

# Course guide 330130 - ETE - Thermal Engineering

 Last modified: 25/04/2024

 Unit in charge:
 Manresa School of Engineering

 Teaching unit:
 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

 Degree:
 BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

 Academic year: 2024
 ECTS Credits: 6.0
 Languages: Catalan, Spanish

# **LECTURER**

Coordinating lecturer:	Pérez Ràfols,	Francisco
Others:	Cobo Molina,	Raül

# **DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES**

#### Specific:

1. Understanding the problems of energy and its transformation. Understanding and mastery of the fundamental concepts of thermal machines.

### Transversal:

 SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
 EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

# **TEACHING METHODOLOGY**

The course consists of two hours of theory a week in face-to-face classes (large groups), with lectures with audiovisual support, and two hours a week in small groups dedicated to laboratory practices and application problems.

# LEARNING OBJECTIVES OF THE SUBJECT

-At the end of the course the student must be able to:

- Know, understand the problem of energy and its transformation.
- Understand and apply the technologies of direct exothermic heat engines.
- Understand and apply the technologies of direct endothermic heat engines.
- Understand and apply the technologies of reverse heat engines.
- Prepare technical reports and resolution of technical application problems.

### **STUDY LOAD**

Туре	Hours	Percentage
Hours large group	30,0	20.00
Hours small group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h



# CONTENTS

### Title of content 1: Energy and the problems of its transformation: thermal machines heat engines

#### **Description:**

Demand and supply of energy. Energy intensity. Primary energy sources. Transformation to useful or final energy. Transformation technologies and transformation performance. Heat engines and maximum transformation performance. Environmental impacts.

#### Specific objectives:

Know, understand the problem of energy and its transformation.

#### **Related activities:**

Continuous assessment test (Deliverable 0 and Deliverable 1). Specific test (First Partial).

Full-or-part-time: 15h Theory classes: 3h Laboratory classes: 3h Self study : 9h

#### **Content Title 2: Direct Exothermic Heat Engines**

#### **Description:**

Thermal power stations. Nuclear power plants. Open cycle gas turbines. Heat exchangers.

### **Specific objectives:**

Understanding, analysis and application of the technologies of thermal, nuclear and open cycle turbines. Understanding, analysis and application of the principles of operation of heat exchangers.

### **Related activities:**

Continuous assessment test (Deliverable 2a, 2b, 2c and 2d). Specific test (First Partial).

**Full-or-part-time:** 45h Theory classes: 9h Laboratory classes: 9h Self study : 27h

### **Content Title 3: Endothermic Direct Heat Engines**

### **Description:** Diesel engines. Otto engines. Sabathè engines.

### Specific objectives:

Understanding, analysis and application of the operating principles and technology of endothermic engines.

### Related activities:

Continuous assessment test (Deliverable 3a and 3b). Final evaluation test (Second Part).

Full-or-part-time: 45h Theory classes: 9h Laboratory classes: 9h Self study : 27h



### **Content Title 4: Reverse Heat Engines**

### **Description:**

Refrigeration and air conditioning. Compression refrigeration machines (one stage and multistage). Refrigerating machines without compression.

### Specific objectives:

Understanding and application of refrigeration and air conditioning technologies.

#### **Related activities:**

Continuous assessment test (Deliverable 4). Final evaluation test (Second Part). Laboratory practices (Laboratory Report).

# Full-or-part-time: 45h

Theory classes: 9h Laboratory classes: 9h Self study : 27h

# **ACTIVITIES**

#### TITLE OF ACTIVITY 1: LABORATORY PRACTICES (Laboratory Report)

#### **Description:**

Carrying out practices in the laboratory related to the subject of refrigeration machines.

### **Specific objectives:**

Development of reasoning techniques and strategies for the analysis and resolution of problems. Preparation of a report with the results obtained experimentally. Written communication. Autonomous Learning.

#### Material:

Statements and practical scripts in the digital Campus.

**Delivery:** 10% of the final grade.

Full-or-part-time: 10h 20m Self study: 8h 20m Laboratory classes: 2h

### TITLE OF ACTIVITY 2: CONTINUOUS ASSESSMENT TEST (Deliverables 0, 1, 2a, 2b, 2c, 2d, 3a, 3b and 4)

### Description:

Carrying out one or more problems for each of the topics seen.

### **Specific objectives:** Autonomous Learning.

**Material:** Problems in the digital Campus.

**Delivery:** 10% of the final grade.

**Full-or-part-time:** 20h Self study: 20h



### TITLE OF ACTIVITY 3: SPECIFIC TEST PROBLEMS (First Partial)

### **Description:**

Taking a written problem-solving test.

#### Specific objectives:

Upon completion of the activity, the student should be able to: Understand the fundamentals of direct exothermic heat engines.

# Material:

Statements problems and calculator.

**Delivery:** 40% of the final grade.

**Full-or-part-time:** 32h Self study: 30h Theory classes: 2h

### TITLE OF ACTIVITY 4: FINAL EVALUATION TEST (Second Part)

# Description:

Taking a written problem-solving test.

### Specific objectives:

Upon completion of the activity, the student should be able to: Understand the fundamentals of reverse heat engines and direct endothermic machines.

#### Material:

Statements problems and calculator.

**Delivery:** 40% of the final grade.

**Full-or-part-time:** 32h Self study: 30h Laboratory classes: 2h

### **GRADING SYSTEM**

Deliverables: 10% of the final grade. Laboratory practices: 10% of the final grade. First Partial: 40% of the final grade. Second Partial: 40% of the final grade.

### **EXAMINATION RULES.**

Activities not submitted will be considered a "0".



# **BIBLIOGRAPHY**

### **Basic:**

- Agüera, J. Termodinámica lógica y motores térmicos. 6a ed. Madrid: Ciencia 3, 1999. ISBN 8486204984.

Moran, Michael J; Shapiro, Howard N. Fundamentos de termodinámica técnica [on line]. 2ª ed. Barcelona [etc.]: Reverté, cop. 2004
 [Consultation: 10/06/2022]. Available on: <a href="https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5635437">https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5635437</a>. ISBN 8429143130.

### **Complementary:**

- Rolle, K.C. Termodinámica [on line]. 6a ed. Mèxico: Pearson Educación, 2006 [Consultation: 03/06/2022]. Available on: <a href="https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB">https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB</a> BooksVis?cod primaria=1000187&codigo libro=4691. ISBN 9702607574.

- Carrera, C.; Comas, A.; Calvo, A. Motores de combustión interna: fundamentos. Barcelona: Edicions UPC, 1993. ISBN 8476533543.

# **RESOURCES**

# **Other resources:**

Non-tabulated resources: Notes on digital campuses. Audiovisual material: Presentations on the digital campus.