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

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: 2022  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

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>39.0</td>
<td>31.20</td>
</tr>
<tr>
<td>Self study</td>
<td>86.0</td>
<td>68.80</td>
</tr>
</tbody>
</table>

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
<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Full-or-part-time</th>
<th>Theory classes</th>
<th>Laboratory classes</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design of control systems</strong></td>
<td>- Internal model principle</td>
<td>21h</td>
<td>6h</td>
<td></td>
<td>15h</td>
</tr>
<tr>
<td><strong>Introduction to power electronics</strong></td>
<td>- Power conversion chain</td>
<td>2h</td>
<td>1h</td>
<td>1h</td>
<td></td>
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<tr>
<td><strong>Synthesis of power electronic circuits</strong></td>
<td>- Connection rules. Examples with SPDT switches</td>
<td>7h</td>
<td>2h</td>
<td>5h</td>
<td></td>
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<tr>
<td><strong>Steady-state analysis and sizing of DC-DC switching converters</strong></td>
<td>- Fundamentals of steady-state analysis</td>
<td>20h</td>
<td>6h</td>
<td></td>
<td>14h</td>
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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 $FM = 30\% \times D + 70\% \times FE$, where D is the mark for the deliverables and FE is the mark obtained in the final exam.

BIBLIOGRAPHY

Basic:

Complementary: