through words or gestures or written through words and/or graphic elements.
- CT5. Analysis and problem-solving: be able to critically assess information, break down complex situations, identify patterns and consider different alternatives, approaches and perspectives in order to find the best solutions and effective negotiations.
- CT8. Entrepreneurial spirit: ability to take on and carry out activities that generate new opportunities, foresee problems or lead to improvements.

Specific skills (CE, by the acronym in Spanish):

- CE11. Ability to apply the foundations of applied thermodynamics and heat transfer to solve problems in engineering projects and activity.
- CE12. Ability to use basic theory of fluid mechanics, including pipeline calculations and flow systems to solve problems in engineering projects and activity.

Learning outcomes (RA, by the acronym in Spanish):

- Ability to effectively solve basic problems in the field of thermodynamics and fluid mechanics commonly found in engineering projects: open and closed cycles, heat transfer systems, or pipeline sizing.

The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes (RA, by the acronym in Spanish)
CB2, CB3, CT2, CT3, CT4, CT5, CT8, CE11, CE12	Ability to effectively solve basic problems in the field of thermodynamics and fluid mechanics commonly found in engineering projects: open and closed cycles, heat transfer systems, or pipeline sizing.

4. CONTENTS

The subject area is divided into four learning units, which are then divided into topics (the number of topics depends on the unit):

Unit 1. Principles of thermodynamics

Unit 2. Gases and fluids in phase change

Unit 3. Steam or gas power cycles

Unit 4. Heat transfer processes

Unit 5. Principle of fluid mechanics

Unit 6. Internal and external flow

Unit 7. Pipeline calculations

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- Master lecture / Web conference
- Problem-based learning (PBL)
- Project-based learning
- Collaborative learning
- Learning based on laboratory work (laboratory, workshop and simulation environments)
- Case study
- Gamification
- Field work

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

On campus:

Learning activity	Number of hours
Master lectures and practical seminars	31
Problem-solving	10
Case studies and field studies	9
Laboratory work	14
Debates and discussions	8
Learning contract (definition of interests, needs and objectives)	2
Autonomous learning	62
Tutorials	12
Knowledge tests	2
TOTAL	**150 h**

7. ASSESSMENT

The assessment systems, plus their weighting in the final grade for the subject area, are as follows:

On campus:

Assessment system	Weighting
On Campus tests to evaluate objectives of theory/practical learning (exam-type objective tests, written compositions, oral presentations, case studies/problem solving, debates, simulation tests)	40%
Reports, written assignments, group work and workshops (off-site tests to assess theory/practical learning (case studies/problem solving))	40%
Attitude assessment tests (class participation)	10%
Self- and co-assessment (learning objectives).	10%

8. BIBLIOGRAPHY

The recommended bibliography is indicated below:

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- Zemansky, M.W. y Dittman, R.H., *Calor y Termodinamica*, McGraw-Hill, Madrid, 1984.
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