Last update: 30-06-2017

230366 - IPE - Introduction to Power Electronics

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2017
Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 2,5 Teaching languages: Spanish, English

Teaching staff

Coordinator: Biel Sole, Domingo
Guinjoan Gispert, Francisco Juan

Others: Biel Sole, Domingo
Guinjoan Gispert, Francisco Juan

Requirements

Basic knowledge on linear circuits and systems as well as on electronic devices.

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.
CEE24. Ability to identify and evaluate innovative ideas and products in the area of electronic technology.

CEE12. Ability to use semiconductor devices taking into account their physical characteristics and limitations.

CEE4. Ability to design continuous and discrete time controllers for power electronic systems.

Transversal:

CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
CT5. 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.
CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

Teaching methodology

Master class
Autonomous work
Problems based learning

Learning objectives of the subject

The course introduces the analysis and design techniques of power elevctronics circuits and their applications to the supply of electronic and electromechanical systems aa well as in renewable energy systems.

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Study load

Total learning time: 62h 30m	Hours large group:	20h	32.00%
	Self study:	42h 30m	68.00%

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Content

Power electronics: why and where?

Learning time: 4h 30m

Theory classes: 2h
Self study : 2h 30m

Description:
Objectives and application of power electronics

Related activities:
MAster class

Specific objectives:
Introduction to electricasl power processing. Definitions of energy, power and average power. The energy conversion chain:examples

Power processing circuits: objectives and circuit elements

Learning time: 10h

Theory classes: 2h
Self study : 8h

Description:
Objectives of a power processing system: .efficiency and control of power flow. Circuit elements.Electrical Interconnection Rules . Type of power conversion : DC-DC, DC-AC, AC-DC. Basic electronic circuits for power conversionPrinciple of operation.

Related activities:
Master class
Simulation lab exercise
Problems to solve.

Specific objectives:
Objectives description of a power processing system: efficiency and control of power flow. Introucing the Circuit elements and Electrical Interconnection Rules of these circuits. Present different types of power conversion : DC-DC, DC-AC, AC-DC. Basic electronic circuits for power conversion. BUck DC Dc converter Bridge inverter and rectifie. Principle of operation.

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DC-DC Conversion: steady-sate operation and components sizing	Learning time: 24h Theory classes: 8h Self study : 16h

Description:
Linear voltage regulators drawbacks. Elementary switching converters: buck, boost and buck-boost converters. Principle of operation in steady state. Electrical components and switching frequency sizing for steady-state compliance.

Related activities:
Master class
Simulation lab exercise
Problems to solve

Specific objectives:
Waveforms periodicity in steady-state: relationships of interest. Ripple. Components sizing: power transistors and diodes: conduction and switching losses, drivers, thermal aspects,. Reactive components.

Dynamic modeling and control of power converters	Learning time: 24h Theory classes: 16h Self study : 8h

Description:
Controlled sources switches modelling. PWM Modulators. Transfer functions deduction. Linear control design

Related activities:
Master class
Simulation lab exercise
Problems to solve

Specific objectives:
Controled, disturbances and control variables. Characterization of control variables. Models and averaged linearization.
Power Converter linerized model. Limitations. Linear controller design

Qualification system

30% Simulation exercices+30% proposed problems+40%Final exam

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Bibliography

Basic:

Erickson, R. W. Fundamentals of power electronics [on line]. 2nd. ed. Dordrecht: Kluwer Academic Publishers, 2001 [Consultation: 15/06/2017]. Available on: <http://link.springer.com/book/10.1007/b100747/page/1>. ISBN 0792372700.