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340100 - ELPO-E5O10 - Power Electronics

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering

Teaching unit: 710 - EEL - Department of Electronic Engineering

Academic year: 2018

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: English

Teaching staff

Coordinator: Miguel Castilla Fernández

Others: Miguel Castilla Fernández

Degree competences to which the subject contributes

Specific:

1. CE25. Applied knowledge to power electronics.

Transversal:

2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
3. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
4. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.
5. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology

The course includes theory classes, which are oriented to introduce the initial knowledge, and exercises and laboratory classes, which are oriented to the application of the basic knowledge. The self study is guided by exercises and problems.

Learning objectives of the subject

The course is oriented to the study of power electronics devices, the analysis and design of power electronics circuits, and the description of the main industrial applications. The objectives include: 1) to know the principles of power electronics, 2) to classify the different kind of power electronics circuits as a function of the input source and loads, 3) to analyze the basic power electronics converters, 3) to design the control circuits that command the basic power electronics converters.

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Study load

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	0h	0.00%
	Hours small group:	30h	20.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

1. Introduction to Power Electronics

Learning time: 11h

Theory classes: 3h
Self study : 8h

Description:
To present the basic principles of Power Electronics

Related activities:
Features of a power converter.
Classification of power converters.
Industrial applications of power converters.

Specific objectives:
To understand the features and diferences between a signal processor circuit and a power processor circuit.
To define the types of power conversion according to the nature of input energy sources and output loads.
To identify the current and future industrial applications of power electronics converters.

2. Power Electronics Devices

Learning time: 20h

Theory classes: 6h
Self study : 14h

Description:
To present the features of the most significant power electronics devices.

Related activities:
Passive components.
Semiconductor devices.
Activation and protection circuits.

Specific objectives:
To understand the features of passive components and semiconductor devices.
To define the static parameters and the switching behaviour of power devices.
To understand the operation of activation and proteccion circuits for power devices.

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3. Rectifier Circuits

Learning time: 29h

Theory classes: 5h
Practical classes: 4h
Laboratory classes: 4h
Guided activities: 2h
Self study : 14h

Description:
To present the basic configurations of rectifier circuits (single-phase, three-phase, circuits with diodes thyristors).
To analyze the properties of the circuits.

Related activities:
Exercices to analyze and design rectifier circuits.
Lab exercise. Measures and experimental verification. Report with the results and discussion.

Specific objectives:
To understand the operation principle of the rectifier circuits.
To learn techniques to analyze rectifier circuits.
To understand the driving circuits of the controlled rectifiers

4. Voltage Regulators

Learning time: 36h

Theory classes: 6h
Practical classes: 4h
Laboratory classes: 4h
Guided activities: 2h
Self study : 20h

Description:
To present the basic configurations of dc-dc switching regulators.
To introduce the basic tools to analyze dc-dc switching regulators in steady-state.

Related activities:
Exercices to analyze and design voltage regulators.
Lab exercise. Measures and experimental verification. Report with the results and discussion.

Specific objectives:
To idenfity the configurations of dc-dc switching regulators.
To learn on techniques to analyze dc-dc- switching regulators in steady-state
To learn on programming tools to evaluate the dynamic performance of these converters
To lean how to design the control circuits

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5. Power Inverters

Learning time: 32h

Theory classes: 6h
Practical classes: 4h
Laboratory classes: 4h
Guided activities: 2h
Self study : 16h

Description:
To present the principle of operation of single-phase and three-phase power inverters and their associated modulation techniques. To analyze the properties of these circuits. To introduce the main applications of the power inverters.

Related activities:
Exercices to analyze and design power inverters.
Lab exercise. Measures and experimental verification. Report with the results and discussion.

Specific objectives:
To learn how to analyze and design power inverters.
To know how to reduce the harmonic content in voltage and current waveforms.
To learn on the techniques to derive dynamic models.

6. AC/AC Power Circuits

Learning time: 22h

Theory classes: 4h
Practical classes: 3h
Laboratory classes: 3h
Self study : 12h

Description:
To present the basic configurations and applications of the AC/AC converters.

Related activities:
Exercices to analyze and design AC/AC converters.
Lab exercise. Measures and experimental verification. Report with the results and discussion.

Specific objectives:
To know the analysis and design techniques for AC regulators, DC coupling converters, and cyclo-converters.
To know the properties of basic AC/AC circuits by experimental tests

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Qualification system

The course is evaluated according to the following items:
* Individual written exams (EXAM).
* Laboratory classes (LAB).
* Achievement of generical and specific skills (SKIL).

La final mark (FM) is obtained using the following equation:
FM=0.6*EXAM+0.3*LAB+0.1*SKIL

The mark EXAM will be re-evaluable if NFIN is higher or equal to 3. In case of re-evaluation, the maximum value of NFIN will be 5.

Regulations for carrying out activities

None

Bibliography

Basic:

Kassakian, John G.; Schlecht, Martin F.; Verghese, George C. Principles of power electronics. Reading: Addison-Wesley, 1991. ISBN 0201096897.

Mohan, Ned; Undeland, Tore M.; Robbins, William P. Power electronics : converters, applications, and design. 2003. New York [etc.]: John Wiley & Sons, 2003. ISBN 0471226939.