230659 - SIMS - Sensors, Instruments and Measurement Systems

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2017
Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: 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

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group:</th>
<th>26h</th>
<th>20.80%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>13h</td>
<td>10.40%</td>
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<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
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<td></td>
<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
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## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Learning time</th>
<th>Theory classes</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.- Introduction to measurement systems.</td>
<td>Structure of a measurement system. Types of measurement systems</td>
<td>2h</td>
<td>1h</td>
<td>1h</td>
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<tr>
<td>2. Characteristics of a measurement system</td>
<td>Definition of basic terminology, types of measures. Methods of assessment of uncertainty in the measurement. Magnitude estimation in the time and frequency domain.</td>
<td>12h</td>
<td>6h</td>
<td>6h</td>
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<tr>
<td>3.- Sensors and signal conditioning</td>
<td>Types of signals. Classification of sensors and analysis of its characteristics. Analysis and circuit design of signal conditioning for sensors.</td>
<td>16h</td>
<td>8h</td>
<td>8h</td>
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<tr>
<td>4.- Signal Acquisition</td>
<td>Structures and circuits for analog signals multiplexing. Sample and hold circuits. Analog to digital and D/A, conversion architectures.</td>
<td>16h</td>
<td>8h</td>
<td>8h</td>
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<tr>
<td>Laboratory 1: Introduction to the lab and measurement theory.</td>
<td>Introduction to Lab View and measurement automation. Measurements with basic tools, Uncertainty assessment.</td>
<td>7h</td>
<td>2h</td>
<td>5h</td>
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</table>
**Laboratory 2: Basic sensors applications.**  
Learning time: 9h  
Laboratory classes: 4h  
Self study: 5h

**Description:**  

**Laboratory 3: Design and implementation of a measurement system.**  
Learning time: 12h  
Theory classes: 6h  
Laboratory classes: 6h

**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.
## Planning of activities

| LABORATORY | Hours: 12h  
Laboratory classes: 12h |
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<thead>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Classroom sessions in the 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.</td>
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</table>

| WRITTEN WORK | Hours: 6h  
Theory classes: 6h |
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Students prepare and write reports results on laboratory practices proposed.</td>
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</table>

| EXERCISES | Hours: 6h  
Theory classes: 6h |
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>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.</td>
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| FINAL EXAMINATION | Hours: 3h  
Theory classes: 3h |
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<tr>
<td><strong>Description:</strong></td>
<td>Based on short questions and problems.</td>
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## Qualification system

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

## Bibliography

**Basic:**