Course guide
820751 - AEER - Electric Drives with High Efficiency and Low Environmental Impact

Last modified: 08/04/2026

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

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

LECTURER

Coordinating lecturer: Andrada Gascon, Pedro

Others: Perat Benavides, Jose Ignacio
Torrent Burgues, Marcel
Blanqué Molina, Balduino

PRIOR SKILLS

Basic knowledge of machines and electrical drives.

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

STUDY LOAD

Type	Hours	Percentage
Laboratory classes	30,0	24.00
Guided activities	10,0	8.00
Self study	85,0	68.00

Total learning time: 125 h

CONTENTS

1.- Electric drives.

Description:
1.1. Definition and design of electric drives.
1.2. Types of electric drives.
1.3. Applications as power range.

Specific objectives:
Describe the different parts of the electric drives. Know their uses in different power ranges.

Related activities:
Classes of problems in the classroom

Full-or-part-time: 8h
Theory classes: 2h
Guided activities: 1h
Self study : 5h

2.- Efficiency, environmental and economic considerations in electric drives

Description:
2.1. Evaluation of losses. Performance.
2.2. Performance improvement opportunities.
2.3. Variable speed and energy saving.
2.4. Environmental considerations. Life cycle assessment (LCA)
2.5. Methodologies of LCA: MEEUP (Methodology for the Eco-Design of Energy Using Products).
2.6. European Directive (EuP 2005/32/EC).
2.7. Economic considerations (Payback, VAN, TIR).

Specific objectives:
Identify the different parameters of energy-saving electric motors and drives.
Explain losses in the motors and electric drives.
Apply a methodology for calculating the energy, environmental and economic evaluation of motors and electric drives.

Related activities:
Class of problems in the classroom
Practical application of the MEEUP methodology on an electric drive.

Full-or-part-time: 14h
Theory classes: 4h
Guided activities: 2h
Self study : 8h

3.- Three-phase induction motor drives

Description:
3.1. Phase induction motors. Analysis of losses.
3.2. Energy efficiency classes.
3.3. Determination of performance. Essays. International Standards (IEC 60034-2, IEEE Std. 112).
3.4. Drives with three-phase induction motors, strategies to improve performance.
3.5. Drives with induction motors, optimal control of energy.

Specific objectives:
Study and show the potential of the drives with three-phase induction motors and high-performance drives.

Related activities:
Class of problems in the classroom.

Full-or-part-time: 14h
Theory classes: 6h
Guided activities: 7h
Self study : 1h

4.- Permanent magnet synchronous motor drives

Description:
4.1. Overview of permanent magnets.
4.2. Synchronous drives with permanent magnets. Classification.
4.3. Synchronous motors of reluctance.
4.4. Continuous current motors, brushless (Brushless D.C. motors)

Specific objectives:
Study and show the potential of the different types of drives with synchronous motors and high-performance drives.

Related activities:
Class of problems in the classroom.

Full-or-part-time: 20h
Theory classes: 8h
Guided activities: 10h
Self study : 2h

5.- Switched reluctance motor drives

Description:
5.1. Constitution and operation principles.
5.2. Reluctant magnetic structure, power electronic converter and position sensors.
5.3. Modelling and control.
5.4. Simulation of auto switched reluctance drives.

Specific objectives:
Study and show the potential of drives with auto switch reluctance motors as drives for high performance.

Related activities:
Class of guided problems in the classroom
Two practices of modelling and simulation of auto switch reluctance drives

Full-or-part-time: 14h
Theory classes: 4h
Guided activities: 2h
Self study : 8h

ACTIVITIES

Assignments

Description:
An individual or group work on some aspect of performance improvement or environmental impact of a specific drive will be performed. The work is to be submitted in class.

Specific objectives:
Deepening of any of the topics of the course.
Teamwork.
Improving oral and written expression.
Solvent use of information.

Full-or-part-time: 45h
Self study: 45h

Practices

Description:
Practice I. Application of MEEUP methodology to a case of an electric drive.
Practice II. Simulation of auto switch reluctance drives I.
Practice III. Simulation of auto switch reluctance drives II.

Full-or-part-time: 10h
Guided activities: 6h
Self study: 4h

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**.

Attendance : 5%
First exam: 20%
Pratices: 15%
Assignments: 20%
Second exam: 40%

EXAMINATION RULES.

The exams will be written tests (without notes) and in person
The works will have to be defended in class.
After each practice, a written report will have to be submitted.

BIBLIOGRAPHY

Basic:
- Hanselman, Duane C. Brushless permanent magnet motor design. 2nd ed. Cranston: The Writer's Collective, cop. 2003. ISBN 1932133631.
- Krishnan, Ramu. Switched reluctance motor drives : modeling, simulation, analysis, design, and applications. Boca Raton [etc.]: CRC Press, cop. 2001. ISBN 0849308380.
- Boldea, Ion ; S.A. Nasar. Electric drives. 3a ed. Boca Raton: CRC Press, 2017. ISBN 9781498748209.