

## Course guide

### 240EQ012 - 240EQ012 - Energy Technology

Last modified: 14/06/2023

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 748 - FIS - Department of Physics.

**Degree:** **Academic year:** 2023 **ECTS Credits:** 4.5  
**Languages:** Catalan, Spanish

#### LECTURER

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**Coordinating lecturer:** Blas Del Hoyo, Alfredo De

**Others:** Blas Del Hoyo, Alfredo De

#### PRIOR SKILLS

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Basic knowledge of physics, chemistry, thermodynamics and heat engines and machines.

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.

**Generical:**

2. Possess independent learning skills to maintain and enhance the competencies of chemical engineering to enable the continued development of their profession.

**Transversal:**

3. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

5. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

#### TEACHING METHODOLOGY

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Subject in process of extinction. There is no teaching, the students that enroll it do so only with the right to an exam.

#### LEARNING OBJECTIVES OF THE SUBJECT

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- Show students the current methods and development to make the most of the different energy sources.
- Understand the physics and technology basics of conversion, storage and transportation, and energy uses.
- Make the student to be aware of the social-economic implications and environmental transformation and use of energy (energy management).

## STUDY LOAD

Type	Hours	Percentage
Self study	72,0	64.00
Hours large group	27,0	24.00
Hours small group	13,5	12.00

**Total learning time:** 112.5 h

## CONTENTS

### 1. Introduction to the energetic problem

#### Description:

Energetic resources, energetic structure, definition of units, forms of energy, previous basic concepts, primary energy, final energy.

#### Specific objectives:

- OE1.1: Define reserves and resources and evaluate the current situation of the main fuels.
- OE1.2: Analyse statistical data of reserves, production and consumption and draw conclusions out of them
- OE1.3: Define the concept of primary energy, secondary and final energy and its relation
- OE1.4: Perform and analyse flow diagrams and energetic balances
- OE1.5: Explain the relation between the energy consumption of a country and its economic activity through parameters such as energy intensity.

#### Related activities:

A1, A2, A5, A6

#### Full-or-part-time: 7h

Theory classes: 2h

Practical classes: 2h

Self study : 3h

### 2. Energy transformation

#### Description:

The deterioration of energy in the processes, energy conversion systems, energy storing systems, exergy.

#### Specific objectives:

- OE2.1: Explain the problem of energy deterioration and relate it to the concept of exergy.
- OE2.2: List some of the major existing energy converters, describe its key attributes and compare them in base to its efficiency.
- OE2.3: List some of the major energy storage systems.

#### Related activities:

A1, A2, A5, A6

#### Full-or-part-time: 4h

Theory classes: 1h

Practical classes: 1h

Self study : 2h

### 3. Fossil fuels

#### Description:

Origin, composition, Combustion reactions with and without excess of air, quantification of the formation of combustion products, current applications, thermal power plants (steam), combined-cycle power plants, environmental impact, prospects for the future

#### Specific objectives:

OE3.1: Describe the main characteristics of the fossil fuels and the combustion process

OE3.2: Solve practical cases determining the composition of the smoke generated and the temperature of combustion

OE3.3: Describe the main characteristics of the production, transport and distribution of the fossil fuels

OE3.4: Describe some of the main technologies and equipment related to the use of coal, oil and natural gas. Apply what has been taught in class to the study of practical cases

OE3.5: Describe the legislative frame regulating the environmental impact of the facilities using these fuels and apply it to solve practical exercises

#### Related activities:

A1, A2, A4, A5, A6

#### Full-or-part-time: 24h

Theory classes: 8h

Practical classes: 7h

Self study : 9h

### 4. Nuclear Fission Energy

#### Description:

Origin, basic concepts of the atomic and nuclear physics, radioactivity, nuclear reactions, nuclear fission, nuclear power plants, nuclear security, new trends.

#### Specific objectives:

OE4.1: Describe the nuclear reactions which can be useful in order to obtain energy

OE4.2: Describe the fission reaction, its main characteristics and reason the interest of the chain fission reaction in order to obtain energy

OE4.3: Define radioactivity and describe the general way of its processes and its impact on the technology of the nuclear power plants (waste potential, waste)

OE4.4: Compare a conventional thermal power plant to a nuclear plant

OE4.5: Solve practical exercises about nuclear power plants.

OE4.6: Number the main types of reactors, explaining its elements and its main characteristics from an operational and security point of view

OE4.7: Describe the combustion cycle and the problem with its final stage: waste. OE4.8: Value the situation of Spain in the global nuclear industry

OE4.9: Reason about the environmental impact of the use of this energy

#### Related activities:

A1, A2, A4, A5, A6

#### Full-or-part-time: 14h

Theory classes: 4h

Practical classes: 4h

Self study : 6h

## 5. Renewable energies

### Description:

Description of the renewable energies, hydroelectric energy, solar thermal and thermoelectric power, photovoltaic solar power, wind energy, bioenergy, use of hydrogen as an energy carrier.

### Specific objectives:

OE5.1: Describe the possible locations, applications and layout of the elements for a hydroelectric, solar or wind use, as well as the main characteristics of this elements.

OE5.2: Describe the main characteristics of other non conventional renewable sources (geothermal, biomass) and number some of its main applications

OE5.3: Solve practical exercises about applications facilities of renewable sources

OE5.4: Value the importance of these sources from an economical and environmental point of view

### Related activities:

A1, A2, A3, A5, A6

### Full-or-part-time: 17h

Theory classes: 4h

Practical classes: 6h

Self study : 7h

## 6. Electrical sector

### Description:

Activities and structure of the electric sector, generation of electric power (power and energy) demand coverage, liberalization of the sector.

