820143 - EMDEE - Electrical Machines Design

**Coordinating unit:** 295 - EEEB - Barcelona East School of Engineering  
**Teaching unit:** 709 - EE - Department of Electrical Engineering  
**Academic year:** 2017  
**Degree:** BACHELOR’S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
**ECTS credits:** 6  
**Teaching languages:** Catalan

### Teaching staff

**Coordinator:** Ramon Bargalló Perpiña  
**Others:** Ramon Bargalló Perpiña

### Prior skills

- Matrix analysis.  
- Fourier Methods.  
- Electromagnetics.  
- Electrical Machines 1 and 2.  
- Use of scientific calculator (HP 50G, CFX9950, other)  
- Use of MATLAB

### Requirements

- Electrical Machines 1 and 2.

### Degree competences to which the subject contributes

#### Specific:

1. Carry out calculations for the design of electrical machines.  
2. Apply regulations and standards based on sound criteria.  
3. Summarise information and undertake self-directed learning activities.

#### Transversal:

4. 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

- Expositive methodology for theory classes.  
- PBL for exercises classes.  
- Training on FE software on laboratory classes.

### Learning objectives of the subject

- (Provide objectives here based on the competences and requirements mentioned.)
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- To do to the student a general scope in the field of electrical machines and drives. The main treated aspects are their modelling and design.
- To put into practice the FE method to analyse and design electrical machines and apparatus
- Explain general rules and methods for size electrical machines.
- Explain the main characteristics for materials used in the electrical machines to obtain an optimal design (technical, economical, environmental, etc. criterions are used)

### Study load

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

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time: 19h</th>
<th>Description</th>
<th>Related activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windings for electrical machines</td>
<td>Theory classes: 6h</td>
<td>Basis: salient pole windings, slot windings, end windings. Phase windings. MMF and EMF. Fractional windings. Other windings.</td>
<td>Winding design for a AC machine. Analysis of MME and EMF.</td>
</tr>
</tbody>
</table>
### Optimal design methods.

**Learning time:** 18h  
Theory classes: 6h  
Laboratory classes: 2h  
Self study: 10h

**Description:**  

**Related activities:**  
Optimal design of an actuator.

### Parameter and losses calculation

**Learning time:** 15h  
Theory classes: 3h  
Laboratory classes: 2h  
Self study: 10h

**Description:**  
FE determination of: losses, emf, cogging torque, torque, inductance, resistance, capacitance, etc.

**Related activities:**  
Transformer analysis.

### Heat transfer

**Learning time:** 18h  
Theory classes: 6h  
Laboratory classes: 2h  
Self study: 10h

**Description:**  

**Related activities:**  
### Design process

**Learning time:** 33h
- Theory classes: 9h
- Laboratory classes: 4h
- Self study: 20h

**Description:**
General formulation for sizing electrical machines. Application to: asynchronous, synchronous and permanent magnet machines. Every course one or more detailed process design will be developed.

**Related activities:**
FE analysis of:
- asynchronous machine. Steady state characteristics
- synchronous PM machine. Torque-angle characteristic, cogging torque, EMF determinations.
- Radial forces. Noise analysis.

### Insulation of electrical machines

**Learning time:** 13h
- Theory classes: 3h
- Self study: 10h

**Description:**

### Qualification system

Final test: 20%
Laboratory: 20%
Homework exercis + classe exercises: 20%
Homework project (design an electrical machines): 40%

### Regulations for carrying out activities

Final test with open books. NO final reexam.
Bibliography

Basic:


Complementary:

