Multidisciplinary Applications I

Code: 102729
ECTS Credits: 6

2025/2026

Degree	Type	Year
Electronic Engineering for Telecommunication	OT	4

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

It is recommended to have obtained the competences of the subjects of the previous courses

Objectives and Contextualisation

The general objective of the course is to apply electronics as a support technology in other fields and activities, and not just in the field of Information Technology and Communications.

It is intended that the student knows and deepens in the design, manufacture and characterization of micro and nanosystems as sensors and actuators for applications in different areas (sensors / actuators, physical, chemical and biological field).

The specific objectives will be:

1) To know and analyze the different types of microelectromechanical and nanoelectromechanical elements (materials, principles of transduction, basic structures, techniques of actuation and detection)

2) Know the techniques of simulation-modeling, design-manufacturing and characterization for micro-nanosystems.

3) Know the different fields of application of MEMS / NEMS and study specific examples

4) Apply the concepts of electronics to design new devices and systems based on micro and nanosystems.

Competences

- Analyse and evaluate the social and environmental impact of technical solutions
- Apply electronics as a support technology in other fields and activities, and not only in the field of Information and Communication Technologies
- Apply the necessary legislation in the exercise of the telecommunications engineer's profession and use the compulsory specifications, regulations and standards
- Communication
- Develop ethics and professionalism.
- Develop personal attitude.
- Develop personal work habits.
- Develop thinking habits.
- Systematically focus the design of electronic applications and products.
- Work in a multidisciplinary group and in a multilingual environment, and communicate, both in writing and orally, knowledge, procedures, results and ideas related with telecommunications and electronics
- Work in a team.

Learning Outcomes

1. Adapt to multidisciplinary and international surroundings.
2. Adapt to unforeseen situations.
3. Apply electronic energy transformation control systems, especially to the field of renewable energy.
4. Assume and respect the role of the different members of a team, as well as the different levels of dependency in the team.
5. Assume social, ethical, professional and legal responsibility, if applicable, derived from professional exercise.
6. Communicate efficiently, orally and in writing, knowledge, results and skills, both professionally and to non-expert audiences.
7. Conceive and design bioelectronic systems in an environment of multidisciplinary cooperation.
8. Conceive and design micro-nano // electromechanical systems
9. Concisely present in Spanish, Catalan and English the design process of an electronic system, from the design phase to the results and implementation.
10. Develop systemic thinking.
11. Estimate the potential economic and social impact of an electronic system.
12. Generate innovative and competitive proposals in professional activity.
13. Identify, manage and resolve conflicts.
14. Identify the applicable legislation in the development of a specifically applied electronic system
15. Identify the causes of environmental impact of a specifically applied electronic system.
16. Make one's own decisions.
17. Manage information by critically incorporating the innovations of one's professional field, and analysing future trends.
18. On a systematic level, deal with the design process of a specific electronic application.
19. Respect diversity in ideas, people and situations.
20. Use English as a language of communication and as the reference in professional relations.
21. Work cooperatively.
22. Work in complex or uncertain surroundings and with limited resources.

Content

PART I. Technologies of energy harvesting (2/3 course)

1. Introduction to energy harvesting technologies and the concepts of "ultralow power consumption" (ULP), "Zeropower", "wireless sensor network" (WSN).

2. Introduction to the different types of collectors according to the different sources of energy.

3. Introduction to mechanical energy collectors. Mechanical block: resonant cantilever. Transducer block: piezoelectric element. SPICE model.

4. Design and simulation of a mechanical energy collector (LABORATORY)

5. Implementation and characterization of a mechanical energy collector (LABORATORY)

Part II: Microelectromechanical systems in portable devices (1/3 subject)

1. Introduction to microelectromechanical systems (MEMS): classification and description.

2. MEMS in mobile devices: typologies and market trends.

3. Specific cases: inertial sensors (accelerometers), biometric sensors (fingerprints) and RF MEMS.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
laboratory work	12	0.48	2, 3, 4, 7, 8, 10, 13, 18, 16, 21, 22, 20
Seminars	15	0.6	1, 2, 4, 6, 10, 9, 12, 17, 13, 14, 18, 16, 19, 21, 22, 20
Theoretical classes	20	0.8	3, 6, 7, 8, 10, 9, 12, 17, 15, 18, 20
Type: Autonomous			
Preparation and edition of the written reports	44	1.76	2, 4, 6, 8, 10, 11, 9, 17, 13, 14, 15, 18, 16, 21, 20
Study for the assimilation of concepts	44	1.76	3, 7, 8, 10, 11, 17, 14, 15, 18, 16, 20

In this subject of the degree, sensors and actuators will be developed, emphasizing especially those for multidisciplinary applications, giving a different vision to the students. The methodology will be based on learning from projects, so students will be offered a certain problem (specific case) that will have to be resolved throughout the course.

