UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: ELECTRONIC SYSTEMS DESIGN I
Code: 311225
Type: CORE COURSE
ECTS credits: 6
Degree: 2374 - MASTER DEGREE PROGRAMME IN TELECOMMUNICATIÓN AND ENGINEERING
Academic year: 2023-24
Center: 308 - SCHOOL POLYTECHNIC OF CUENCA
Group(s): 30
Year: 1
Duration: First semester
Main language: Spanish
Second language:
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **RAQUEL CERVIGON ABAD** - Group(s): **30**

Building/Office	Department	Phone number	Email	Office hours
E. Politécnica Cuenca (0.05)	INGENIERÍA ELÉCTRICA, ELECTRÓNICA, AUTOMÁTICA Y COMUNICACIONES	926054049	raquel.cervigon@uclm.es	It will be published in the corresponding application of the UCLM Virtual Secretary.

2. Pre-Requisites

No prerequisites, except those imposed by the general curriculum. However, it is recommended to have basic knowledge about the manufacture of integrated circuits.

3. Justification in the curriculum, relation to other subjects and to the profession

The design of circuits and digital systems is an issue of crucial importance in today's society, whose technological base is based, to a large extent, on integrated circuits based on silicon MOSFET transistors. The subject addresses aspects of structured design, such as the circuit and systems test. The aim is to provide the student with a double perspective: on the one hand, the abstract vision of the design of integrated circuits; and on the other, the technological reality of the circuits of the moment.

4. Degree competences achieved in this course

Course competences

Code	Description
E10	The ability to design and build integrated circuits.
E14	The ability to apply advanced knowledge of photonics and optoelectronics, as well as high-frequency electronics.
G01	The ability to conceptualise, calculate and design products, processes and facilities in all fields of Telecommunications Engineering.
G04	The ability to perform mathematical modelling, calculations and simulations in technology centres and engineering companies, particularly in tasks involving research, development and innovation in all areas related to Telecommunications Engineering and related multidisciplinary fields.
G07	The ability to launch, lead and manage the manufacturing processes of electronic and telecommunications equipment, guaranteeing the safety of people and assets, the final quality of products, and their standardisation.
G08	The ability to apply acquired knowledge and solve problems in new or unknown settings within wide and multidisciplinary environments while being capable of integrating knowledge.
G11	The ability to know how to communicate their conclusions and the latest supporting knowledge or data to both specialised and non-specialised audiences clearly and free from ambiguity.
G12	The ability to have the learning skills which allow them to continue studying in a largely self-directed or autonomous way.
G14	The ability to have knowledge and understanding which provides a basis or opportunity to be original in the development and/or application of ideas, often within a research context.
G15	The ability to integrate knowledge and face the complexities of making assessments based on information which, whether incomplete or limited, includes reflections on the social and ethical responsibilities in the application of their knowledge and judgements.

5. Objectives or Learning Outcomes

Course learning outcomes

Description
Analysis and synthesis of technical documentation.
Application of methods and resources for the design and manufacture of digital, analog and mixed integrated circuits.
Application of the appropriate simulation processes for the verification of the design of integrated circuits.
Cálculo de los costes de diseño, fabricación y verificación de circuitos integrados.
Understanding of technical documentation in English and mastery of specific vocabulary in this language.
Understanding of advanced concepts on the design of integrated electronic systems.
Knowledge of MEMs devices.
Knowledge of the principles of operation and manufacture of microsystems and nanoelectronics.
Knowledge of the heterogeneous integrated systems and their applications.
Knowledge and respect of professional ethics and deontology.

Determination of the maximum operating speed of the integrated circuit depending on the technology used.
Determination of the design requirements of a circuit starting from the specifications at the system level.
Management of the main techniques of verification and testing of integrated circuits.
Correct use of oral and written expression to convey ideas, technologies, results, etc.

