Course guide
820756 - ELA - Advanced Electrotechnics

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 2013). (Optional subject).

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

LECTURER

Coordinating lecturer: Prieto Araujo, Eduardo

Others: Prieto Araujo, Eduardo
Gomis Bellmunt, Oriol

PRIOR SKILLS

Previous knowledge in Circuit Theory and Electrical Engineering

REQUIREMENTS

No prerequisites

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
CT4. 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.

TEACHING METHODOLOGY

The course development includes the following teaching methods:
- Master class (EXP): theory exposition and Slides-based lecturing.
- Oriented individual works (TD): individual works of reduced complexity or extensión. The acquired knowledge will be applied in these works, and the results will be presented. Their ellaboration will start in the classroom (with the teacher guidance) and will end out of the classroom.
- Evaluation activities (EV). Some problems will be proposed as assignement.
In parallel, the students will have to follow the non-contact part of the course (readings and exercises).
During the semester the students will work, in teams of 3 or 4 people, on a tutored project about a specific energy topic, and will write a technical report (or a general scope article, depending on the subject) on that topic, that will defend before their tutor.

LEARNING OBJECTIVES OF THE SUBJECT

Provide students advanced tools and techniques in the field of electrical engineering.

STUDY LOAD

Type	Hours	Percentage
Laboratory classes	30,0	23.08
Self study	85,0	65.38
Guided activities	15,0	11.54

Total learning time: 130 h

CONTENTS

Transient analisys of electrical circuits

Description:
This content will provide students the necessary tools to work with circuit differential equations

Specific objectives:
- State space equations of electrical circuits.
- Transfer functions of electrical cirtuits.

Related activities:
A1.- Simulation with Simulink of the transient response of a power converter

Full-or-part-time: 44h
Laboratory classes: 9h
Guided activities: 5h
Self study : 30h

Instantaneous power theory

Description:
This content is to provide students an overview of the Instantaneous Power Theory and its applications.

Full-or-part-time: 33h
Laboratory classes: 8h
Guided activities: 5h
Self study : 20h

Converter control (PLL, current control, reference calculation): balanced and unbalanced systems.

Description:
This content will provide students the essential knowledge to analize balanced and unbalanced systems, focused on power converters application, including their control (PLL, current loop, reference calculation)

Specific objectives:
- PLL (Phase locked loop)
- Current loop
- Reference calculation
- Unbalanced system

Related activities:
A2. Simulink simulation of a converter connected to a balanced system
A3. Simulink simulation of a converter connected to a balanced system

Full-or-part-time: 33h
Laboratory classes: 8h
Guided activities: 5h
Self study : 20h

Matrix transforms: Park' Transform

Description:
This content will introduce the main matrix transformations and they will be applied to an specific case: network and converter modelling.

Related activities:
A4. Simulink modelization of a three-phase grid.

Full-or-part-time: 15h
Laboratory classes: 5h
Self study : 10h

ACTIVITIES

A1.- Simulation with Simulink of the transient response of a power converter

Full-or-part-time: 7h
Laboratory classes: 2h
Guided activities: 5h

A2. Simulink simulation of a power converter connected to a balanced system

Full-or-part-time: 9h 30m
Laboratory classes: 2h
Guided activities: 5h
Self study: 2h 30m

A3. Simulink simulation of a power converter connected to an unbalanced system

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

A4. Simulink modelization of a three-phase grid.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

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**.

Written test (final exam) (PE): 50 %
Oriented individual works (TD): 40 %
Oral presentations (PO): 10%

BIBLIOGRAPHY

Basic:
- Novotny, D. W; Lipo, T. A. Vector control and dynamics of AC drives. New York: Clarendon Press, 1996. ISBN 0198564392.
- Chua, Leon O; Desoer, Charles A; Kuh, Ernest S. Linear and nonlinear circuits. New York [etc.]: McGraw-Hill, cop. 1987. ISBN 9780070108981.

Complementary:
- Trzynadlowski, Andrzej M. Control of induction motors [on line]. San Diego, CA [etc.]: Academic Press, cop. 2001 [Consultation: 01/10/2026]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/monograph/9780127015101/control-of-induction-motors. ISBN 0127015108.