

Course guide

230641 - PCP - Power Control and Processing

Last modified: 11/05/2022

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

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

Academic year: 2022 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: DOMINGO BIEL, FRANCESC GUINJOAN

Others: ALBERTO POVEDA, EDUARD ALARCÓN

PRIOR SKILLS

Basic knowledge on linear control systems and power electronics

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. Ability to understand and apply the principles of operation of power electronic systems in regulation, undulation and amplification applications.
2. Ability to understand and apply the principles of operation of the current control method and its application to battery charging, supply for LED lighting, power factor correction, and "Low Power supplies"
3. Ability to apply state control techniques to the design of controllers for power electronic systems.
4. Ability to design continuous and discrete time controllers for power electronic systems.

Transversal:

5. 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.
6. 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
- Other activities

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:

The aim of this course is to introduce the students in several techniques of modelling, design and control of power processing systems for regulation, wide-band amplification and waveform generation in different applications.

Requisites: Students coming from academic studies other than B. Sc. Electronics Systems Engineering or equivalent ones, should have successfully passed the examinations of the bridging courses "Control" and "POT".

Learning results of the subject:

- Ability to derive state models of switching power converter circuits.
- Ability to design and verify the features, by numerical simulation, of state linear controllers for switching power converters in amplification, regulation and waveform generation applications.
- Ability to identify the design restrictions involved in the digital implementation of continuous time controllers for switching power converters.

STUDY LOAD

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

Total learning time: 125 h

CONTENTS

1. Introduction to power processing systems

Description:

- Circuit elements in high-efficiency power processors
- Power conversion types
- Switching power converters
- Functionalities and control requirements: regulation, amplification and waveform generation.

Full-or-part-time: 10h

Theory classes: 3h

Self study : 7h

2. Switching converters modelling

Description:

- State space description of dynamical systems
- Dynamical systems classification (linear and nonlinear systems, time-varying and time-invariant systems, SISO and MIMO systems)
- State-space models of switching power converters: nonlinear and linearized models.
- Steady-state behaviour. Equilibrium points.
- Linearized dynamical behaviour: transfer functions

Full-or-part-time: 25h

Theory classes: 7h

Self study : 18h

3. State-space linear control techniques in switching power converters

Description:

- Eigenvalues. Stability analysis.
- Output feedback.
- State feedback. Pole placement design through Ackermann's formula
- Discrete-time control: analysis and constraints. Implementation issues

Full-or-part-time: 44h

Theory classes: 14h

Self study : 30h

4. Control applications in power electronics

Description:

- Output feedback and state feedback in switching power regulators
- Control of grid-connected inverters
- Power factor correction and battery chargers.
- Wide-band amplifiers
- Current control for switching power regulators

Full-or-part-time: 46h

Theory classes: 15h

Self study : 31h

ACTIVITIES

LECTURES

EXERCISES

Description:

Exercises to strengthen the theoretical knowledge.

OTHER ACTIVITIES

Description:

Numerical simulation homework

EXTENDED ANSWER TEST (FINAL EXAM)

Description:

Final examination.

GRADING SYSTEM

Mid course exam (50%)

Final exam (50%)



BIBLIOGRAPHY

Basic:

- Åström, K.J.; Murray, R.M. Feedback systems: an introduction for scientists and engineers. Princeton: Princeton University Press, 2008. ISBN 9780691135762.
- 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:

- Golnaraghi, F.; Kuo, B.C. Automatic control systems. 10th ed. New York: McGraw Hill Education, 2017. ISBN 9781259643835.