Course guide
230669 - MEMS - Microelectromechanical Systems

Last modified: 11/04/2025

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2022). (Optional subject).

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: ANGEL RODRIGUEZ MARTINEZ

Others:

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

Type	Hours	Percentage
Self study	86,0	68.80
Hours large group	39,0	31.20

Total learning time: 125 h

CONTENTS

(ENG) 1. Introduction to MEMS

Description:
- Introduction to MEMS, examples, aplications.
- MEMS design and fabrication process outline.
- MEMS for sustainability.

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

(ENG) 2. Foce 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
- Sustainability in MEMS cicle of life

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:
- Castañer Muñoz, Luis. Understanding MEMS : principles and applications [on line]. Chichester: Wiley, [2016] [Consultation: 07/06/2021]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=4183022. ISBN 9781119055426.
- Senturia, S.D. Microsystem design [on line]. Boston: Kluwer Academoc, 2001 [Consultation: 21/05/2020]. Available on: http://link.springer.com/book/10.1007/b117574. ISBN 0792372468.
- Liu, C. Foundations of MEMS. 2nd ed. Essex: Pearson Education Limited, 2012. ISBN 9780273752240.
- Pozar, David M. Microwave engineering [on line]. 4th ed. Hoboken: Wiley, 2012 [Consultation: 07/06/2021]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=2064708. ISBN 9780470631553.

RESOURCES

Audiovisual material:
- Exemples. Resource

Hyperlink:
- Transparencies. Resource