Course guide
230677 - EMD - Electric Motor Drives

Last modified: 13/05/2015

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

Degree: **Academic year:** 2015 **ECTS Credits:** 5.0
Languages: English

LECTURER

Coordinating lecturer: Arias Pujol, Antoni

Others: JOSEP BORDONAU FARRERONS
Busquets Monge, Sergio
Pou Felix, Josep

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEE1. Ability to understand and apply the principles of operation of power electronic systems in regulation, undulation and amplification applications.
CEE4. Ability to design continuous and discrete time controllers for power electronic systems.

Transversal:
1. 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.

2. 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.

TEACHING METHODOLOGY

- Lectures
- Laboratory practical work
- Individual work (distance)
- Oral presentations
- Short answer test (Test)

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:

The aim of the course is to convey to the student a general picture of the state of the art in alternating current energy conversion technology and a fundamental understanding of the design and control of the associated power converters. Special emphasis will be given to popular applications such as renewable energy systems, electric vehicles, and industrial motor drives.

Learning results of the subject:

- Knowledge of the semiconductor devices and advanced topologies used in alternating current power converters.
- Knowledge of the typical applications of these power converters.
- Knowledge of the modulation techniques for these power converters.
- Ability to design controllers for these converters in motor drives and grid-connected applications.
- Ability to model the conversion system to run numerical simulations and evaluate the system performance.
- Ability to develop techniques for the design, analysis and evaluation of electronic systems in applications such as automation, aerospace, energy distribution and generation, consumer electronics, biomedicine, etc.
- Ability to analyze, design and evaluate electronic systems for power control and energy conversion.

STUDY LOAD

Type	Hours	Percentage
Hours large group	26,0	20.80
Hours small group	13,0	10.40
Self study	86,0	68.80

Total learning time: 125 h

CONTENTS

1. Introduction.

Description:
Presentation of the course motivation, objectives, scope, and organization.

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

2. Power Semiconductor Switching Devices.

Description:
Presentation of the different power semiconductor switching devices used in ac power converters and their characteristics.

Full-or-part-time: 10h
Theory classes: 2h
Guided activities: 5h
Self study : 3h

3. Topologies.

Description:
Sinthesis of the different power converter topological structures from a general structure.

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

4. Modulation Techniques for Single-Phase Dc-Ac Converters.

Description:
Presentation and analysis of the main modulation techniques for single-phase dc-ac converters.

Full-or-part-time: 12h
Theory classes: 3h
Guided activities: 5h
Self study : 4h

5. Modulation Techniques for Three-Phase Dc-Ac Converters.

Description:
Presentation and analysis of the main modulation techniques for three-phase dc-ac converters.

Full-or-part-time: 15h
Theory classes: 4h
Laboratory classes: 1h
Guided activities: 5h
Self study : 5h

6. Modeling of Three-Phase Converters.

Description:
Derivation of the switching, average, and linear models of systems including three-phase converters. Use of these models.

Full-or-part-time: 13h
Theory classes: 3h
Laboratory classes: 1h
Guided activities: 5h
Self study : 4h

7. Control of Three-Phase Converters.

Description:
Design of conventional controllers for systems including three-phase converters.

Full-or-part-time: 9h
Theory classes: 1h
Laboratory classes: 1h
Guided activities: 5h
Self study : 2h

8. Multilevel Converters and Applications.

Description:
Presentation of the main multilevel converter families and their applications.

Full-or-part-time: 19h
Theory classes: 5h
Laboratory classes: 3h
Guided activities: 5h
Self study : 6h

9. Matrix Converters and Applications.

Description:
- Topologies.
- Features.
- Modulation strategies.
- Control Strategies.
- Applications.

Full-or-part-time: 20h
Theory classes: 4h
Laboratory classes: 6h
Guided activities: 5h
Self study : 5h

10. Review, Discussion, and Advanced Topics.

Description:
Review of the course contents to engage the students in a discussion with the professor about the topics covered, and presentation of the current research trends in ac energy conversion.

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 1h
Guided activities: 5h
Self study : 3h

GRADING SYSTEM

Test: 40%
Individual assessments: 30%
Laboratory assessments: 30%

BIBLIOGRAPHY

Basic:
- Mohan, N.; Undeland, T.M.; Robbins, P.W. Power electronics: converters, applications, and design. 3rd ed. New York: John Wiley and Sons, 2003. ISBN 0471226939.
- Rashid, M.H. Power electronics: circuits, devices, and applications. 3rd ed. Upper Saddle River, NJ: Pearson/Prentice Hall, 2004. ISBN 0131011405.
- Kazmierkowski, M.P.; Krishnan, R.; Blaabjerg, F. (eds.). Control in power electronics: selected problems [on line]. Amsterdam: Academic Press, 2002 [Consultation: 16/07/2013]. Available on: http://www.sciencedirect.com/science/book/9780124027725. ISBN 0124027725.
- Erickson, R.W.; Maksimovic, D. Fundamentals of power electronics [on line]. 2nd ed. Dordrecht: Kluwer Academic Publishers, 2001 [Consultation: 11/02/2015]. Available on: http://link.springer.com/book/10.1007/b100747/page/1. ISBN 0792372700.

Complementary:
- Holmes, D.G.; Lipo, T.A. Pulse width modulation for power converters: principles and practice. Hoboken, NJ: John Wiley, 2003. ISBN 0471208140.

RESOURCES

Other resources:
Papers published in the IEEE Transactions on Power Electronics, IEEE Transactions on Industrial Electronics, IEEE Transactions on Industry Applications, and analogous journals.