295118 - 295II233 - IoT Sensors & Mems

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
723 - CS - Department of Computer Science
702 - CEM - Department of Materials Science and Engineering
712 - EM - Department of Mechanical Engineering

Academic year: 2019
Degree: MASTER'S DEGREE IN INTERDISCIPLINARY AND INNOVATIVE ENGINEERING (Syllabus 2019).
(Teaching unit Optional)
ECTS credits: 6
Teaching languages: English

Teaching staff
Coordinator: Cosp Vilella, Jordi
Others: Madrenas Boadas, Jordi
Pérez Poch, Antoni
Travieso Rodríguez, Antonio
Jiménez Piqué, Emilio

Opening hours
Timetable: To be determined

Prior skills
Electronic Systems, Computing, Mechanical Systems, Material Science and Technology

Requirements
Data acquisition & Instrumentation

Degree competences to which the subject contributes

Specific:
CEMUEII-15. Design and implement acquisition, actuation and control systems that integrate electronic, electrical and mechanical technology in the field of intelligent production systems. (Specific competence of the Advanced Manufacturing Systems specialty)

Generical:
CGMUEII-01. Participate in technological innovation projects in multidisciplinary problems, applying mathematical, analytical, scientific, instrumental, technological and management knowledge.
CGMUEII-05. To communicate hypotheses, procedures and results to specialized and non-specialized audiences in a clear and unambiguous way, both orally and through reports and diagrams, in the context of the development of technical solutions for problems of an interdisciplinary nature.

Transversal:
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
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
Laboratory classes
Laboratory practical work
Individual and group work

Learning objectives of the subject

The aim of this course is to train students in methods to design and use intelligent sensor systems and their connection to the Internet-of-Things, with special emphasis to Micro-Electromechanical Systems (MEMS)

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>22h</th>
<th>14.67%</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>22h</td>
<td>14.67%</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>4h</td>
<td>2.67%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>102h</td>
<td>68.00%</td>
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</table>
# Content

## The signal acquisition chain

**Learning time:** 30h  
Theory classes: 4h  
Laboratory classes: 4h  
Guided activities: 2h  
Self study: 20h

**Description:**  
Introduction to intelligent sensor systems and its signal acquisition stages. Microelectronics and amplifiers.

**Related activities:**  
Lectures and application exercises.  
Laboratory exercises:  
Sensor signal acquisition

**Specific objectives:**  
Analyze, design and use analog front-end stages for sensor signal acquisition

## MEMS. The microfabrications process.

**Learning time:** 28h  
Theory classes: 4h  
Laboratory classes: 4h  
Self study: 20h

**Description:**  
MEMS materials and the microfabrication process (Litography and other microfabrication techniques, Introduction to Process integration)

**Related activities:**  
Lectures and application exercises.  
Laboratory exercises:  
Fabrication of a model MEMS by masking

**Specific objectives:**  
Understand and know the different MEMS microfabrication process and materials.
## MEMS structures and modeling

<table>
<thead>
<tr>
<th>Learning time: 28h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Self study: 20h</td>
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</tbody>
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**Description:**
Description of the most common MEMS structures and their mechanical analysis.

**Related activities:**
- Lectures and application exercises.
- Laboratory exercises:
  - MEMS simulation and experimental measures.

**Specific objectives:**
- Analyse MEMS structures and determine its fundamental parameters.

## Digital signal processing and their implementation on microcontrollers

<table>
<thead>
<tr>
<th>Learning time: 32h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Laboratory classes: 6h</td>
</tr>
<tr>
<td>Guided activities: 2h</td>
</tr>
<tr>
<td>Self study: 20h</td>
</tr>
</tbody>
</table>

**Description:**
Description and use of the microcontroller system to acquire and process signals from sensors.

**Related activities:**
- Lectures and application exercises.
- Laboratory exercises:
  - Microcontroller system electronic circuit and its programming

**Specific objectives:**
- Use microcontroller systems for signal acquisition and wireless connection.
### Networks

**Learning time:** 32h  
- Theory classes: 6h  
- Laboratory classes: 4h  
- Self study: 22h

**Description:**  
Data link layer for IoT: Wireless communication technologies, wire communication technologies, Manet Networks, RFID, Bluetooth.  
Network layer for IoT: 6lowPAN, dynamic routing for wireless ad-hoc network.  
Communication protocols for IoT: Service-oriented protocols (COAP, protocols based on the exchange of messages (MQTT)), Service discovery protocols.  
Data processing for IoT: Cloud computing, Fog computing.

**Related activities:**  
Lectures and application exercises.  
Laboratory:  
- Internet connection. Devices showing actual real-time monitoring, Exposition of device functionality as services - COAP protocol, Machine-to-machine communications: Broadcast and MQTT application.

**Specific objectives:**  
Understand current communication network protocols for IoT.  
Know how to connect and internetwork devices, with real-time data processing.

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### Qualification system

Final exam, Group assessments, Laboratory assessments

### Regulations for carrying out activities

To be determined

### Bibliography

**Basic:**


