

## Course guide

### 330130 - ETE - Thermal Engineering

Last modified: 04/05/2023

**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:** 2023    **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:**

2. 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.

3. 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

Type	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

Laboratory classes: 2h

Self study: 8h 20m

#### 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

Theory classes: 2h

Self study: 30h

### 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

Laboratory classes: 2h

Self study: 30h

## 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:

- 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: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5635437>. ISBN 8429143130.
- Agüera, J. Termodinámica lógica y motores térmicos. 6a ed. Madrid: Ciencia 3, 1999. ISBN 8486204984.

### Complementary:

- Rolle, K.C. Termodinámica [on line]. 6a ed. México: Pearson Educación, 2006 [Consultation: 03/06/2022]. Available on: [https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=4691](https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_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.