Course guide
295323 - 295SE013 - Advanced Electronic Conversion of Electrical Energy

Last modified: 07/07/2025

Unit in charge: Barcelona East School of Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: MASTER'S DEGREE IN TECHNOLOGIES FOR DISTRIBUTED ENERGY SYSTEMS (Syllabus 2025). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Martínez García, Herminio (Departamento de Ingeniería Electrónica).

Others: Martínez García, Herminio (Departamento de Ingeniería Electrónica).

PRIOR SKILLS

Please, see the Spanish version of the syllabus.

REQUIREMENTS

Please, see the Spanish version of the syllabus.

LEARNING RESULTS

Knowledges:
K1. Identify renewable resources as sources of electrical energy.
K2. Identify the structural and functional particularities and applicable regulations of decentralised electrical systems.
K3. Recognise and compare the electronic subsystems used in processing and managing electrical energy in distributed electrical systems.

Skills:
S1. Analyse, design and evaluate the reliability and life cycle of decentralised electrical systems based on renewable energy sources. Assess the reliability and life cycle of a distributed system for energy generation from renewable resources.
S3. Assess the impact and needs of new electricity consumption models and relate them to the change in energy model resulting from the decarbonisation of energy sources.
S2. Analyse the electronic subsystems required in a renewable energy plant and evaluate automation and control technologies for energy management of smart electrical grids and microgrids in a decentralised energy system.

Competences:
C4. Apply the knowledge acquired and appropriate methodologies to analysis and design in the field of decentralised electrical systems with renewable sources.
C2. Identify and analyse problems that require making autonomous, informed and reasoned decisions in order to act with social responsibility following ethical values and principles.

TEACHING METHODOLOGY

Two theory classes per week with a total of 4.0 h/week, which encompass matter of theory, problems, and laboratory classes.

Additionally, throughout the semester, different classes will be held (schedule will be announced at the beginning of term) with the whole group or part thereof in order to explain, develop and assess cross (generic) competences assigned to the subject.

The course uses:

- Lecture methodology by 40%.
- Individual work by 30% .
- Work in groups by 30 %.

The student will develop, in groups of, at most, 2 students, a project of the course design, simulation, and/or implementation related to the content of the course.

LEARNING OBJECTIVES OF THE SUBJECT

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STUDY LOAD

Type	Hours	Percentage
Hours large group	28,0	18.67
Self study	94,0	62.67
Hours small group	28,0	18.67

Total learning time: 150 h

CONTENTS

1.- Power Electronics Introduction in the Context of the Distributed Energy Systems.

Description:
Please, see the Spanish version of the syllabus.

Full-or-part-time: 12h
Theory classes: 2h
Self study : 10h

2.- Review of DC/DC Conversion in the Context of the Distributed and Renewable Energy Systems: Chopper Circuits.

Description:
Please, see the Spanish version of the syllabus.

Full-or-part-time: 14h
Theory classes: 4h
Self study : 10h

3.- Switching-Mode Power Supply Systems.

Description:
Please, see the Spanish version of the syllabus.

Full-or-part-time: 18h
Theory classes: 5h
Laboratory classes: 3h
Self study : 10h

4.- Control of DC/DC Converters and Swicthing-Mode Power Sypply Systems.

Description:
Please, see the Spanish version of the syllabus.

Full-or-part-time: 24h
Theory classes: 10h
Laboratory classes: 4h
Self study : 10h

5.- DC/AC Conversion in the Context of the Distributed and Renewable Energy Systems: Inverter Circuits.

Description:
Please, see the Spanish version of the syllabus.

Full-or-part-time: 17h
Theory classes: 5h
Laboratory classes: 2h
Self study : 10h

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Description:
Please, see the Spanish version of the syllabus.

Full-or-part-time: 15h
Theory classes: 3h
Laboratory classes: 2h
Self study : 10h

7.- Resonant Power Converters.

Description:
Please, see the Spanish version of the syllabus.

Full-or-part-time: 16h
Theory classes: 6h
Self study : 10h

8.- Integration of Electrical Energy Conversion Subsystems in Distributed and Renewable Energy Systems, and Emerging Trends in Electrical Energy Processing.

Description:
Please, see the Spanish version of the syllabus.

Full-or-part-time: 34h
Theory classes: 10h
Laboratory classes: 4h
Self study : 20h

GRADING SYSTEM

The grade or scoring of the course will be carried out according to:

- Midterm exams: 20 %.
- Final exam: 40 %.
- Course project (project to design, simulate, and implement power electronic systems): 20 %.
- Laboratory activities and tests: 20 %.

All these tasks will also serve to assess the cross (generic) competences assigned to the course.

This course does not have re-assessment test ("prova de reavaluació").

EXAMINATION RULES.

The implementation of the different tests consists of:

- Midterm exams: written tests, theoretical or sizing problems of solar energy testing, and analysis and/or synthesis (design) of power electronic systems.
- Final exam: written, theoretical and/or sizing problems of solar energy test, and analysis and synthesis (design) of power electronic systems.
- Course project: The course project will involve conducting course design work, sizing and/or simulation related to the contents of the subject.
- Activities, testing and laboratory experiments: Laboratory experiences and activities on Electronics Engineering.

Thanks to all these tasks, the cross (generic) competences assigned to the course will be also evaluated.

BIBLIOGRAPHY

Basic:
- Erickson, Robert W.; Maksimovic, Dragan. Fundamentals of power electronics [on line]. 3rd ed. Cham: Springer, 2020 [Consultation: 12/09/2025]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-030-43881-4. ISBN 3030438813.

Complementary:
- Mohan, Ned; Undeland, Tore M.; Robbins, William P. Power electronics : converters, applications , and design. 3rd ed. New York [etc.]: John Wiley & Sons Inc., cop. 2003. ISBN 9780471226932.