320025 - EQSE - Efficiency and Quality in Electrical Systems

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

**Teaching unit:** 709 - DEE - Department of Electrical Engineering

**Academic year:** 2019

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

**ECTS credits:** 6

**Teaching languages:** Catalan, Spanish

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### Degree competences to which the subject contributes

#### Transversal:

1. **TEAMWORK - Level 2.** Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

2. **EFFECTIVE USE OF INFORMATION RESOURCES - Level 3.** Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

3. **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.

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### Teaching methodology

All available documentation to begin the course in Digital Campus: Timed detailed programming and activities to develop, readings and class presentations, articles and technical documentation, web’s interest to conduct practices, etc.

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### Learning objectives of the subject

Recognize and quantify the importance of rational and efficient use of energy, focusing on electric power applications, both from the standpoint of economic and legal environment.

Assess and quantify the quality of electric power, as long as it is a ‘product’ we buy and use.

Providing knowledge and information that will enable studies on quantitative and qualitative aspects above.

Know the organizations, businesses, institutions, etc., Which are related to the topic.

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### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
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</thead>
<tbody>
<tr>
<td>Hours medium group: 15h</td>
<td>10.00%</td>
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<tr>
<td>Hours small group: 15h</td>
<td>10.00%</td>
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<tr>
<td>Self study: 90h</td>
<td>60.00%</td>
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</table>
## Content

### TOPIC 1: EFFICIENT USE OF ELECTRICAL ENERGY

**Description:**
1.1. Introduction
1.2. Inefficiencies in electrical systems.
1.2.1. Power in electrical systems.
1.2.2. Performance, power factor and efficiency factor.
1.2.3. Load inefficiencies.
1.2.4. Installation inefficiencies.
1.2.5. Supply inefficiencies.
1.3. Legal references and regulations.
1.4. Improving the efficiency of electrical systems.
1.5. Applying reactive power compensation in non-distorted networks.
1.6. Electricity rates and demand management.

**Learning time:** 24h
- Theory classes: 12h
- Practical classes: 8h
- Laboratory classes: 4h
- Guided activities: 0h

**Laboratory sessions**
- Practical P1. Efficiency analysis of loads and installations.
- Practical P2. Efficiency analysis of generation and transport systems.

### TOPIC 2: ELECTROMAGNETIC COMPATIBILITY, QUALITY AND EFFICIENCY

**Description:**
2.1. Introduction to the problem of interference. Definitions. Symbols used. Relationship between levels of emission and immunity. EMI generation of propagation.
2.2. Disturbances.
2.2.2. Disturbance sources.
2.2.3. Coupling.
2.3. Shielding
2.4. Earth and ground.
2.5. Cables
2.6. Solutions to electromagnetic compatibility problems.
2.7. Electromagnetic compatibility regulations.

**Learning time:** 16h
- Theory classes: 10h
- Practical classes: 4h
- Laboratory classes: 2h
- Guided activities: 0h

**Laboratory sessions**
- Practical P3. Design of an installation according to electromagnetic compatibility criteria.
**TOPIC 3: QUALITY OF ELECTRICAL ENERGY**

<table>
<thead>
<tr>
<th>Description</th>
<th>Learning time: 26h</th>
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<tbody>
<tr>
<td>3.1. Introduction</td>
<td>Theory classes: 14h</td>
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<tr>
<td>3.2. Disturbances in electrical networks: types, definitions and effects.</td>
<td>Practical classes: 6h</td>
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<tr>
<td>3.2.1. Frequency variations.</td>
<td>Laboratory classes: 6h</td>
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<td>3.2.2. Voltage fluctuations.</td>
<td>Guided activities: 0h</td>
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<td>3.2.3. Imbalances in three-phase systems.</td>
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<td>3.2.4. Harmonics.</td>
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<td>3.2.5. Oscillatory transients.</td>
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<td>3.2.6. Impulsive transients caused by lightning.</td>
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<td>3.2.7. Flicker.</td>
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<td>3.3. Legal references and regulations.</td>
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<td>3.4. Quality of service</td>
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<td>3.4.1. Continuity of supply. Indicators (ASIDI, ASIFI).</td>
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<td>3.4.2. Product quality.</td>
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<td>3.4.3. Customer information.</td>
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<td>3.5. Measuring and recording electrical quantities.</td>
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<td>3.6. Disturbance compensation and filtering.</td>
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<td>3.7. Electrical installations and ground connection.</td>
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<td>3.8. Emergency systems.</td>
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<td>Laboratory sessions</td>
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<tr>
<td>Practical P6. Implementation of corrective systems.</td>
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</tbody>
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**Description:**

- 3.1. Introduction
- 3.2. Disturbances in electrical networks: types, definitions and effects.
  - 3.2.1. Frequency variations.
  - 3.2.2. Voltage fluctuations.
  - 3.2.3. Imbalances in three-phase systems.
  - 3.2.4. Harmonics.
  - 3.2.5. Oscillatory transients.
  - 3.2.6. Impulsive transients caused by lightning.
  - 3.2.7. Flicker.
- 3.3. Legal references and regulations.
- 3.4. Quality of service
  - 3.4.1. Continuity of supply. Indicators (ASIDI, ASIFI).
  - 3.4.2. Product quality.
  - 3.4.3. Customer information.
- 3.5. Measuring and recording electrical quantities.
- 3.6. Disturbance compensation and filtering.
- 3.7. Electrical installations and ground connection.
- 3.8. Emergency systems.

**Laboratory sessions**

- Practical P5. Measurement of quality indicators (II).
- Practical P6. Implementation of corrective systems.
Qualification system

There will be a continuous assessment model for the basic purpose of weighing both self-employment as teamwork of students.

First test: 35%
Second test: 35%
Other reports and papers presented: 10%
Laboratory: 10%
Effective oral and written communication: 10%

Unsatisfactory results from the examination of the first test may be redirected by a written test to be carried out on the day set for the examination of the second test. Students with a score lower than 5.0 will be able to access this test. The qualification mark will be between 0 and 5 points. The score obtained by the renewal will replace the initial result as long as it is higher than the one before.

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.

Regulations for carrying out activities

The evaluations consist of the evaluation followed by acts of face and / or other measurable activities that are part of continuous assessment. Failure to perform any acts or activities, shall be deemed qualified to zero.

Bibliography

Basic:

Complementary: