Last update: 06-05-2019

# 230643 - IS - Instrumentation and Sensors

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 710 - EEL - Department of Electronic Engineering

Academic year: 2019

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

ECTS credits: 5 Teaching languages: English

## Teaching staff

Coordinator: PERE JOAN RIU I COSTA

Others: RAMON BRAGÓS BARDIA

## Degree competences to which the subject contributes

Specific:

1. Ability to integrate instrumentation systems on mobile devices.

2. Ability to evaluate the quality and safety of electronic products including reliability, physical testing, electrical safety and electromagnetic compatibility.
3. Ability to deploy distributed instrumentation systems and advanced sensor networks including self-powered systems based on energy harvesting from the environment.
4. Ability to design, implement and operate high performance laboratory electronic instrumentation, with emphasis on error analysis, calibration and virtual control.

Transversal:

5. 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.
6. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

## Teaching methodology

- Lectures
- Application classes
- Laboratory practical work
- Exercises
- Short answer test (Control)
- Extended answer test (Final Exam)

## Learning objectives of the subject

Learning objectives of the subject:

The aim of this course is to train students in methods of design, implementation and operation of advanced instrumentation and sensor systems. This includes instrumentation and sensor networks, advanced sensor conditioning methods, smart sensor systems and error analysis. Also reliability, electrical safety and electromagnetic compatibility issues are covered.

Last update: 06-05-2019

# 230643 - IS - Instrumentation and Sensors

Learning results of the subject:

- Ability to understand the physical principles and manufacturing technologies of advanced sensors.
- Know how to design and manage instrument and sensor networks and associated synchronization problems.
- Knowledge of various techniques of collecting energy from the environment.
- Ability to understand the technical specifications of high-sensitivity and high frequency measurement equipment.
- Knowledge of the basic principles of the calibration of instruments and the techniques used to carry it out.
- Ability to design virtual instrumentation and automatic test systems.
- Knowledge for integrating instrumentation systems on mobile devices.
- Ability to interpret the regulations affecting electronic products.
- Knowledge of the various tests required to verify electronic products.

## Study load

| | | | |
|---|---|---|---|
| Total learning time: 125h | Hours large group: | 26h | 20.80% |
| | Hours medium group: | 0h | 0.00% |
| | Hours small group: | 13h | 10.40% |
| | Guided activities: | 0h | 0.00% |
| | Self study: | 86h | 68.80% |

Last update: 06-05-2019

# 230643 - IS - Instrumentation and Sensors

## Content

### 1. Introduction

Learning time: 7h

Theory classes: 2h
Guided activities: 1h
Self study : 4h

Description:
- Instrumentation systems architecture
- Sensor networks architecture
- Data transfer and power supply needs of instrumentation and sensor systems
- General considerations about instrumentation and sensor system specification and verification

### 2. Instrumentation systems

Learning time: 51h

Theory classes: 10h
Laboratory classes: 6h
Guided activities: 10h
Self study : 25h

Description:
- Advanced instrumentation systems architectures
- Virtual instrumentation
- Error analysis and specification
- Estimation theory
- Instrumentation systems calibration techniques

### 3. Sensor systems

Learning time: 53h

Theory classes: 9h
Laboratory classes: 8h
Guided activities: 10h
Self study : 26h

Description:
- Sensor principles, implementation and characteristics review
- Advanced sensor conditioning techniques
- Coherent detection methods for AC sensors
- Self-correction and self-calibration techniques
- Smart-sensor structure and standards
- Sensor networks
- Energy harvesting techniques for sensor systems

Last update: 06-05-2019

# 230643 - IS - Instrumentation and Sensors

| 4. Reliability, electrical safety and electromagnetic compatibility in measurement systems | Learning time: 14h<br>Theory classes: 4h<br>Guided activities: 4h<br>Self study : 6h |
|---|---|

Description:
- Electromagnetic compatibility issues in measurement systems
- Interference identification and reduction techniques
- Electrical safety
- Reliability

## Planning of activities

### LABORATORY

Description:
- Synchronization techniques on LXI
- Instrument calibration
- Guarding and shielding
- Coherent and synchronous detection of AC sensors
- Self-calibration of a sensor
- IEEE 1451 Smart sensor standard implementation

### EXERCISES

Description:
- Exercises to strengthen the theoretical knowledge
- Guided study of sensors, instruments and methods related materials

### SHORT ANSWER TEST (CONTROL)

Description:
Mid term control.

### EXTENDED ANSWER TEST (FINAL EXAMINATION)

Description:
Final examination.

Last update: 06-05-2019

# 230643 - IS - Instrumentation and Sensors

## Qualification system

Final examination: 50%
Exercises: 20%
Laboratory assessments: 30%

## Bibliography

### Basic:

Putten, A.F.P.V. Electronic measurement systems: theory and practice. 2nd ed. Bristol ; Philadelphia: IOP Publishing, 1996. ISBN 978-0750303408.

### Complementary:

Meijer, G.C.M. (ed.). Smart sensor systems. Chichester, UK: J. Wiley & Sons, 2008. ISBN 0470866918.

Dargie, W.; Poellabauer, C. Fundamentals of wireless sensor networks: theory and practice [on line]. Chichester: John Wiley & Sons, 2010 [Consultation: 17/07/2017]. Available on: <http://onlinelibrary.wiley.com/book/10.1002/9780470666388>. ISBN 9780470666388.

Pallás Areny, R.; Webster, J.G. Sensors and signal conditioning. 2nd ed. New York: John Wiley and Sons, 2001. ISBN 0471332321.