### Specific objectives:

OE6.1: Define the electric sector, numbering its main objectives and activities.

OE6.2: Describe the main characteristics of the structure of the electric power demand, of the generation (normal and special regime) and the transport and argue about the need to program the production and encourage the self-producers of energy

OE6.3: Explain the structure of costs of the electrical system and the methodology of the tax rate in Spain

OE6.4: Name the different planning and management existing models, describing the new liberalization situation of the electrical national market.

### Related activities:

A1, A2, A5, A6

### Full-or-part-time: 6h

Theory classes: 3h

Practical classes: 1h

Self study : 2h

## 7. Energy savings. Cogeneration

### Description:

Efficiency, energy-saving measures, cogeneration.

### Specific objectives:

OE7.1: Define the concept of the value of the energy

OE7.2: Number the optimization criteria of the industrial energy consumption, explaining some examples.

OE7.3: Describe the basis of cogeneration and justify its interest from an energy-saving point of view.

OE7.4: Solve practical exercises about the cogeneration plants and about the analysis of investment profitability in energy-saving.

### Related activities:

A1, A2, A3, A5, A6

### Full-or-part-time: 9h

Theory classes: 2h

Practical classes: 4h

Self study : 3h

## ACTIVITIES

### A1. RESOLUTION OF EXERCISES

#### Description:

In groups of 4, the students solve the exercises set out by the professor during the duration of the classroom activity. At the end of each class session group, the obtained results must be handed in to the professor. In following days, the Professor will return the corrected exercises to the students, indicating the most important errors. Sometimes, each group will have to finish a part of the exercise out of the classroom and hand it in on the corresponding date.

#### Specific objectives:

OE1.2, OE1.4, OE1.5, OE2.1, OE2.2, OE3.2, OE3.3, OE3.4, OE3.5, OE4.3, OE4.5 , OE4.7 , OE4.9, OE5.3 , OE5.4 , OE6.2 , OE6.3 , OE7.4

#### Material:

Exercises handed in by the professor, bibliographic material of the students, calculator and computer.

#### Delivery:

Answers to the proposed exercises

### Full-or-part-time: 44h

Laboratory classes: 28h

Self study: 16h

## A2. THEORY CLASSES

**Description:**

The professor explains during a lecture the basic concepts of the dealt topics. The theory concepts are built up with numeric exercises.

**Specific objectives:**

All

**Material:**

Presentations of the professor, collection of exercises, calculator and computer.

**Delivery:**

Additional documentation

**Full-or-part-time:** 40h

Laboratory classes: 24h

Self study: 16h

## A3. SEMINAR

**Description:**

An expert of the industrial sector or a renowned investigator exposes an actual topic related to the theme of the subject.

**Specific objectives:**

OE3.3, OE5.1, OE7.2

**Material:**

Presentation of the speaker, computing material

**Delivery:**

A test with questions about the exposed topic which the student must answer the last 10 minutes of the session.

**Full-or-part-time:** 4h

Laboratory classes: 4h

## A4. SIMULATOR OF A NUCLEAR PLANT

**Description:**

Use of a simulator of a nuclear plant to explain some basic concepts about the operation and functioning of a nuclear plant and the principles of nuclear safety.

**Specific objectives:**

OE4.6

**Material:**

RELAP simulation code adapted to the teaching, computer and projector.

**Delivery:**

Each student must answer to a test of 5 questions during the last 10 minutes of the session.

**Full-or-part-time:** 2h

Laboratory classes: 2h

#### A5. PARTIAL EXAM

**Description:**

Exam of the units from 1 to 4. It consists of two parts valued individually. A part is a test and the other part one or some numerical exercises. Each student can solve the part of the exercises with its own bibliographic material.

**Specific objectives:**

Objectives topics 1 to 4

**Material:**

Exam, documentation of each student.

**Delivery:**

Solved exam

**Full-or-part-time:** 10h

Laboratory classes: 2h

Self study: 8h

#### A6. FINAL EXAM

**Description:**

Exam of all the topics dealt during the course. Just as the partial exam, it consists of two parts valued individually. A part is a test and the other part one or some numerical exercises. Each student can solve the part of the exercises with its own bibliographic material.

**Specific objectives:**

All

**Material:**

Exam, documentation of each student.

**Delivery:**

Solved exam

**Full-or-part-time:** 15h

Laboratory classes: 3h

Self study: 12h

### GRADING SYSTEM

Subject in process of extinction. There is only one final test that corresponds to 100% of the final grade of the subject.

### BIBLIOGRAPHY

**Basic:**

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- Bosser, Jordi; Fernández Boyer, Gonçal; Bergua, José Ma. Curs de centrals hidroelèctriques : principals conceptes i referències. Barcelona: CPDA, 1995.

**Complementary:**

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- Çengel, Yunus A; Boles, Michael A. Termodinámica [on line]. 7a ed. México [etc.]: McGraw-Hill, cop. 2012 [Consultation:

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- Sørensen, Bent E. Renewable energy : physics, engineering, environmental impacts, economy & planning. 4th ed. Burlington, Massachusetts: Elsevier Academic Press, cop. 2011. ISBN 9780123750259.

- Ortega, Xavier ; Jorba, Jaume. Las Radiaciones ionizantes : utilización y riesgos [on line]. 2a ed. Barcelona: Edicions UPC, 1996-2001 [Consultation: 22/04/2016]. Available on: <http://hdl.handle.net/2099.3/36551>. ISBN 8483011700.