230669 - MEMS - Mems. Microelectromechanical Systems

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 ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: 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

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<tr>
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<th>Hours large group:</th>
<th>39h</th>
<th>31.20%</th>
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<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
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<td>Hours small group:</td>
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<td></td>
<td>Guided activities:</td>
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<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
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## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time</th>
<th>Description</th>
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| **1. Introduction to MEMS** | 6h | - Scaling of forces to the microworld. 
- MEMS design and fabrication process outline. |
| **2. Elasticity** | 17h | - Stress and strain 
- Elastic properties of main materials 
- Beam equation 
- Membranes 
- Flexures |
| **3. Piezoresistance and piezoelectricity** | 18h | - Piezoresistance and piezoelectric coefficients 
- Pressure sensors based on piezoresistors |
| **4. Electrostatic actuation and sensing** | 17h | - Electrostatic force 
- Pull-in and pull-out 
- Comb actuators and differential capacitance |
5. **Inertial sensors**

**Description:**
- accelerometers
- gyroscopes

**Learning time:** 16h  
- Theory classes: 5h  
- Self study: 11h

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6. **Resonators**

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

**Learning time:** 15h  
- Theory classes: 5h  
- Self study: 10h

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7. **Microfluidics and electrokinetics**

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

**Learning time:** 18h  
- Theory classes: 6h  
- Self study: 12h

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8. **Fabrication processes**

**Description:**
- Bulk micromachining
- Surface micromachining
- Foundry services

**Learning time:** 18h  
- Theory classes: 6h  
- Self study: 12h
### Planning of activities

<table>
<thead>
<tr>
<th>EXERCISES</th>
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<tr>
<td><strong>Description:</strong></td>
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<td>Exercises to strengthen the theoretical knowledge.</td>
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<th>EXTENDED ANSWER TEST</th>
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<td><strong>Description:</strong></td>
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<td>Final examination.</td>
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### Qualification system

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

### Bibliography

**Basic:**