Course guide
820736 - ME - Energy Markets

Last modified: 08/04/2026

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.
715 - EIO - Department of Statistics and Operations Research.

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

Academic year: 2026 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Roberto Villafáfila Robles

Others: Carlos González de Miguel
Fco. Javier Heredia Cervera

PRIOR SKILLS

Background on energy systems and their operation, economy and linear programming.

REQUIREMENTS

To have done Energy resources and The power grid courses.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEEN8. (ENG) Entendre, descriure i analitzar de forma clara i amplia el funcionament dels mercats energètics i portar a terme la contractació de subministres energètics de forma optimitzada.
CEEN9. (ENG) Dur a terme projectes relacionats amb la gestió de l'energia en diferents sectors productius i de serveis, reconeixent i valors els avenços i novetats en aquest camp i aportant idees novedosas.

Generical:
CGEN05. (ENG) Tenir capacitat de lideratge i esprit emprenedor necessari per a assumir la direcció tècnica i de gestió en organitzacions públiques i privades del sector energètic.

Transversal:
CT1a. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Basic:
CB 8. (ENG) Que els estudiants siguin capaços de d'integrar coneixements i enfrentar-se a la complexitat de formular judicis a partir d'una informació que, essent incompleta o limitada, inclogui reflexions sobre les responsabilitats socials i ètiques vinculades a l'aplicació del seus conexicements i judicis.
CB 9. (ENG) Que els estudiants sàpiguen comunicar les seves conclusions i coneixements (i darrers raonaments que els sostentin), a públics especialitzats i no especialitzats de manera clara i sense ambigüitats.

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 existing concepts in the field of energy markets.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	24.00
Self study	80,0	64.00
Hours small group	15,0	12.00

Total learning time: 125 h

CONTENTS

T1. Energy markets structure

Description:
Introduction to energy markets. Stakeholders and rules of different energy markets. Trading.

Specific objectives:
Understand the energy markets in within the socio-techno-economic frame, their particularities depending on the type of energy, and the different options of trading.

Related activities:
Electricity market analysis.

Full-or-part-time: 62h 30m
Theory classes: 14h
Guided activities: 8h 30m
Self study : 40h

T2. Optimal operation in energy markets

Description:
Mathematical models and optimization techniques applied to operation issues problems in energy markets.

Specific objectives:
Knowing the different optimization problems of the stakeholders and operators of energy markets and be able to model and solve computationally.

Related activities:
Optimal operation of electricity market.

Full-or-part-time: 62h 30m
Theory classes: 16h
Guided activities: 6h 30m
Self study : 40h

ACTIVITIES

T1. Energy market analysis

Description:
Activity to be developed in groups to improve the background about the performance of energy markets.

Specific objectives:
Analyze rules, estructures and characteristics for a indivudual energy market.

Material:
Lectures notes, bibliography.

Delivery:
Report dealing with topic proposed.

Full-or-part-time: 8h 30m
Guided activities: 8h 30m

T2. Optimal operation in energy markets

Description:
Individual activity to implement the models and optimization techniques applied in the operation of energy markets presented in the theoretical sessions.

Specific objectives:
Be able to solve with mathematical optimization software energy markets operation problems based on real data.

Delivery:
Lecture notes. Mathematical optimization software. Bibliography.

Full-or-part-time: 6h 30m
Guided activities: 6h 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**.

Final writing exam (PE): 60%
Individual/group assignment (TR): 40%
In order to apply this marking system, a minimum mark of 4 must be obtained in both parts of the final written test.
If this minimum marks is not achieved in the final written exam, the weight of the assignment is reduced to 20%, i.e. 10% T1 and 10% T2, and the written exam becomes 80%, i.e. 40 % T1 and 40% T2.

EXAMINATION RULES.

The writing exam (PE) will deal with the issues described during the course. Any kind of supporting material is not allowed unless otherwise indicated.
There will be two practical assignments (TR) that will be developed in groups. The assignments will be delivered in writing format.
All parts of the written exam must be completed as well as all the assignments in order to be evaluated, and also, be able to attend retaken exam.

BIBLIOGRAPHY

Basic:

- Kirschen, Daniel Sadi ; Goran Strbac. Fundamentals of power system economics [on line]. 2nd ed. Chichester [etc.]: John Wiley & Sons, 2019 [Consultation: 21/10/2025]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/reader.action?docID=5446642&c=RVBVQg. ISBN 9781119309888.
- Gómez Expósito, Antonio; Conejo, Antonio J.; Cañizares, Claudio. Electric energy systems : analysis and operation [on line]. 2n 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.

Complementary:

- Nocedal, J.; Wright, S. J. Numerical optimization [on line]. 2nd ed. Berlin: Springer, cop. 2006 [Consultation: 30/06/2025]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-0-387-40065-5. ISBN 0387303030.
- Zhu, Jizhong. Optimization of power system operation [on line]. New Jersey: Wiley-IEEE, 2015 [Consultation: 02/07/2025]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=456286. ISBN 9781118993361.