Course guides
230669 - MEMS - Mems. Microelectromechanical Systems

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 ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).
Academic year: 2020
ECTS Credits: 5.0
Languages: English

LECTURER
Coordinating lecturer: LUIS CASTAÑER MUÑOZ, ANGEL RODRIGUEZ
Others: SANDRA BERMEJO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES
Transversal:
1. 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.
2. 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
- Individual work (distance)
- Exercises
- Extended answer test (Final Exam)

LEARNING OBJECTIVES OF THE SUBJECT
Learning objectives of the subject:
Understanding the general principles and tools of the microelectromechanical systems and devices and its applications.

Learning results of the subject:
- Independent ability to propose, plan and develop MEMS devices and applications
- Ability to understand multidomain problems: thermal, fluidic, mechanical and electrical
- Ability to design a fabrication process of a MEMS device
**STUDY LOAD**

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>39.0</td>
<td>31.20</td>
</tr>
<tr>
<td>Self study</td>
<td>86.0</td>
<td>68.80</td>
</tr>
</tbody>
</table>

Total learning time: 125 h

**CONTENTS**

1. **Introduction to MEMS**
   
   **Description:**
   - Scaling of forces to the microworld.
   - MEMS design and fabrication process outline.
   
   **Full-or-part-time:** 6h
   - Theory classes: 1h
   - Self study: 5h

2. **Elasticity**
   
   **Description:**
   - Stress and strain
   - Elastic properties of main materials
   - Beam equation
   - Membranes
   - Flexures
   
   **Full-or-part-time:** 17h
   - Theory classes: 5h
   - Self study: 12h

3. **Piezoresistance and piezoelectricity**
   
   **Description:**
   - Piezoresistance and piezoelectric coefficients
   - Pressure sensors based on piezoresistors
   
   **Full-or-part-time:** 18h
   - Theory classes: 6h
   - Self study: 12h
### 4. Electrostatic actuation and sensing

**Description:**
- Electrostatic force
- Pull-in and pull-out
- Comb actuators and differential capacitance

**Full-or-part-time:** 17h  
Theory classes: 5h  
Self study: 12h

### 5. Inertial sensors

**Description:**
- Accelerometers  
- Gyroscopes

**Full-or-part-time:** 16h  
Theory classes: 5h  
Self study: 11h

### 6. Resonators

**Description:**
- Resonator model  
- Equivalent circuit  
- Applications

**Full-or-part-time:** 15h  
Theory classes: 5h  
Self study: 10h

### 7. Microfluidics and electrokinetics

**Description:**
- Pressure driven flow  
- Electrokinetic flow  
- Nanoparticle selfassembly  
- Dielectrophoresis  
- Liquid lenses and displays

**Full-or-part-time:** 18h  
Theory classes: 6h  
Self study: 12h
8. Fabrication processes

Description:
- Bulk micromachining
- Surface micromachining
- Foundry services

Full-or-part-time: 18h
Theory classes: 6h
Self study: 12h

ACTIVITIES

EXERCISES

Description:
Exercises to strengthen the theoretical knowledge.

EXTENDED ANSWER TEST

Description:
Final examination.

GRADING SYSTEM

Final examination: from 50% to 60%
Individual assessments: from 40% to 50%

BIBLIOGRAPHY

Basic: