Course guide
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).
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2022). (Optional subject).

Academic year: 2022 ECTS Credits: 5.0 Languages: English

LECTURER
Coordinating lecturer: ANGEL RODRIGUEZ
Others: LLUÍS PRADELL 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>Self study</td>
<td>86,0</td>
<td>68.80</td>
</tr>
<tr>
<td>Hours large group</td>
<td>39,0</td>
<td>31.20</td>
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</tbody>
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Total learning time: 125 h

CONTENTS

(ENG) 1. Introduction to MEMS

Description:
- Introduction to MEMS, examples, applications.
- MEMS design and fabrication process outline.

Full-or-part-time: 2h
Theory classes: 1h
Self study: 1h

(ENG) 2. Force scaling

Description:
- Scaling of forces to the microworld.
- Examples

Full-or-part-time: 5h
Theory classes: 1h
Self study: 4h

(ENG) 2. Elasticity

Description:
- Stress and strain
- Elastic properties of main materials
- Beam equation
- Membranes
- Flexures

Full-or-part-time: 16h
Theory classes: 4h
Self study: 12h

(ENG) 4. Piezoresistance and piezoelectricity

Description:
- Piezoresistance and piezoelectric coefficients
- Pressure sensors based on piezoresistors

Full-or-part-time: 18h
Theory classes: 6h
Self study: 12h
(ENG) 5. Electrostatic actuation and sensing

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

Full-or-part-time: 16h
Theory classes: 4h
Self study: 12h

(ENG) 6. Resonators

Description:
- Resonator model
- Equivalent circuit
- Applications

Full-or-part-time: 14h
Theory classes: 4h
Self study: 10h

(ENG) 7. Inertial sensors

Description:
- Accelerometers
- Gyroscopes

Full-or-part-time: 15h
Theory classes: 4h
Self study: 11h

(ENG) 8. Microfluidics and electrokinetics

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

Full-or-part-time: 11h
Theory classes: 5h
Self study: 6h

(ENG) 9. RF-MEMS

Description:
RF-MEMS

Full-or-part-time: 11h
Theory classes: 5h
Self study: 6h
**ENG 10. Fabrication processes**

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

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

**ACTIVITIES**

**ENG THEME WORK**

**Description:**
Short bibliographic research work on a topic of interest to the student. Made a summary in technical magazine format and brief presentation in the classroom.

**Full-or-part-time:** 6h  
Self study: 6h

**EXTENDED ANSWER TEST**

**Description:**
Final examination.

**GRADING SYSTEM**

Class Attendance 10%

Homework consists on deliverables: 40%

..., Problem solving from the problem collection and Tests

..., MEMS world awareness

Course project (Research work, paper writing and ppt) 50%

**BIBLIOGRAPHY**

**Basic:**
RESOURCES

Audiovisual material:
- Exemples. Resource

Hyperlink:
- Transparencies. Resource