COURSE PROGRAM

Academic year: 2024/2025

Identification and characteristics of the course					
Code	401092			ECTS Credits	6
Name	Electronic Design Techniques				
Name (Spanish)	Técnicas de Diseño Electrónico				
Degree	Master in Telecommunications Engineering (MUIT)				
Centre	School of technology				
Semester	2º	Character	Mandatory		
Module	Telecommunication Technology				
Material	Electronic Design Techniques				

Lecturers			
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Subject Area	Electronics
Department	Electrical Engineering, Electronics and Automation
Coordinating lecturer	Horacio M. González Velasco

Competencies

Basic competencies:

CB9: Skills to communicate conclusions, and the knowledge and rationale underpinning these, to specialized and non-specialized audiences in a clear and unambiguous way.

General technical competencies:

CG4: Capacity for mathematical modeling, calculation and simulation in technology centers and engineering companies, particularly in research, development and innovation in all areas related to the Telecommunications Engineering and related multidisciplinary fields.

CG12: Possess skills for self-directed and autonomous lifelong learning.

CG13: Knowledge, understanding and ability to implement the necessary legislation in the exercise of the profession of Telecommunication Engineer.

Transverse competencies:

CT01: Innovative and entrepreneurial spirit.

CT04: Skills to communicate conclusions, along with the knowledge and the reasons behind them, to specialized and non-specialized audiences, both orally and in writing, in Spanish and English.

CT07: Critical thinking skills and creativity as a means to have the opportunity to be original in the generation, development and / or application of ideas in a research or professional context.

CT10: Focus on quality and continuous improvement.

CT13: Ability to integrate knowledge and face the complexity of formulating opinions from incomplete or limited information.

Specific competencies:

CTT10: Ability to design and manufacture integrated circuits.

CTT12: Ability to use programmable logic devices, as well as advanced electronic systems, both analog and digital.

CTT15: Ability to develop electronic instrumentation and transducers, actuators and sensors.

Contents and Syllabus

Course outline

Descriptors: Sensors, transducers and actuators. Design of signal conditioning circuits. Programmable Logic Devices (PLDs). PLD Design techniques. Manufacturing technology of integrated circuits.

Course contents

Theme 1: Introduction: electronics and design.
Contents of theme 1: Electronic systems, classification and specifications. System-level electronic design. Circuit-level electronic design.
Description of practical activities for Theme 1:

Theme 2: Manufacturing process of integrated circuits
Contents of theme 2: Introduction. Unit processes in integrated circuits manufacturing. CMOS manufacturing technology: available devices, design rules and layout.
Description of practical activities for Theme 2: Introduction to layout design. Use of ERC, LVS and Spice simulation in layout design.

Theme 3: Digital IC design using CMOS technology.
Contents of theme 3: Introduction: digital signals and circuits. MOSFET Transistor. CMOS logic circuits. Physical design.
Description of practical activities for Theme 3: Design of digital integrated circuits using basic cells. Automatic routing. Design and use of padframes.

Theme 4: Introduction to sensors, transducers and actuators
Contents of theme 4: Basic definitions. Characteristics and types. Resistive transducers. Variable reactance transducers. Self-generating transducers. Other transducers.
Description of practical activities for Theme 4: Case study on the sensorization of an electronic measurement system. Description, analysis and comparison of the different options.

Theme 5: Design of signal conditioning circuits.
Contents of theme 5: Basic definitions. Signal conditioning for resistive transducers. Signal conditioning for capacitive transducers. Signal conditioning for self-generating transducers.
Description of practical activities for Theme 5: Design and assembly of a signal conditioning circuit for a voltage generator sensor using operational amplifiers.

Theme 6: Introduction to data acquisition and measurement using microcontrollers
Contents of theme 6: General concepts. Programming focused on the exchange with the outside world. Reading and writing analog signals. Reading and writing digital signals. Implementation of digital communication protocols. Timing of events and tasks. Basic implementation of libraries.
Description of practical activities for Theme 6: Implementation of data reading and writing functions using a microcontroller. Development of a simple analog-digital embedded system.

Educational activities

Student workload (hours per lesson)		Lectures	Practical sessions				Monitoring activity	Homework
Lesson	**Total**	**GG**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
1	9	3		0			0	6
2	35	8		5			0	22
3	30	10		2			0	18
4	17	5		2			0	10
5	19	5		2			0	12
6	37	11		4			0	22
Evaluation	3	3		0			0	0
Total	150	45		15	0	0		90

L: Lectures (85 students).
HI: Hospital internships (7 students)
LAB: Lab sessions or field practice (15 students)
COM: Computer room or language laboratory practice (20 students).
SEM: Problem-solving classes, seminars or case studies (40 students)
SGT: Scheduled group tutorials (educational monitoring, ECTS-type tutorials)
PS: Personal study, individual or group work and reading of bibliography

Teaching methodology

The following methodologies will be used:

- Participative lectures.
- Problem solving.
- Cooperative and collaborative learning.
- Problem-based learning.
- Project-based learning.Lectures in the laboratory.

