Course guide
820020 - TTC - Thermodynamics and Heat Transfer

Unit in charge: Barcelona East School of Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics.

Degree:
- BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
- BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
- BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Compulsory subject).
- BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
- BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Degree competences to which the subject contributes
Specific:
CEI-07. Understand applied thermodynamics and heat transfer, their basic principles and their application to engineering problems.

Transversal:
2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

Teaching methodology
The contents of the subject will be developed using master classes and promoting the participation of students with active methodologies. The student must perform individual work while solving problems and preparing exams, and also teamwork to tackle complex problems and lab practices.

Learning objectives of the subject
Give the student basic knowledge in the analysis of thermodynamical systems (both power or refrigeration systems) as well as in the basic heat transfer mechanisms.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>15.0</td>
<td>10.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90.0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>45.0</td>
<td>30.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

1.- INTRODUCTION TO THERMODYNAMICS

Description:

Specific objectives:
Understand the basic knowledge required for the study of thermodynamics.

Full-or-part-time: 29h
Theory classes: 11h 30m
Laboratory classes: 2h 30m
Self study : 15h

2.- FIRST LAW OF THERMODYNAMICS

Description:

Specific objectives:
To know and to use different expressions of energy and work involved in a thermodynamical system. To study basic thermodynamical processes. To apply the first law of thermodynamics to the analysis of open and close systems.

Full-or-part-time: 29h
Theory classes: 11h 30m
Laboratory classes: 2h 30m
Self study : 15h
3.- SECOND LAW OF THERMODYNAMICS

**Description:**

**Specific objectives:**
To understand the concept of entropy and the second law of thermodynamics, and its application to thermal engines. To know the ideal power cycles for producing mechanical work. To know the ideal steam compression cycle for refrigeration and heat pumping applications.

**Full-or-part-time:** 26h 30m
Theory classes: 11h 30m
Self study: 15h

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4.- CONDUCTIVE HEAT TRANSFER

**Description:**

**Specific objectives:**
To present the general differential equation for conduction heat transfer and its application in simple geometries. To show the concept of thermal resistance and its application to flat and cylindrical walls.

**Full-or-part-time:** 23h 30m
Theory classes: 6h
Laboratory classes: 2h 30m
Self study: 15h

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5.- CONVECTIVE HEAT TRANSFER

**Description:**

**Specific objectives:**
To describe the convective heat transfer mechanism and its classification according to the nature of the flow. To use different empirical correlations that allow to estimate the convection heat transfer.

**Full-or-part-time:** 21h
Theory classes: 6h
Self study: 15h

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6.- RADIATIVE HEAT TRANSFER

**Description:**

**Specific objectives:**
To understand the physical nature of electromagnetic radiation and its modelling and interaction studies.

**Full-or-part-time:** 21h
Theory classes: 6h
Self study: 15h
**GRADING SYSTEM**

Mid-term exams (35%); Homework activities (10 %); Final exam (35 %); Lab practices (15 %); Generic skills (5 %).

In order to pass the course it is mandatory to attend to all lab practices and deliver the correspondent lab reports.

There is a re-evaluation test for this subject. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf)

**EXAMINATION RULES.**

The evaluation will be conducted through written tests both for the mid-terms and final exam.

There will be 2 homework activities due during the term. These activities will be delivered online through the course's intranet.

Practices will be graded based on a pre-test to be presented before the lab practice start, attendance (mandatory) and lab activity developed, together with the preparation and delivery of lab reports.

**BIBLIOGRAPHY**

**Basic:**

**Complementary:**