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300260 - SENSORS - Sensors and Interfaces

Coordinating unit: 300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering

Teaching unit: 710 - EEL - Department of Electronic Engineering

Academic year: 2019

Degree: MASTER'S DEGREE IN APPLIED TELECOMMUNICATIONS AND ENGINEERING MANAGEMENT (MASTEAM) (Syllabus 2015). (Teaching unit Compulsory)
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: RAMON PALLAS ARENY

Others: Primer quadrimestre:
RAMON PALLAS ARENY - M1A11

Prior skills

DC and AC circuit analysis, linear system theory, analysis and design of basic analog, digital and mixed-signal electronic circuits using passive and active electronic components.

Requirements

No further requirements.

Degree competences to which the subject contributes

Basic:

CB7. (ENG) CB7 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio.

Specific:

07 MTM. (ENG) Concebir, diseñar e implementar nuevas soluciones para desarrollar aplicaciones basadas en la incorporación de sensores en sistemas electrónicos, para mejorar cualquier proceso en cualquier ámbito social.

08 MTM. (ENG) Diseñar e implementar redes de sensores inalámbricas para cualquier aplicación de cualquier ámbito social.

Generical:

03 DIS. (ENG) Diseñar aplicaciones de alto valor añadido basadas en las Tecnologías de la Información y las Comunicaciones (TIC), aplicadas a cualquier ámbito de la sociedad.

Transversal:

03 TLG. 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

Lectures in the classroom and autonomous work outside the classroom.

Learning objectives of the subject

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. At the end of the course the student should be able to:
1. Understand the structure of measurement systems based on electronic sensors and intended for measurement and control applications and for human-machine interfaces.
2. Describe the function and relevant specifications of each component of measurement systems.
3. Conceptually design a system intended to solve a particular measurement problem.
4. Propose alternative solutions to implement each function and their advantages and shortcomings.
5. Identify possible problems in the physical connection between sensors and their electronic interfaces, and to propose criteria and methods to solve those problems as well as performance parameters and methods to evaluate those solutions.

Study load

Total learning time: 75h	Hours large group:	27h	36.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	48h	64.00%

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Content

1. Design of the measurement chain.title english

Learning time: 27h
Theory classes: 11h
Self study : 16h

Description:
Functions in sensor-based measurement systems. Feedback-based measurement systems: advantages and shortcomings. Transfer characteristic of digitizing systems: resolution. Impedance adaptation and signal coupling. Dynamic range: power supply rails and noise. Calibration: uncertainty, accuracy.

Related activities:
Lectures, homework: questionnaires and exercises, test.

2. Structure and characteristics of electronic sensors.

Learning time: 15h
Theory classes: 5h
Self study : 10h

Description:
Measurement methods based on sensors. Primary sensors: MEMS. Static performance: sensitivity, resolution, accuracy, linearity. Dynamic performance: dynamic sensitivity, response time.

3. Analog sensors and their signal conditioners.

Learning time: 24h
Theory classes: 8h
Self study : 16h

Description:
Resistive sensors. Sensors based on reactance changes. Electromagnetic sensors. Self-generating sensors. Signal conditioning: self-heating, cabling, linearization. DC signals conditioning: offset, single-ended and differential precision amplifiers. AC signals conditioning: gain-bandwidth trade-off. Transimpedance and charge amplifiers.

4. Digital sensors and their electronic interfaces

Learning time: 9h
Theory classes: 3h
Self study : 6h

Description:
Quasi-digital sensors: design options. Digital position encoders. Time and frequency measurement. Uncertainty in signal timing: trigger errors. Direct signal-to-microcontroller interfaces. Voltage level matching and transient reduction.

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Qualification system

Midterm written exam (50 %) and a final written exam (50 %).

Bibliography

Basic:

Pallás Areny, Ramón; Webster, John G. Sensors and signal conditioning. 2nd ed. New York [etc.]: John Wiley & Sons, cop. 2001. ISBN 0471332321.

Complementary:

Fraden, Jacob. Handbook of modern sensors : physics, designs, and applications [on line]. 3rd ed. New York [etc.] : Woodbury, N.Y.: Springer ; American Institute of Physics, cop. 2004 [Consultation: 03/10/2018]. Available on: <https://link.springer.com/book/10.1007%2Fb97321>. ISBN 0387007504.

Pallás Areny, Ramón; Webster, John G. Analog signal processing. New York [etc.]: John Wiley & Sons, cop. 1999. ISBN 0471125288.