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.
- CEE2. 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>Total learning time: 62h 30m</th>
<th>Hours large group:</th>
<th>20h</th>
<th>32.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study:</td>
<td>42h 30m</td>
<td></td>
<td>68.00%</td>
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</tbody>
</table>
## Content

### Power electronics: why and where?

<table>
<thead>
<tr>
<th>Description:</th>
<th>Objectives and application of power electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related activities:</td>
<td>Master class</td>
</tr>
<tr>
<td>Specific objectives:</td>
<td>Introduction to electrical power processing. Definitions of energy, power and average power. The energy conversion chain: examples</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>4h 30m</th>
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</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Self study:</td>
<td>2h 30m</td>
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</tbody>
</table>

### Power processing circuits: objectives and circuit elements

<table>
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<tbody>
<tr>
<td>Related activities:</td>
<td>Master class</td>
</tr>
<tr>
<td></td>
<td>Simulation lab exercise</td>
</tr>
<tr>
<td></td>
<td>Problems to solve.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>10h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Self study:</td>
<td>8h</td>
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</tbody>
</table>
### DC-DC Conversion: steady-sate operation and components sizing

**Description:**

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

**Specific objectives:**

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

### Dynamic modeling and control of power converters

**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:**
Controlled disturbances and control variables. Characterization of control variables. Models and averaged linearization. Power Converter linearized model. Limitations. Linear controller design

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

### Qualification system

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

Basic: