340102 - MAE1-E4009 - Electrical Machines I

Degree competences to which the subject contributes

Specific:
- 6. CE19. Ability to calculate design electrical machines.

Transversal:
1. 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.
2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

Teaching methodology
- In the theory classes, be exposed and develop the theoretical foundations of programmed materials. They consist of theoretical explanations complemented by activities to encourage participation, discussion and critical analysis by students.
- The kinds of problems will arise and solve exercises for the subject under discussion. Students should meet individually or in groups, indicating problems.
- Within hours of laboratory practice the students will be required and submit the relevant report of the activity along with appropriate calculations and critical considerations.
- Group work will be undertaken during the course of a specific topic related to the subject.

Learning objectives of the subject
- Provide the basics of transformers and rotating electrical machines.
- Know the various constituents and key technological aspects of transformers and rotating electrical machines.
- Present the different types of transformers and their applications.
- Analyze the performance of transformers (single and three phase) from the equivalent circuit.
- To study the electromechanical conversion of energy and implement their primary relationships in machinery and electrical devices.
- Present the main uses of the synchronous machine as a motor and a generator.
- Study the constructive peculiarities of the synchronous machine and its operation principle.
- Analyze the behavior of the synchronous machine in steady state using its equivalent circuit.
- Clearly identify what is meant by the parameters of the plate in electrical machines.
- Plan and implement appropriate laboratory testing electrical machines.
### Study load

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Total learning time:</td>
<td>150h</td>
<td></td>
</tr>
<tr>
<td>Hours large group:</td>
<td>45h</td>
<td>30.00%</td>
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<tr>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
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<tr>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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</table>
# Content

<table>
<thead>
<tr>
<th>1. - Principles of electric machinery</th>
<th>Learning time: 31h</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 9h</td>
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<tr>
<td></td>
<td>Laboratory classes: 4h</td>
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<td>Self study: 18h</td>
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**Description:**
- 1.1. Introduction to electrical machines.
- 1.2. Main energy circuits.
- 1.3. Nominal parameters or assigned. Losses.

<table>
<thead>
<tr>
<th>2. - Transformers</th>
<th>Learning time: 40h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 12h</td>
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<tr>
<td></td>
<td>Laboratory classes: 4h</td>
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<td>Self study: 24h</td>
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</tbody>
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**Description:**
- 2.1. The single-phase power transformer.
- 2.2. Determination of circuit parameters.
- 2.3. Three phase transformers.
- 2.4. Other applications of the transformer.

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<tr>
<th>3. - Electromechanical Conversion of energy</th>
<th>Learning time: 26h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 8h</td>
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<tr>
<td></td>
<td>Practical classes: 2h</td>
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<td>Self study: 16h</td>
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**Description:**
- 3.2. Energy stored in the magnetic field.
- 3.3. Forces and torque in electromechanical systems.
- 3.4. Dynamic equations.

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<tr>
<th>4. - Technological principles of the rotating electric machinery</th>
<th>Learning time: 13h</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
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<tr>
<td></td>
<td>Laboratory classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study: 8h</td>
</tr>
</tbody>
</table>

**Description:**
- 4.1. Air gap magnetic field.
- 4.2. Electromotive forces induced in the windings.
- 4.3. Aspects of construction and operation of electrical machines.
5.- Synchronous Electric Machines

**Description:**
5.2.- Equivalent circuit. Determination of circuit parameters.
5.3.- The synchronous generator load. Methods predetermination of excitation load.
5.4.- Synchronous Generator; feeding a load operation isolated and connected to the network.
5.5.- The synchronous machine as a motor. Curves.
5.6.- Magnet synchronous motor.
5.7.- Synchronous machine with salient poles.

**Learning time:** 40h
- Theory classes: 12h
- Laboratory classes: 4h
- Self study: 24h

**Qualification system**
- First test carried out during the course (30%).
- Test conducted at the end of the course (45%).
- Realization laboratory practice (25%).

**Regulations for carrying out activities**
- The written tests are face and individual.
- In classes of problems and/or laboratory practices will be assessed, where appropriate, the prior work with the presentation of results of the activity.

**Bibliography**

**Basic:**

**Complementary:**