Universitat Autònoma de Barcelona

2018/2019

Sensors and Actuators for Information and Communication Technology

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

Paris Velez Rasero

Prerequisites

No pre-requirements are needed

Objectives and Contextualisation

There are two main objectives: first of all, to introduce the main transducing mechanisms involved in the sensing and actuating operations of mobile devices such as electrostatic, electrodynamic, piezoelectric and piezoresistive. 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: design, simulation and characterization of transducer elements and sensing devices

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Classroom lectures	24	0.96	
Laboratory sessions	15	0.6	
Type: Supervised			

Tutorships. Build-up of the written report and oral presentation of the laboratory results	15	0.6
Type: Autonomous		
Study of subject material and bibliography	90	3.6

Evaluation

a) Process and programmed evaluation activities

The subject will be evaluated from the following activities:

- EP1: Partial exam 1. Exam of part 1. 35% of FINAL MARK.

- EP2: Partial exam 2. Exam of part 2. 35% of FINAL MARK.

- LABINF1: Laboratory report. Part 1. 7.5% of FINAL MARK.

- LABINF2: Laboratory report. Part 2. 7.5% of FINAL MARK.

- LABORA1: Laboratory work oral presentation. Part 1. 7.5% of FINAL MARK.

- LABORA2: Laboratory work oral presentation. Part 2. 7.5% of FINAL MARK.

The fulfillment of ALL these previous activities will enable the "continuous evaluation", if the average mark (over 10) of the two partial exams is over 4.5.

The activities with second opportunity (recoverable) are:

EP1 and EP2, as indicated in section c).

The activities with NO second opportunity (unrecoverable) are:

LABINF1, LABINF2, LABORA1 and LABORA2.

In order to enable the evaluation of LABINF1/2 i LABORA1/2 it is necessary:

1) To attend ALL laboratory sessions (proof forms must be provided in case of absence).

2) To deliver ALL written reports in time.

RESUME:

NOTA FINAL = NOTA EXAMEN*0.7 + NOTA LAB*0.3

NOTA EXAMEN = NOTA_EP1*0.5 + NOTA_EP2*0.5

NOTA LAB = NOTA_ LABINF1*0.25+NOTA_LABINF2*0.25+NOTA_LABORA1*0.25+NOTA_ LABORA2*0.25

All the NOTES (MARKS) in the previous expressions are considered over 10.

b) Evaluation activities program

The calendar for the evaluation activities* will be published through the "Aula Moodle" (CAMPUS VIRTUAL) during the first weeks of the semester. But it is predicted that:

-EP1 will take place at half semester: last week dedicated to Part 1.

-EP2 will take place at the end of semester: last week dedicated to Part 2.

-Written reports of laboratory activities, LABINF1/2, will be delivered no later than the FINAL exam*, as will be indicated in the "Aula Moodle".

*Final exams calendar will be published at the web of "Escola d'Enginyeria" (exams section).

***c)* Recovery process**

According to the UAB normative, the student can only go in for the recovery process if he has performed ALL two partial exams. So, the only recoverable evaluation activities (with second opportunity) are the partial exams EP1 and EP2, through a RECOVERY/IMPROVEMENT FINAL EXAM.

This RECOVERY/IMPROVEMENT FINAL EXAM has 2 independent parts corresponding to Part 1 and Part 2, so that it allows recover/improve the mark of a single part or the one of both parts of the subject. Thus, the mark of each part, NOTA_FINAL1 and NOTA_FINAL2, will replace the mark of the corresponding partial exam, NOTA_EP1 i NOTA_EP2, just in case the first is higher than the second.

Consequently, the RECOVERY/IMPROVEMENT FINAL EXAM, will NEVER give an EXAM mark lower than the obtained from the partial exams.

RESUME:

NOTA FINAL = NOTA EXAMEN*0.7 + NOTA LAB*0.3

NOTA EXAMEN = MAX(NOTA_EP1 ; NOTA_FINAL1)*0.5 + MAX(NOTA_EP2 ; NOTA_FINAL2)*0.5

NOTA LAB = NOTA_ LABINF1*0.25+NOTA_LABINF2*0.25+NOTA_LABORA1*0.25+NOTA_ LABORA2*0.25

All the NOTES (MARKS) in the previous expressions are considered over 10.

***d)* Qualifications revision procedure**

For each evaluation activity it will be indicated (through Campus Virtual) place, date and time of the revision, in which the student will have the opportunity to revise the activity with the professor. In this context, the student will be able to ask for questions about the evaluation, which will be considered by the professor responsible of the subject. The revision is UNIQUE: if the student does not attend a revision, there will not be any other opportunity to revise the evaluation activity.

***e)* Qualifications**

A student will be considered as NOT EVALUABLE ("No Avaluable", NA) if ONE or BOTH of the following conditions are satisfied:

a) The student has not performed any of the partial exams EP1 and EP2 and/or the student has not delivered/performed the laboratory reports/presentations LABINF1/2 and LABORA1/2.

b) The NOTA EXAMEN is lower than 4.5.

On the other hand, according to UAB normative, among those students with a final mark over 9.0, it will be possible to grant a maximum number of "Matrícules d'Honor" (MH) equal to 5% of the total number of matriculate students. In case the total number of matriculate students is under 20, 1 MH can be granted.

***f)* Irregularities from the student, copy and plagiarism**

Notwithstanding of other disciplinary measure, it will be qualified with ZERO all the irregularities committed by the student that could lead to a change in the qualification of any evaluation activity.Therefore, the copy, the plagiarism, the fraud, to leave copying, etc. in any of the evaluation activities will imply to FAIL the subject with a ZERO as final qualification.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Partial written exam. Part1	35%	1.5	0.06	1, 4, 5
Partial written exam. Part2	35%	1.5	0.06	1, 3, 5
Presentation of laboratory results. Oral and written report	30%	3	0.12	1, 2, 3, 4, 6, 5, 7

Bibliography

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