Learning outcomes

1. Students can project, calculate and design products, processes and facilities in all the ambits of Communication Engineering.
2. Students can lead, plan and supervise multidisciplinary teams.
3. Students can model mathematically, calculate and simulate in technological and engineering company centres, especially in research, development and innovation tasks in all the areas with regard to Communication Engineering and similar multidisciplinary areas.
4. Students can elaborate, plan, manage, coordinate, and manage projects in technical and economy aspects in all the areas or Communications Engineering, following quality and environmental criteria.
5. Students can assume the general direction, technical direction and direction of research, development and innovation projects in companies and technology centres.
6. Students can initiate, direct and manage manufacturing processes of electronic and telecommunication equipment, with guarantee of safety for people and goods, the final quality of the products and their homologation.
7. Students can apply acquired knowledge and solve problems in new or unfamiliar environments within broader and multidisciplinary contexts, being able to integrate knowledge.
8. Students know how to communicate, orally and in writing, the conclusions (including the knowledge and ultimate reasons that support them) to specialized and non-specialized audiences in a clear and unambiguous way.

Assessment methods

- For the course, two assessment modalities are established, which are detailed below: continuous assessment modality and global assessment modality.
- The choice of the global assessment modality, FOR EACH OF THE CONVOCATIONS, corresponds to the student, who must carry it out within the deadlines established in the current evaluation regulations, through a consult in the Virtual Classroom of the subject.
- In case of absence of request by the student, the assigned modality will be continuous assessment.

Global assessment modality.

- The grade of each student will be obtained **exclusively from the final exam**, which will consist of three tests:
    - **Theoretical part:** 25% of the overall grade (minimum grade 3.0 out of 10).
    - **Problems part:** 35% of the overall grade (minimum grade 3.0 out of 10).
    - **Laboratory exam:** 40% of the overall grade (minimum grade 5.0 out of 10).

      In this last test the student must demonstrate that he/she has acquired the competences of VLSI design using the learned software, as well as those of programming systems for acquisition and control using microcontrollers.
- In case of not exceeding the minimum required in any of the sections, the maximum grade that will appear will be "Suspenso (4.0)".

Continuous assessment modality.

- For the evaluation of the student, **continuous evaluation tests** carried out during the teching period, and **a final test**, will be used.
- **Continuous evaluation tests (CE):** they will account for **50%** of the final grade.

  There will be several qualifying tests throughout the teaching period, mainly practical, so that 50% of the EC grade will correspond to the tests related to the first three themes (first block) and the other 50% will correspond to the tests related to the other three themes (second block). None of the continuous evaluation tests will be recoverable in any of the calls, neither ordinary nor extraordinary.

  It will be necessary to obtain **a grade of at least 5.0 points out of 10 in the continuous evaluation part** in order to pass the course.
- **Final exam (FE):** It will account for **50%** of the final grade. It will have a duration of three hours and will consist of a theoretical part and another of problems with the following weighting (for the grade EF):
    - **Theoretical part:** 40%
    - **Problems part:** 60%

  A grade of at least 3.0 out of 10 on both the theory and problem portions of the written exam will be required to pass the course.
- In case of not exceeding the minimum required in any of the sections, the maximum grade that will appear will be "Suspenso (4.0)".

Bibliography (basic and complementary)

Basic bibliography:

- Y. Haik, T.M Shahin, *Engineering design process 2e*. Cengage Learning, 2011.
- R.J. Baker, *CMOS Circuit Design, Layout and Simulation 3e*. Wiley, 2010.
- N. H. E. Weste, D. Money Harris, *CMOS VLSI Design. A Circuits and Systems Perspective*, Addison-Wesley, 4ª edición, 2011.
- J. Fraden, *Handbook of Modern Sensors*, Springer, 3ª edición, 2004.
- R. Pallás, *Sensores y acondicionadores de señal*. Marcombo, 3ª edición, 1998.
- M.A. Pérez García y otros, *Instrumentación electrónica*, Thomson, 2004.

Complementary bibliography:

- A. S. Sedra y K. C. Smith. *Circuitos Microelectrónicos"*. McGraw Hill, 5ª edición, 2006.
- R. Geiger, P. Allen, N. Strader, *VLSI Design Techniques for Analog and Digital Circuits*, McGraw-Hill, 1990.
- M. A. Pérez. *Instrumentación Electrónica. 230 problemas resueltos*. Garceta, 2012.
- H. N. Norton, *Handbook of transducers*. Prentice Hall, 1989.
- S. Franco. *Diseño con amplificadores operacionales y circuitos integrados analógicos*. McGraw-Hill, 3ª edición, 2004.

Other resources and complementary materials

The slides used during the classes and the proposed problem collections will be available to students in the "Virtual Campus" of the subject.