320023 - CEER - Power Plants and Renewable Energies

**Coordinating unit:** 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

**Teaching unit:**
- 709 - EE - Department of Electrical Engineering
- 729 - MF - Department of Fluid Mechanics

**Academic year:** 2019

**Degree:** BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

**ECTS credits:** 6

**Teaching languages:** Catalan

**Teaching staff**

**Coordinator:** Jaume Saura

**Others:** Iñaki Candela.

**Degree competences to which the subject contributes**

**Specific:**
1. ELE: Ability to calculate and design electrical power lines and transmission.
2. ELE: Ability to calculate and design electrical machines.
3. ELE: Ability to calculate and design high-voltage electrical installations.

**Transversal:**
4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
5. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 3. Taking social, economic and environmental factors into account in the application of solutions. Undertaking projects that tie in with human development and sustainability.

**Teaching methodology**

- Face-to-face lecture sessions.
- Face-to-face practical work sessions.
- Independent learning and exercises.
- Preparation and completion of group activities subject to assessment.

In the face-to-face lecture sessions, the lecturer will introduce the basic theory, concepts, methods and results for the subject and use examples to facilitate students' understanding.

There will be two types of practical class work sessions:
a) Sessions in which the lecturer will provide students with guidelines to analyse data for solving problems by applying methods, concepts and theoretical results (80%).
d) Sessions in which students give presentations of group work (20%).

Students will be expected to study in their own time so that they are familiar with concepts and are able to solve the exercises set, whether manually or with the help of a computer. In scheduled multiple-choice test sessions via the Digital Campus, students will be tested on their acquisition of knowledge, specific vocabulary related to power stations, and concepts of physics applied to power stations.

In small groups, students will carry out projects and present them publicly in applied sessions.

**Learning objectives of the subject**
This subject introduces students to the various available energy sources (in particular those used in present-day use), the operating principles of each source, the ways in which power stations transform this energy into electrical energy, the power dimensions of each energy source, the main elements of power stations, and the difference between macro and micro power stations. Students will learn to design photovoltaic systems and select wind turbines and alternators, and will gain an understanding of the excitation, regulation and control of the various types of power stations.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group:</td>
<td>15h</td>
<td>10.00%</td>
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<tr>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>6h</td>
<td>4.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>84h</td>
<td>56.00%</td>
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</tbody>
</table>
# Content

<table>
<thead>
<tr>
<th>TOPIC 1: WATER POWER STATIONS</th>
<th>Learning time: 20h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 10h</td>
</tr>
<tr>
<td>- Description of a hydraulic power station.</td>
<td>Self study: 10h</td>
</tr>
<tr>
<td>- Catchment, dams and pumped storage.</td>
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<tr>
<td>- Turbines. Hydropower exploitation.</td>
<td></td>
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<tr>
<td>- Dynamo excitation.</td>
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<tr>
<td>- Generation values. Transformation, protection and control. Elevation and distribution.</td>
<td></td>
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<tr>
<td>- Pumping stations.</td>
<td></td>
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<tr>
<td>- Small water power stations.</td>
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<tr>
<td>- Water power stations in Spain.</td>
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</tbody>
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<table>
<thead>
<tr>
<th>TOPIC 2: THERMAL POWER STATIONS</th>
<th>Learning time: 16h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 8h</td>
</tr>
<tr>
<td>- Description of a thermal power station.</td>
<td>Self study: 8h</td>
</tr>
<tr>
<td>- Operation and work cycles.</td>
<td></td>
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<tr>
<td>- Thermal power stations in Spain.</td>
<td></td>
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<tr>
<td>- Existing coal-fired thermal power stations.</td>
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<tr>
<td>- Fossil-fuel power stations.</td>
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<tr>
<td>- Cogeneration plants.</td>
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<tr>
<td>- Biomass power stations.</td>
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<tr>
<td>- Waste-to-energy incineration plants. Municipal solid waste.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>TOPIC 3: Nuclear Power Plants</th>
<th>Learning time: 10h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 5h</td>
</tr>
<tr>
<td>- Nuclear fission.</td>
<td>Self study: 5h</td>
</tr>
<tr>
<td>- Components of a nuclear power plant: fuel, moderator, control rods, coolant, containment building.</td>
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</tr>
<tr>
<td>- Nuclear reactors.</td>
<td></td>
</tr>
<tr>
<td>- Largest nuclear power plants in Spain.</td>
<td></td>
</tr>
</tbody>
</table>
## TOPIC 4: PHOTOVOLTAIC ENERGY

**Learning time:** 20h  
Theory classes: 10h  
Self study: 10h

**Description:**  
- The Sun: coordinates, position, spherical trigonometry.  
- Solar radiation.  
- Solar cells and panels.  
- Free-standing installations.  
- Grid-connected installations.  
- Solar power plants.

## TOPIC 5: Wind Energy

**Learning time:** 26h  
Theory classes: 13h  
Self study: 13h

**Description:**  
- Wind: Average values, turbulence, speed distribution. Extreme values, wake turbulence.  
- Wind turbines.  
- Regulation and control. Modes of operation.  
- Quality of energy produced by wind turbines.  
- Wind farm.  
- Largest wind farms in Spain.

## TOPIC 6: GENERATORS AND EXCITATION

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

**Description:**  
- Vector diagram of currents and power.  
- Excitation systems.  
- Direct-current exciter.  
- Rectified excitation.  
- Brushless excitation.  
- System control: frequency and voltage.  
- Programming generation. Covering load demand.
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<table>
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<tr>
<th>TOPIC 7: GENERAL CONCEPTS OF GENERATION</th>
<th>Learning time: 12h</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 6h</td>
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<tr>
<td></td>
<td>Self study: 6h</td>
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</tbody>
</table>

Description:
- Energy and society. Energy resources. Primary energy.
- History of electrical energy generation.
- Environmental problems in electrical energy generation.
- The production market. Supply and demand. The market operator.
- Legislative framework.

Qualification system
- 1st exam: 40%
- 2nd exam: 40%
- Workcalss: 20%

The unsatisfactory results of the 1st partial exam may be redirected through a written test to be done during class hours. This test can be accessed by all enrolled students. The qualification of the test with a score of 0 and 10. The mark obtained by applying the conversion will replace the initial qualification as long as it is superior.

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.
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Bibliography

Basic:


Complementary:


