Course guide
820774 - ESEP - Efficiency in Power Systems

Last modified: 08/04/2026

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

Degree: MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2022). (Optional subject).

Academic year: 2026 **ECTS Credits:** 5.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Sumper, Andreas

Others: Roberto Villafáfila Robles
F. Javier Heredia Cervera
Andreas Sumper

PRIOR SKILLS

Knowledge of power systems and linear programming.

REQUIREMENTS

Have taken the specilality courses of the subject Energy economy and markets, and the compulsory course Energy markets.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMT-8. Understand, describe and analyse, in a clear and comprehensive manner, the functioning of energy markets and carry out the optimum procurement of energy supplies
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-2. Identify and describe the components of electrical systems (production, transportation, distribution, markets, procurement and consumption) and evaluate the technological solutions used in the production of electricity.
CEMT-9. Undertake projects related to energy management in production and service sectors, recognise and value advances and developments in the field and contribute innovative ideas.

TEACHING METHODOLOGY

- In-person class:
Lectures (CM): 20 h
Active lectures: 10 h
Theoretica-practical work (TD): 13 h
Evaluation activities (EV): 2 h
- No attendance:
Limited scope project/activity (PR): 15 h
Broad scope project/activity (PA): 25 h
Self-study (EA): 40 h

LEARNING OBJECTIVES OF THE SUBJECT

Know, understand and be able to apply the techniques and technologies in order to improve efficiency in power systems.

STUDY LOAD

Type	Hours	Percentage
Hours small group	30,0	24.00
Self study	85,0	68.00
Guided activities	10,0	8.00

Total learning time: 125 h

CONTENTS

Introduction

Description:
Review of power system components and power system equations. Introduction to energy efficiency in power systems.

Specific objectives:
Understand the different aspects that affect power system efficiency.

Full-or-part-time: 4h
Theory classes: 2h
Self study : 2h

Technologies

Description:
Technologies for improving energy efficiency.

Specific objectives:
Know the technologies.

Related activities:
Technologies

Full-or-part-time: 60h 30m
Theory classes: 14h
Guided activities: 7h 30m
Self study : 39h

Techniques

Description:
Modeling and optimization techniques. Linear and non-linear programming. Heuristics methods.

Specific objectives:
Know optimization techniques.

Related activities:
Techniques.

Full-or-part-time: 60h 30m
Theory classes: 14h
Guided activities: 7h 30m
Self study : 39h

ACTIVITIES

Technologies

Description:
Student will work in pairs in order to apply their knowledge on power system efficiency.

Specific objectives:
Analyze the improvement of efficiency in power systems and explain orally the analysis.

Material:
Lecture notes. Bibliography.

Delivery:
Writing report and presentation.

Full-or-part-time: 7h 30m
Guided activities: 7h 30m

Techniques

Description:
Individual activity in order to implement the optimization techniques described at lecture sessions.

Material:
Lecture notes. Bibliography. Optimization software.

Delivery:
Report.

Full-or-part-time: 7h 30m
Guided activities: 7h 30m

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

Writing exam (PE): 60%
Individual/group assignment (TR): 40%

EXAMINATION RULES.

The writing exam (PE) will deal with the issues described during the course. Any kind of supporting material is not allowed.
There will be one practical assignment (TR) that will be developed in groups. The assignment will be delivered in writing format and presented orally.

BIBLIOGRAPHY

Basic:

- Gómez Expósito, Antonio; Conejo, Antonio J.; Cañizares, Claudio. Electric energy systems : analysis and operation [on line]. 2nd ed. Boca Raton: CRC Press, 2020 [Consultation: 19/09/2025]. Available on: https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/edit/10.1201/9781315192246/electric-energy-systems-antonio-gomez-exposito-antonio-conejo-claudio-canizares. ISBN 9780367734275.
- Momoh, James A. Electric power system applications of optimization. 2a ed. Boca Raton, FL, [etc.]: CRC Press, cop. 2009. ISBN 9781420065862.