Course guide
230739 - PCPE - Principles of Control and Power Electronics

Last modified: 25/05/2023

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

Degree: MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2022). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura

Others: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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
- Exercises
- Extended answer test (Final Exam)

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:
The aim of this course is to introduce the students in the methods used to analyze and design control systems, as well as in the fundamentals of power electronics circuits, focusing on the analysis, modelling and design of DC-DC power converters.
Learning results of the subject:
Understand and apply linear control theory in nonlinear and linear systems and know the operating principle of power converters. Synthesize, analyze and dynamically model energy processing circuits.

STUDY LOAD

Type	Hours	Percentage
Self study	86,0	68.80
Hours large group	39,0	31.20

Total learning time: 125 h

CONTENTS

Introduction to control systems

Description:
- Control goals in a feedback system
- Continuous-time control vs discrete-time control

Full-or-part-time: 4h
Theory classes: 2h
Self study : 2h

System's modelling

Description:
- State space models
- Linear systems. Time response and frequency response of LTI systems.
- Linearization of nonlinear systems
- Block diagram transformation

Full-or-part-time: 29h
Theory classes: 9h
Self study : 20h

Stability of control systems

Description:
- Internal and BIBO stability in LTI systems
- The Routh criterion
- Nyquist stability criterion
- Gain and phase margins

Full-or-part-time: 22h
Theory classes: 7h
Self study : 15h

Design of control systems

Description:
- Internal model principle
- Phase-lead compensator
- Phase-lag compensator
- PID controller

Full-or-part-time: 21h
Theory classes: 6h
Self study : 15h

Introduction to power electronics

Description:
- Power conversion chain
- Control requirements in power electronics

Full-or-part-time: 2h
Theory classes: 1h
Laboratory classes: 1h

Synthesis of power electronic circuits

Description:
- Connection rules. Examples with SPDT switches
- Switch implementation fundamentals
- Elemental switching DC-DC voltage converters

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

Steady-state analysis and sizing of DC-DC switching converters

Description:
- Fundamentals of steady-state analysis
- Design-oriented analysis of a boost converter
- Other switching converter topologies

Full-or-part-time: 20h
Theory classes: 6h
Self study : 14h

Converters dynamic modelling

Description:
- Converter modelling: state equations
- Bilinear switched model
- State-space averaged model
- Steady-state and transfer functions

Full-or-part-time: 20h
Theory classes: 6h
Self study : 14h

GRADING SYSTEM

Students are graded by delivering proposed exercises to be done at home and by a final exam. The final mark (FM) is given by the expression FM = 30% * D + 70% * FE, where D is the mark for the deliverables and FE is the mark obtained in the final exam.

BIBLIOGRAPHY

Basic:
- Erickson, R.W.; Maksimovic, D.. Fundamentals of power electronics [on line]. 3rd ed. Cham: Springer, 2020 [Consultation: 28/09/2022]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-030-43881-4. ISBN 9783030438814.
- Ogata, K. Modern control engineering. 5th ed. Boston: Pearson, 2010. ISBN 9780137133376.
- Åström, K.J.; Murray, R.M.. Feedback systems: an introduction for scientists and engineers. 2nd ed. Princeton ; Oxford: Princeton University Press, 2021. ISBN 9780691193984.

Complementary:
- Golnaraghi, F.; Kuo, B.C. Automatic control systems. 10th ed. New York: McGraw Hill Education, 2017. ISBN 9781259643835.
- Krein, P.T. Elements of power electronics. 2nd ed. New York: Oxford University Press, 2016. ISBN 9780199388424.