Universitat Autònoma de Barcelona

Sensors and Actuators for Information and Communication Technology 2016/2017

Code: 42847
ECTS Credits: 6

Degree	Type	Year	Semester
4313797 Telecommunications Engineering	OT	2	1

Contact

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Use of languages

Principal working language: english (eng)

Teachers

Francisco Javier Mata Contreras

Prerequisites

No pre-requirements are needed

Objectives and Contextualisation

There are two main objectives: first of all, the main transducing mechanisms involved in the sensing and actuating operations of mobile devices such as electrostatic, electrodynamic, piezoelectric, piezoresistive, optoelectronic and thermoelectric will be introduced. Based on real applications, the most significant examples of sensors and actuators found in ICT portable devices will be reviewed and analysed. The second objective is focused on the principles and design strategies for RF/microwave and wireless sensors for wireless communications and sensing, including examples in real applications.

Skills

- Capacity for critical reasoning and thought as means for originality in the generation, development and/or application of ideas in a research or professional context.
- Capacity for developing electronic instrumentation as well as transducers, actuators and sensors.
- Capacity to apply advanced photonic and optoelectronic knowledge , as well as high frequency electronics
- Student should possess the learning skills that enable them to continue studying in a way that is largely student led or independent
- Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously

Learning outcomes

1. Capacity for critical reasoning and thought as means for originality in the generation, development and/or application of ideas in a research or professional context.
2. Characterize the transducer elements of sensors and actuators.
3. Design RF and wireless sensors for application in industrial and medical environments, etc.
4. Design sensors and actuators for mobile devices and selfpowered systems

5. Student should possess the learning skills that enable them to continue studying in a way that is largely student led or independent
6. Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
7. Use electromagnetic simulation tools to design RF sensors and wireless sensors

Content

PART I

Unit 1. Transducing mechanisms.

Electrostatic, piezoelectric, electrodynamic, piezoresistive, optoelectronic and thermoelectric. SPICE models.

Unit 2. Sensing and actuating devices.

Microphone, pressure sensor, gas sensor, inertial sensor, light sensor, pico projector, micro speaker

Unit 3. Self-powering technologies. The Energy Harvesting concept.

Power consumption levels in ICT devices. Limits of battery technology. Energy harvesting strategies.

PART II

Unit 1. Introduction to RF/microwave sensors.

Unit 2. Spatial sensors.

Alignment, displacement, position and rotation speed.

Unit 3. Permittivity sensors.

Balanced sensors and comparators. Sensors for medical applications.

Unit 4. Other RF/microwave-based sensors.

Wireless and RFID sensors.

Methodology

Classroom lectures

Laboratory sessions: simulation and characterization of transducer elements and sensing devices

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Classroom lectures	24	0.96	3, 4, 5
Laboratory sessions	15	0.6	1, 2, 3, 4, 7
Type: Supervised			

Tutorships. Build-up of the written report and oral presentation of the laboratory results	15	0.6	1, 2, 3, 4, 6, 7
Type: Autonomous			
Study of subject material and bibliography	90	3.6	1, 3, 4, 5

Evaluation

Part I

Written exam (70%)

Final work, oral and written report (30%)

Part II

Written exam (70%)

Report and results of the lab exercises (30%)

The final score will be the average of the evaluation of the two parts. The professors in charge of the subject reserve the right to slightly modify the evaluation procedure, if it is deemed necessary.

NOT PRESENTED qualification is obtained if the student does not carry out any of the evaluation requirements (written exam or final work or lab exercices)

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Final exam	70%	3	0.12	1, 3, 4, 6
Presentation of laboratory results. Oral and written report	30%	3	0.12	1, 2, 3, 4, 6, 5, 7

Bibliography

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Sensors (Update). Vol.4. H. Baltes, W. Göpel, J. Hesse. Wiley-VCH.

Practical MEMS. Ville Kaajakari. Small Gear Publishing. ISBN: 978-0-9822991-0-4 (2009).

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Sensors and tranducers, M.J. Usher and D.A. Keating, Ed. Macmillan, London, Second Edition 1996.

Sensors and transducers, Sinclair, I. R., Oxford Newnes, 3rd ed (2001).

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Handbook of modern sensors: physics, designs, and applications. Fraden, Jacob. Springer-Verlag New York Inc., cop. 3rd ed (2004).

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Artificial Transmission Lines for RF and Microwave Applications, F. Martin, Wiley.