Course guide
230659 - SIMS - Sensors, Instruments and Measurement Systems

Last modified: 11/05/2022

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

Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2022 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Juan Ramos Castro

Others: Juan Ramos Castro, Josep Ma Torrents Dolz

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Ability to develop electronic instrumentation, as well as transducers, actuators and sensors.
4. Ability to design, implement and operate high performance laboratory electronic instrumentation, with emphasis on error analysis, calibration and virtual control.
5. Ability to deploy distributed instrumentation systems and advanced sensor networks including self-powered systems based on energy harvesting from the environment.

Transversal:
2. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

3. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

TEACHING METHODOLOGY

- Lectures
- Application classes
- Laboratory classes
- Laboratory practical work
- Group work (distance)
- Individual work (distance)
- Exercises
- Extended answer test (Final Exam)

LEARNING OBJECTIVES OF THE SUBJECT

-Ability to perform the specification, implementation, documentation and development of equipment and instrumentation electronics and considering both the technical and related regulatory compliance.
-Ability to apply electronic and assistive technology in other fields and activities, not only in the field of Information Technologies and Communications.
-Ability to design analog electronic circuits and data capture. -Ability to specify and use electronic instrumentation and measurement systems.
-Ability to analyze and solve problems of interference and electromagnetic compatibility in measurement systems

STUDY LOAD

Type	Hours	Percentage
Hours large group	26,0	20.80
Hours small group	13,0	10.40
Self study	86,0	68.80

Total learning time: 125 h

CONTENTS

1.- Introduction to measurement systems.

Description:
Structure of a measurement system. Types of measurement systems

Related competencies :
CEE8. Ability to deploy distributed instrumentation systems and advanced sensor networks including self-powered systems based on energy harvesting from the environment.

Full-or-part-time: 2h
Theory classes: 1h
Self study : 1h

2. Characteristics of a measurement system

Description:
Definition of basic terminology, types of measures. Methods of assessment of uncertainty in the measurement. Magnitude estimation in the time and frequency domain.

Full-or-part-time: 12h
Theory classes: 6h
Self study : 6h

3.- Sensors and signal conditioning

Description:
Types of signals. Classification of sensors and analysis of its characteristics. Analysis and circuit design of signal conditioning for sensors.

Full-or-part-time: 16h
Theory classes: 8h
Self study : 8h

4.- Signal Acquisition

Description:
Structures and circuits for analog signals multiplexing. Sample and hold circuits. Analog to digital and D/A, conversion architectures.

Full-or-part-time: 16h
Theory classes: 8h
Self study : 8h

Laboratory 1: Introduction to the lab and measurement theory.

Description:
Introduction to Lab View and measurement automation. Measurements with basic tools, Uncertainty assessment.

Full-or-part-time: 7h
Laboratory classes: 2h
Self study : 5h

Laboratory 2: Basic sensors applications.

Description:
Design and assembly of signal conditioning circuits for resistive sensors. Sensor linearization, temperature measurements. Variable reactance sensors, and its signal conditioning circuits. The Wheatstone bridge for modulators sensors.

Full-or-part-time: 9h
Laboratory classes: 4h
Self study : 5h

Laboratory 3: Design and implementation of a measurement system.

Description:
Project design of a complete system of measurement: Choice of suitable sensors for measuring, design and installation of signal conditioning circuits, the choice of the structure of multiplexing and signal acquisition. Acquisition and processing software design.

Full-or-part-time: 12h
Theory classes: 6h
Laboratory classes: 6h

ACTIVITIES

LABORATORY

Description:
Classroom sessions in teh lab for the development of different teaching practices included in the agenda. Measures with basic instrumentation, construction of measuring circuits with basic sensors and implementation of a complete measurement system.

Full-or-part-time: 12h
Laboratory classes: 12h

WRITTEN WORK

Description:
Students prepare and write reports results on laboratory practices proposed.

Full-or-part-time: 6h
Theory classes: 6h

EXERCISES

Description:
The students have a collection of problems of past examinations with solutions to consolidate concepts and analysis /design methodologies. The exercises are for self-evaluation.

Full-or-part-time: 6h
Theory classes: 6h

FINAL EXAMINATION

Description:
Based on short questions and problems.

Full-or-part-time: 3h
Theory classes: 3h

GRADING SYSTEM

Final examination: 50%
Laboratory assessments: 25%
Written work: 25%

BIBLIOGRAPHY

Basic:
- Pallás-Areny, Ramón; Webster, John G. Sensors and signal conditioning [on line]. 2nd ed. New York: John Wiley & Sons, 2001 [Consultation: 03/02/2021]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=4747125. ISBN 0471332321.
- Webster, J.G.; Eren, H. (eds.). Measurement, instrumentation and sensors handbook : electromagnetic, optical, radiation, chemical, and biomedical measurement [on line]. 2nd ed. Boca Raton: CRC Press, 2014 [Consultation: 17/03/2021]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=1407945. ISBN 9781138072183.
- Fraden, J. Handbook of modern sensors : physics, designs, and applications [on line]. 5th ed. Cham: Springer International Publishing, 2016 [Consultation: 07/07/2020]. Available on: https://dx.doi.org/10.1007/978-3-319-19303-8. ISBN 9783319193038.