To achieve the objectives the training activities include:

Theoretical classes Explanation by the teacher of the basic concepts depending on the specific case to be resolved

Seminars: discussion and analysis of aspects to be solved and raised according to the specific case.

Laboratory classes. practical works in the specific laboratory according to the case to be resolved. Part of these work will include the use of simulation tools

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Active Participation Laboratory	10%	1	0.04	1, 3, 4, 5, 8, 10, 12, 17, 13, 18, 16, 19, 21, 22
Laboratory written report	30%	6	0.24	3, 6, 8, 11, 9, 12, 14, 15, 18, 16
Oral Presentation or written report of one of the cases	35%	4	0.16	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 9, 12, 17, 13, 14, 15, 18, 16, 19, 21, 20
Partial written exams	25%	4	0.16	3, 6, 8, 11, 9, 17, 14, 15, 18, 16

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The evaluation of the subject will have 3 different sections:

a) 1 partial written test of the subject (25%), and with a grade above 4 to make an average with the rest of the grades. This test can be recovered in the final exam of recovery of the subject, requiring a 4 to make an average.

b) Oral or written presentation of one of the cases worked on in the second part of the subject. Compulsory and non-recoverable activity (35%).

c) The practices, which are mandatory attendance, will have a final weight of 40%. The evaluation of them will be done with 2 grades:

Written report of the work developed in the laboratory, especially valuing the interpretation and discussion of the results in comparison with those expected theoretically and/or simulated (30%). This work is mandatory and recoverable. To recover/improve the grade of the written laboratory report, a second deadline will be set (announced in the subject's Moodle Classroom) to review and respond to the corrections that the teacher has made on the first version of the original work.

Active participation in laboratory sessions (with the possibility of an oral exam or questionnaire in the laboratory to individually assess participation), 10%.

The "Not assessable" grade will only be awarded if the student does not participate in any activity with assessment (attendance at laboratory sessions, oral presentation, exams).

To obtain an Honors Grade (which can be given to 5% of the number of students enrolled), it will be necessary to have grades above 9 in all sections or with a final average higher than 9.2

This subject/module does not provide for the single assessment system.

Bibliography

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Erturk, Alper, and D. J Inman. Piezoelectric Energy Harvesting Alper Erturk, Daniel J. Inman. 1st ed. Chichester: Wiley, 2011. Print. ebook i online.

Sensors, Actuators and their interfaces: a multidisciplinary introduction. Ida, N. 978-1-61353-006-1 (2020), eBook

Analysis and design principles of MEMS devices. Minhang, Bao. ISBN: 978-0-444-51616-9, (2005), eBook

Understanding MEMS : Principles and Applications, Luis Castañer, Willey, ISBN: 978-1-119-05542-6 (2015), eBook -MEMS Mechanical Sensors (Artech House microelectromechanical systems (MEMS) series), Steve Beeby et al. ISBN: 978-1-58053-536-6 (2004), eBook

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

Microsystems Design. S.D. Senturia. Kluwer Academic Publishers (2001).

Fundamentals of Microfabrication. The Science of Miniaturization (2nd edition). M.J. Madou. CRC Press, (2002).

Sensors. Vol.7. . W. Göpel, J. Hesse, J.N. Zemel. Wiley-VCH.

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

Resonant MEMS, O.Brand, I.Dufour, S,M.Heinrich, F.Josse, Wiley-VCH, AMN collection, (2015)

Software

Pspice student version

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	321	Catalan	first semester	morning-mixed
(PLAB) Practical laboratories	321	Catalan	first semester	morning-mixed
(TE) Theory	321	Catalan	first semester	morning-mixed