Course guide
300260 - SENSORS - Sensors and Interfaces

Last modified: 06/06/2024

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

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

Academic year: 2024 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Reverter Cubarsi, Ferran

Others: Reverter Cubarsi, Ferran

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

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.

Basic:
CB7. Students will be able to apply the acquired knowledge and their ability to solve problems in new or little explored environments in broader (or multidisciplinary) contexts related to their study area.

TEACHING METHODOLOGY

Lectures in the classroom, laboratory sessions, and autonomous work.

LEARNING OBJECTIVES OF THE SUBJECT

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

Type	Hours	Percentage
Hours large group	27,0	36.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

1. Measurement chain

Description:
Block diagram of a measurement system. Multisensor system. Embedded system. Types of signal (analog vs digital, single-ended vs differential). Input-output characteristic. Sensitivity. Systematic vs. random error. Accuracy vs. precision. Calibration.

Related activities:
Lectures and homework.

Full-or-part-time: 14h
Theory classes: 5h
Self study : 9h

2. Electronic sensors

Description:
Thermal sensors: RTD, thermistor, silicon-based, and thermocouple. Mechanical sensors: strain gauge, capacitive, and piezoelectric. Operating principle, subtypes, input-output characteristic, and limitations (2 wire vs. 4 wire, self-heating, non-linearity, cold-junction compensation). MEMS topologies.

Related activities:
Lectures, laboratory sessions and homework

Full-or-part-time: 28h
Theory classes: 4h
Practical classes: 6h
Self study : 18h

3. Signal conditioners

Description:
Signal-to-voltage conversion. Amplification. Shifting. Operational amplifier. Differential amplifier. Instrumentation amplifier. Common-mode rejection ratio. Static and dynamic limitations. Gain-bandwidth trade-off.

Related activities:
Lectures, laboratory sessions and homework

Full-or-part-time: 22h
Theory classes: 4h
Practical classes: 4h
Self study : 14h

4. Data converters

Description:
Anti-aliasing filter, sample & hold, ADC. Input-output characteristic. Quantization error. Signal-to-noise ratio. Resolution. Number of bits. Architectures of ADC: SAR, flash, slope, sigma-delta, and pipeline.

Related activities:
Lectures and homework

Full-or-part-time: 11h
Theory classes: 4h
Self study : 7h

ACTIVITIES

Lectures

Full-or-part-time: 34h
Theory classes: 17h
Self study: 17h

Laboratory sessions

Full-or-part-time: 30h
Practical classes: 10h
Self study: 20h

Homework

Full-or-part-time: 11h
Self study: 11h

GRADING SYSTEM

Final written exam (50%), guided laboratory sessions (30%), and experimental project (20%).

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: 26/07/2022]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-319-19303-8. ISBN 0387007504.
- Pallás Areny, Ramón; Webster, John G. Analog signal processing. New York [etc.]: John Wiley & Sons, cop. 1999. ISBN 0471125288.