820149 - ASM - Actuators and Sensors for Mechatronics

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 709 - EE - Department of Electrical Engineering
Academic year: 2015
Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: English

Teaching staff
Coordinator: Ramón Bargalló Perpiñà
Others: Jordi Sust

Opening hours
Timetable: UR1- BA17, usually I am on my room on mornings.

Prior skills
Some knowledge of:
- Physical concepts: electromagnetism, mechanics.....
- Electrical circuits: DC, AC and transient analysis (Sistemas Electricos)
- Matlab (not compulsory, but recommended)

Requirements
Not necessary

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. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology

Theory sessions to show fundamental principles, Problem sessions to show how apply theory concepts to basic and advanced calculation, Practical sessions to train the student to use and postprocessing FE software to design electromechanical actuators and sensors. Every student must solve a set of homework exercises and design a sensor or actuator using these FE tools.

Learning objectives of the subject
Electromagnetism theory applied to actuators design.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Total learning time: 150h</th>
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<tbody>
<tr>
<td>Hours large group:</td>
<td>30h</td>
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<tr>
<td>Hours medium group:</td>
<td>0h</td>
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<tr>
<td>Hours small group:</td>
<td>15h</td>
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<tr>
<td>Guided activities:</td>
<td>15h</td>
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<tr>
<td>Self study:</td>
<td>90h</td>
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<tr>
<td>Content</td>
<td>Learning time: 16h</td>
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<tr>
<td><strong>(ENG) - Electromagnetism principles.</strong></td>
<td>Theory classes: 4h</td>
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<td></td>
<td>Laboratory classes: 2h</td>
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<tr>
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<td>Guided activities: 4h</td>
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<td>Self study: 6h</td>
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**Description:**
Overview of magnetic actuators and sensors. Basic electromagnetics. Maxwell’s equations.

**Related activities:**
Analytical and numerical solution of some typical problems in electromagnetism

<table>
<thead>
<tr>
<th>Content</th>
<th>Learning time: 20h</th>
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<tbody>
<tr>
<td><strong>(ENG) - Magnetic materials, Permanent magnets, Conductors.</strong></td>
<td>Theory classes: 6h</td>
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<td>Laboratory classes: 2h</td>
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<td>Guided activities: 4h</td>
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<td>Self study: 8h</td>
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**Description:**

**Related activities:**
Modelling magnetic materials. Experimental determination of magnetic and losses characteristics

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<thead>
<tr>
<th>Content</th>
<th>Learning time: 19h</th>
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<tbody>
<tr>
<td><strong>(ENG) - Magnetic circuit approach.</strong></td>
<td>Theory classes: 6h</td>
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<tr>
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<td>Laboratory classes: 1h</td>
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<td>Guided activities: 4h</td>
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<td>Self study: 8h</td>
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**Description:**

**Related activities:**
Magnetostatic Inductor analysis using magnetic circuit approach.
## (ENG) - Finite elements approach.

**Description:**

**Related activities:**
1. Magnetostatic Inductor analysis using FE software.
2. Automatic analysis of transformer. Link between FEMM and OCTAVE.

**Learning time:** 19h
- Theory classes: 5h
- Laboratory classes: 2h
- Guided activities: 4h
- Self study: 8h

## (ENG) - Electromechanical conversion principles.

**Description:**

**Related activities:**
Linear actuator analysis using FE methods. Making animations.

**Learning time:** 20h
- Theory classes: 6h
- Laboratory classes: 2h
- Guided activities: 4h
- Self study: 8h

## (ENG) - Permanent magnet actuators.
**Characteristics. Applications**

**Description:**

**Related activities:**
Voice-coil design and optimization. Link between FEMM and OptiY
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(ENG) - Losses and Cooling of electromagnetic devices.

Learning time: 20h
Theory classes: 6h
Laboratory classes: 2h
Guided activities: 4h
Self study: 8h

Description:
Losses in magnetic devices: Joule losses, magnetic losses, other losses. Heating and cooling of electromechanical devices.

Related activities:
Thermal analysis of devices using FE methods.


Learning time: 16h
Theory classes: 6h
Laboratory classes: 2h
Guided activities: 2h
Self study: 6h

Description:
Sizing of some magnetic actuators and sensors. Initial sizing. Main dimensions. Design using FE methods.

Related activities:
Simultaneous, thermal and electromagnetic analysis of devices using FE methods. Design Optimization.

Qualification system

- Homework exercises: 20%
- Project Design: 35%
- Laboratory sessions: 20%
- Final test: 20%
- Generic Competences: 5%

Regulations for carrying out activities

Open Book final exam
Bibliography

Basic:


Complementary:


Others resources:

Bargallo. Finite elements for electrical engineering. EUETIB-UPC- 2008