Course guide
240023 - 240023 - Basic Thermodynamics

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 748 - FIS - Department of Physics.
Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).
Academic year: 2023  ECTS Credits: 6.0  Languages: Catalan, Spanish

LECTURER
Coordinating lecturer: DAVID ORENCIO LOPEZ PEREZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

TEACHING METHODOLOGY

The course planning is based on continuous work during the whole semester. Attending lectures will be a positive element in the global evaluation of the course.
Throughout the semester, theory and problem sessions will be flexibly programmed, i.e. there can be certain weeks in which students will mostly receive theory lectures or will be solving problems. Nevertheless, theory sessions will not be more than 50% of classroom time. We consider that the subject’s learning necessary implies understanding of theoretic concepts and their application to concrete engineering situations related with thermal phenomena in order to achieve specific competencies.
The student’s activities in the laboratory, around 8 classroom hours (maximum), will be programmed towards the end of the semester. We intend that the student has an active attitude in the laboratory which allows him/her to reason on theoretical concepts acquired during the semester. This is why it is essential that this activity is programmed towards the end of the semester.

LEARNING OBJECTIVES OF THE SUBJECT

The general objective is to acquire basic competencies on Classic Thermodynamics providing a balanced introduction to the most relevant concepts and phenomena while building a solid base for later development.
Specific objectives:
- Introducing fundamental concepts and principles in an explicit form to provide students with the correct information that will enable them to understand thermal phenomena
- Enabling students to feel comfortable when facing particular problems in the industrial engineering, chemical engineering and materials engineering dominion.
- Expressing magnitudes in their IS (international system) units, as well as knowing factor units to convert to other unit systems.
- Knowing the performance of measuring devices related with the subject’s content.
- Allowing the students to think over the numerical obtained results.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>90.0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>52.0</td>
<td>34.67</td>
</tr>
<tr>
<td>Hours small group</td>
<td>8.0</td>
<td>5.33</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

**Topic I. Basic concepts**

**Description:**
Introduction to thermodynamics. Thermodynamic system, thermodynamic variable, balance state, thermodynamic transformation. Zero Principle and Temperature. Thermometers and empirical thermometric scales

**Related competencies:**
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

**Full-or-part-time:** 12h

- Theory classes: 3h
- Practical classes: 2h
- Self study: 7h

**Topic II. Single-component systems**

**Description:**

**Related competencies:**
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

**Full-or-part-time:** 31h

- Theory classes: 6h
- Practical classes: 4h
- Laboratory classes: 2h
- Self study: 19h
### Topic III. First Principle of Thermodynamics

**Description:**
Heat concept. Dilatation work in simple PVT systems. Dissipative work. First Principle of thermodynamics and internal energy. Enthalpy

**Related competencies:**
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

**Full-or-part-time:** 19h 30m
- Theory classes: 3h
- Practical classes: 3h
- Laboratory classes: 2h
- Self study: 11h 30m

### Topic IV. Applications of the First Principle of Thermodynamics

**Description:**
Energetic properties of a simple PVT system. Joule-Gay Lussac’s experiment. Ideal gas' energetic properties. Thermodynamic transformations of an ideal gas. Joule-Kelvin’s experiment and real gas' energetic properties

**Related competencies:**
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

**Full-or-part-time:** 21h
- Theory classes: 4h
- Practical classes: 3h
- Laboratory classes: 2h
- Self study: 12h

### Topic V. Second Principle of Thermodynamics: Machines

**Description:**

**Related competencies:**
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

**Full-or-part-time:** 18h
- Theory classes: 4h
- Practical classes: 2h
- Laboratory classes: 1h
- Self study: 11h
**Topic VI. Second Principle of Thermodynamics: Entropy**

**Description:**

**Related competencies:**
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

**Full-or-part-time:** 22h
Theory classes: 4h
Practical classes: 5h
Self study: 13h

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**Topic VII. Thermodynamics potentials**

**Description:**

**Related competencies:**
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

**Full-or-part-time:** 14h 30m
Theory classes: 3h
Practical classes: 3h
Self study: 8h 30m

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**Topic VIII. Phase transitions in single-component systems**

**Description:**
Balance conditions between phases in simple PVT systems. First order phase transitions: Clausius-Clapeyron equation. Superior order phase transitions.

**Related competencies:**
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

**Full-or-part-time:** 9h
Theory classes: 2h
Practical classes: 1h
Self study: 6h
**ACTIVITIES**

**EXPERIMENTAL DATA TREATMENT (PREVIOUS PRACTICE)**

**Description:**
Students will measure (in groups of 2 people) a collection of experimental data related with thermodynamics in which a group of abilities will be asked: graphic representation, linear regression and reflexion on the obtained results.

**Full-or-part-time:** 3h
Laboratory classes: 1h
Self study: 2h

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**GRADING SYSTEM**

The evaluation takes into account three mechanisms:

- **Final exam (EF).** A written evaluation with exercises and theory enabling to certify the overall level of achievement in specific competences.

- **Partial exam in the middle of the semester (MQ).** Evaluation of theory-practical exercises in a test and non-test format enabling the student a reflection of the level of competences achieved during the first half of the course.

- **Laboratory (LAB).** Evaluation of the activity made by the student during lab classes with a group. The non-assistance of the student will count in this mechanism as a zero (not reached) without the possibility of recovery.

The final mark is calculated with the formula:

$$\text{Final Mark} = 0.6 \times \text{EF} + 0.25 \times \text{MQ} + 0.15 \times \text{LAB}$$

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**EXAMINATION RULES.**

The final exam will consist on two well differentiated parts: one with an official formulary made by the professors teaching the course and the other part without it. The professors can decide if any of the parts does not need calculator for its resolution.

The partial exam in the middle of the semester will be carried out without the formulary and with or without a calculator.

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**BIBLIOGRAPHY**

**Basic:**

**Complementary:**

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**RESOURCES**

**Other resources:**
Handbook with problems wordings, test questions and laboratory practices. Use of ATENEA.