820756 - ELA - Advanced Electrical Engineering

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5  
Teaching languages: English

Teaching staff
Coordinator: Bergas Jane, Joan Gabriel
Others: Bergas Jane, Joan Gabriel

Opening hours
Timetable: Monday from 10:30 to 13:00
Monday from 19:00 to 21:00
Wednesday from 10:30 to 13:00

Prior skills
Previous knowledge in Circuit Theory and Electrical Engineering

Requirements
No prerequisites

Degree competences to which the subject contributes

Transversal:
CT4. 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.

Teaching methodology
The course development includes the following teaching methods:
- Master class (EXP): theory exposition and Slides-based lecturing.
- Oriented individual works (TD): individual works of reduced complexity or extensión. The acquired knowledge will be applied in these works, and the results will be presented. Their elaboration will start in the classroom (with the teacher guidance) and will end out of the classroom.
- Evaluation activities (EV). Some problems will be proposed as assignment.
In parallel, the students will have to follow the non-contact part of the course (readings and exercises).
During the semester the students will work, in teams of 3 or 4 people, on a tutored project about a specific energy topic, and will write a technical report (or a general scope article, depending on the subject) on that topic, that will defend before their tutor.

Learning objectives of the subject
To provide students with the advanced tools and techniques in the field of electrical engineering.
### Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time: 125h</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>30h</td>
<td>24.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>10h</td>
<td>8.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>85h</td>
<td>68.00%</td>
</tr>
</tbody>
</table>
## Content

### Transient analysis of electrical circuits.

<table>
<thead>
<tr>
<th>Learning time: 44h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory classes: 9h</td>
</tr>
<tr>
<td>Guided activities: 5h</td>
</tr>
<tr>
<td>Self study: 30h</td>
</tr>
</tbody>
</table>

**Description:**
This content is to give students with the necessary tools for the obtantion of the differential equations that describe a circuit.

**Related activities:**

**Specific objectives:**
- State space equations of electrical circuits.
- Transfer functions of electrical circuits.

### Instant power theory

<table>
<thead>
<tr>
<th>Learning time: 33h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory classes: 8h</td>
</tr>
<tr>
<td>Guided activities: 5h</td>
</tr>
<tr>
<td>Self study: 20h</td>
</tr>
</tbody>
</table>

**Description:**
This content is to give students a brief overview on Instant Power Theory and its applications.

### Phase-lock loop (PLL's): single-phase and three-phased in unbalanced systems.

<table>
<thead>
<tr>
<th>Learning time: 33h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory classes: 8h</td>
</tr>
<tr>
<td>Guided activities: 5h</td>
</tr>
<tr>
<td>Self study: 20h</td>
</tr>
</tbody>
</table>

**Description:**
Nowadays, PLL's are the most used technique to synchronize Active Front End (AFE's) with main's voltages. This content will give an overview on PLL's, either single-phase or three-phase (in unbalances systems and with voltage sags).

**Related activities:**
A2. Simulink simulation of a single-phase PLL.

**Specific objectives:**
- SRF-PLL (Synchronous reference frame PLL).
- DSRF-PLL (Doble Synchronous reference frame PLL).
- Single-phase PLL (SOGI, ANF, others...)
### Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Laboratory classes</th>
<th>Self study</th>
<th>Guided activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A1.- Simulation with Simulink of the transient response of a DC Motor.</strong></td>
<td>7h</td>
<td>2h</td>
<td>10h</td>
<td>5h</td>
</tr>
<tr>
<td><strong>A2. Simulink simulation of a single-phase PLL.</strong></td>
<td>9h 30m</td>
<td>2h</td>
<td>2h 30m</td>
<td>5h</td>
</tr>
<tr>
<td><strong>A3. Simulink simulation of a three-phases PLL in a system with an unbalanced voltage sag.</strong></td>
<td>18h</td>
<td>3h</td>
<td>5h</td>
<td>10h</td>
</tr>
<tr>
<td><strong>A4. Simulink modelization of a three-phase grid.</strong></td>
<td>8h</td>
<td>3h</td>
<td>5h</td>
<td></td>
</tr>
</tbody>
</table>

### Qualification system

- Written test (final exam) (PE): 50 %
- Oriented individual works (TD): 40 %
- Oral presentations (PO): 10 %

**Matrix transforms: Park Transform**

**Description:**
In this content, the Matrix transform will be introduced and applied to a particular case: the transient modelling of a three-phase grid.

**Related activities:**

**Learning time:** 15h
- Laboratory classes: 5h
- Self study: 10h
Bibliography

Basic:


Complementary: