Last update: 02-06-2015

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 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 MECHANICAL 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: electromagmetism, 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 traint he 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

Last update: 02-06-2015

820149 - ASM - Actuators and Sensors for Mechatronics

Electromagnetism theory applied to actuators design.

Study load

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	15h	10.00%
	Self study:	90h	60.00%

Last update: 02-06-2015

820149 - ASM - Actuators and Sensors for Mechatronics

Content

(ENG) -Electromagnetism principles.

Learning time: 16h

Theory classes: 4h
Laboratory classes: 2h
Guided activities: 4h
Self study : 6h

Description:
Overview of magnetic actuators and sensors. Basic electromagnetics. Maxwell's equations.

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

(ENG) -Magnetic materials, Permanent magnets, Conductors.

Learning time: 20h

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

Description:
Materials for magnetic devices. Coils: wire and conductor characteristics. Magnetic steel: magnetic characteristics, hysteresis and eddy current losses, laminations. Permanent magnets: magnetization process, magnetic characteristics, MAximum energy product. Temperature effects. LEakage paths.

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

(ENG) -Magnetic circuit approach.

Learning time: 19h

Theory classes: 6h
Laboratory classes: 1h
Guided activities: 4h
Self study : 8h

Description:
mmf, flux and reluctance. Laws of magnetic circuits. Magnetic circuit elements. Magnetic equivalent circuits.

Related activities:
Magnetostatic Inductor analysis using magnetic circuit approach.

Last update: 02-06-2015

820149 - ASM - Actuators and Sensors for Mechatronics

(ENG) -Finite elements approach.	Learning time: 19h Theory classes: 5h Laboratory classes: 2h Guided activities: 4h Self study : 8h

Description:
Energy conservation and Functional minimization. Triangular elements. Matrix equation. Finite-element models. FE software: preprocessing unit, processing unit, postprocessing unit. Postprocessed quantities.

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

(ENG) -Electromechanical conversión principles.	Learning time: 20h Theory classes: 6h Laboratory classes: 2h Guided activities: 4h Self study : 8h

Description:
Inductance and Speedance. Magnetic Energy. Magnetic force. Equations of motion.

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

(ENG) -Permanent magnet actuators. Characteristics. Applications	Learning time: 20h Theory classes: 6h Laboratory classes: 2h Guided activities: 4h Self study : 8h

Description:
Permanent magnet devices: classification. Modeling. Magnetic sensors. Magnetic linear actuators. Rotating actuators. Stepper motors. Voice-coil motors. Brushless motors.

Related activities:
Voice-coil design and optimization. Link between FEMM anb OptiY

820149 - ASM - Actuators and Sensors for Mechatronics

(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.

(ENG) -Actuators design. Restrictions. Limits. Initial sizing. Optimization.	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:
Simultaneuos, thermal and electromagnetic analysis of devices using FE methods. Design Optimization.

Qualification system

- Homework exercices: 20 %
- Project Design: 35%
- Laboratori sessions: 20%
- Final test: 20%
- Generic Competences: 5%

Regulations for carrying out activities

Open Book final exam

820149 - ASM - Actuators and Sensors for Mechatronics

Bibliography

Basic:

Brauer, J. R. Magnetic actuators and sensors. Hoboken, N.J.: IEEE Press : Wiley-Interscience, cop. 2006. ISBN 9780471731696.

Brandao Faria, J. A. Electromagnetic foundations of electrical engineering. Chichester: Wiley, 2008. ISBN 9780470727096.

Complementary:

Pawlak, A. M. Sensors and actuators in mechatronics : design and applications. Boca Raton: CRC/Taylor & Francis, cop. 2007. ISBN 9780849390135.

Chai, H.-D. Electromechanical motion devices. Upper Saddle River, NJ: Prentice Hall, cop. 1998. ISBN 0132634198.

Others resources:

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