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: 2019
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 electronics circuits and their applications to the supply of electronic and electromechanical systems as well as in renewable energy systems.
### Study load

<table>
<thead>
<tr>
<th><strong>Total learning time:</strong> 62h 30m</th>
<th>Hours large group:</th>
<th>20h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Self study:</td>
<td>42h 30m</td>
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<td></td>
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<td>68.00%</td>
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</tbody>
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- **Total learning time:** 62h 30m
- **Hours large group:** 20h (32.00%)
- **Self study:** 42h 30m (68.00%)
## Content

<table>
<thead>
<tr>
<th>Power electronics: why and where?</th>
<th>Learning time: 4h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> Objective and application of power electronics</td>
<td><strong>Theory classes:</strong> 2h</td>
</tr>
<tr>
<td><strong>Related activities:</strong> Master class</td>
<td><strong>Self study:</strong> 2h 30m</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong> Introduction to electric power processing. Definitions of energy, power and average power. The energy conversion chain: examples</td>
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<table>
<thead>
<tr>
<th>Power processing circuits: objectives and circuit elements</th>
<th>Learning time: 10h</th>
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<tbody>
<tr>
<td><strong>Description:</strong> 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 conversion. Principle of operation.</td>
<td><strong>Theory classes:</strong> 2h</td>
</tr>
<tr>
<td><strong>Related activities:</strong> Master class</td>
<td><strong>Self study:</strong> 8h</td>
</tr>
<tr>
<td>Simulation lab exercise</td>
<td>Problems to solve.</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong> Objectives description of a power processing system: efficiency and control of power flow. Introducing 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.</td>
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### DC-DC Conversion: steady-state operation and components sizing

**Learning time:** 24h  
Theory classes: 8h  
Self study: 16h

**Description:**  

**Related activities:**  
- Master class  
- Simulation lab exercise  
- Problems to solve

**Specific objectives:**  

### 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:**  
- Power Converter linearized model. Limitations. Linear controller design.

### Qualification system

- 30% Simulation exercises  
- 30% proposed problems  
- 40% Final exam
Bibliography

Basic: