# Course guide
# 820769 - EEI - Industrial Energy Efficiency

**Last modified:** 30/05/2024

**Unit in charge:** Barcelona School of Industrial Engineering
**Teaching unit:** 709 - DEE - Department of Electrical Engineering.

**Degree:** MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN ELECTRIC POWER SYSTEMS AND DRIVES (Syllabus 2021). (Optional subject).
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2022). (Optional subject).

**Academic year:** 2024 **ECTS Credits:** 5.0 **Languages:** English

## LECTURER

**Coordinating lecturer:** ANDREAS SUMPER

**Others:** Sumper, Andreas
Konuray, Ali Osman
Ranaboldo, Matteo

## PRIOR SKILLS

Basics of Electrical and Thermal Equipment

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**
CEMT-4. Efficiently collect data on renewable energy resources and their statistical treatment and apply knowledge and endpoint criteria in the design and evaluation of technology solutions for using renewable energy resources, for both isolated systems and those connected to networks. They will also be able to recognise and evaluate the newest technological applications in the use of renewable energy resources.
CEMT-3. Assess the economic, social and environmental impact of the production, use and management of energy, with a holistic view of the life cycle of the different systems, and recognise and value the most remarkable developments in the fields of energy efficiency and the rational use of energy.
CEMT-5. Employ technical and economic criteria to select the most appropriate thermal equipment for a given application, dimension thermal equipment and facilities, and recognise and evaluate the newest technological applications in the production, transportation, distribution, storage and use of thermal energy.

## TEACHING METHODOLOGY

During the development of the course will be used the following teaching methods:

-Lecture or conference (EXP): exhibition of knowledge by teachers through lectures by guest speakers.
-Participatory classes (PART): collective resolution of exercises, conducting debates and group dynamics with the teacher and other students in the classroom; presentation of a classroom activity performed individually or in small groups.
-Work conducted theoretical and practical (TD): completion of a classroom activity or exercise theoretical or practical, individually or in small groups, with the advice of the teacher.
-Project, with reduced work scope (PR): learning based on the conducting individual or group to work reduced complexity or length, applying knowledge and presenting results.
-Project with large work scope (PA): based learning design, planning and implementation of a project or group work full complexity or length, applying and expanding knowledge and writing a report poured This approach and the results and conclusions.
-Evaluation Activities (EV).

## LEARNING OBJECTIVES OF THE SUBJECT

Understand the main technologies and methodologies for energy efficiency in industrial energy systems
- Understand the main energy technologies, both electrical and thermal
- Understand demand side management as an energy efficiency solution
- Understand energy efficiency methodologies
- Gain knowledge of optimisation for efficiency problems
- Understand and solve specific engineering problems

## STUDY LOAD

| Type | Hours | Percentage |
|---|---|---|
| Hours small group | 13,5 | 11.20 |
| Hours large group | 27,0 | 22.41 |
| Self study | 80,0 | 66.39 |

**Total learning time:** 120.5 h

## CONTENTS

### Introduction to energy efficiency

**Description:**
Introduction to energy efficiency: Understand the importance of energy technologies, climate change and the impact of efficiency measures in a global and European context. Gain insights into maximising energy efficiency for a sustainable future. Role of industry in the energy efficiency.

**Full-or-part-time:** 8h
Theory classes: 2h
Practical classes: 1h
Self study : 5h

### Energy Flow in Industries and Demand Side Management

**Description:**
The module introduces the flow of energy within industries, factories and facilities.
Students will explore demand-side flexibility (DSF), which includes strategies such as energy efficiency and demand response (DR) programmes. Industrial Demand Response (IDR) is particularly promising in leveraging DSF as it allows industries to optimise their manufacturing processes, taking into account energy consumption and costs, to participate in DR programmes. Students will gain an insight into the scheduling and optimisation techniques that can be used for energy efficient operation of industries.

**Full-or-part-time:** 43h
Theory classes: 12h
Laboratory classes: 6h
Self study : 25h

**Energy efficiency technologies**

**Description:**
Several energy efficiency technologies will be presented:
- Lighting for industrial applications.
- Motor efficiency
- Drive efficiency
- Electric heating technology
The student learns to evaluate the economic feasibility of the solutions.

**Full-or-part-time:** 33h
Theory classes: 6h
Practical classes: 2h
Self study : 25h

**Thermal efficiency**

**Description:**
Introduction
Exergy balance
Cycles and machines

**Full-or-part-time:** 41h
Theory classes: 10h
Laboratory classes: 6h
Self study : 25h

## GRADING SYSTEM

In order to be able to have an evaluation of the subject, it is a necessary condition to have attended, carried out and delivered the reports of all the laboratory sessions and of the study case. In case this necessary condition is not met, the grade will be NP (Not Presented). If the necessary condition is met, then the calculation will be as follows:

The final grade is calculated by the weighted sum of the following parts:
–SC: Study Case Report and Presentation: 25%
–PCDR: Practical Case Demand Response: 10%
–RTL: Report Thermal Lab: 10%
–RPP: Power plant analysis: 5%
–FET: Final Exam Thermal: 15%
–FEE: Final Exam Electric: 35%

## EXAMINATION RULES.

Individual evaluation of the theory content by tests, problem-based learning, production of reports, presentations

## BIBLIOGRAPHY

**Basic:**
- Thollander, Patrik ; Jenny Palm. Improving energy efficiency in industrial energy systems [on line]. London: Springer, 2013 [Consultation: 06/10/2016]. Available on: http://dx.doi.org/10.1007/978-1-4471-4162-4. ISBN 1283622033.
- Sumper, A.; Baggini, A. Electrical energy efficiency : technologies and applications [on line]. United Kingdom: John Wiley & Sons, 2012 [Consultation: 24/03/2023]. Available on: https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/book/10.1002/9781119990048. ISBN 9780470975510.