6. Units / Contents

Unit 1: Introduction to the design of analog and mixed integrated circuits.
- **Unit 1.1** Characterization of MOS transistors
- **Unit 1.2** CMOS inverter. Static and dynamic behavior.
- **Unit 1.3** Combination and sequential logic.
- **Unit 1.4** Analog circuits.
- **Unit 1.5** Mixed circuits.

Unit 2: Verification of behavior: simulation.
- **Unit 2.1** Functional, logical and circuit level simulation.

Unit 3: Manufacture, testing and encapsulation of integrated circuits.
- **Unit 3.1** Functional test.
- **Unit 3.2** Diagnostic or manufacturing test.

Unit 4: Introduction to nanoelectronics.
- **Unit 4.1** Introduction to nanotechnology.
- **Unit 4.2** Nanomaterials. Nanodevice fabrication techniques
- **Unit 4.3** Nanoelectronics applications.

Unit 5: Optoelectronics and Photonics.
- **Unit 5.1** Introduction to optoelectronics.
- **Unit 5.2** Optoelectronic Devices and Sensors.
- **Unit 5.3** Applications of optoelectronics.

Unit 6: Practices.
- **Unit 6.1** Practice 1. Introduction to the Design and Simulation of Integrated Circuits.
- **Unit 6.2** Practice 2. Design and simulation of digital integrated circuits.
- **Unit 6.3** Practice 3. Design and simulation of analog integrated circuits.
- **Unit 6.4** Practice 4. Design and simulation of mixed integrated circuits.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	E10 E14 G04 G12 G14 G15	0.72	18	N	-	
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	E10 E14 G01 G04 G07 G08 G11 G12 G14 G15	0.24	6	N	-	
Class Attendance (practical) [ON-SITE]	Practical or hands-on activities	E10 E14 G01 G04 G07 G08 G11 G12 G14 G15	0.72	18	N	-	
Writing of reports or projects [OFF-SITE]	Guided or supervised work	E10 E14 G01 G04 G07 G08 G11 G12 G14 G15	1.28	32	Y	Y	
Final test [ON-SITE]	Assessment tests	CB06 CB07 CB08 CB09 CB10 E10 E14	0.08	2	Y	Y	
Individual tutoring sessions [ON-SITE]	Other Methodologies	E10 E14 G01 G04 G07 G08 G11 G12 G14 G15	0.04	1	N	-	
Study and Exam Preparation [OFF-SITE]	Self-study	E10 E14 G01 G04 G07 G08 G11 G12 G14 G15	2.52	63	N	-	
Writing of reports or projects [OFF-SITE]	Individual presentation of projects and reports	E10 E14 G01 G04 G07 G08 G11 G12 G14 G15	0.4	10	Y	N	
		Total:	**6**	**150**			
		Total credits of in-class work: 1.8					**Total class time hours: 45**
		Total credits of out of class work: 4.2					**Total hours of out of class work: 105**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Progress Tests	50.00%	60.00%	Written tests and/or problem solving or case studies.
Laboratory sessions	40.00%	40.00%	Defence of the laboratory practicals.
Theoretical papers assessment	10.00%	0.00%	Performance and oral presentation of the proposed work.
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

It is necessary to have passed with flying colours (score over 4 out of 10 points) the compulsory tests set out. The student who passes the laboratory (grade higher than 5 points) will have his grade maintained during the following course, unless he voluntarily decides to repeat it. If the student does not pass the course in the next course, he will have to do the laboratory practices again.

Non-continuous evaluation:

Students who are unable to attend training activities on a regular basis, with justification, must inform the subject's teacher at the beginning of the semester and may carry out the activities and present them on the date indicated.
The weightings indicated in the section on 'assessments' will be applied, provided that both the 'final test' and the 'laboratory practices' have obtained marks equal to or higher than 4 points; otherwise the subject will be considered as not passed.

Specifications for the resit/retake exam:

If the laboratory has been approved, the 'final exam' may be recovered by means of an examination on the date set by the sub-directorate of studies. The procedure for recovering the laboratory practices after the closure of the ordinary call will be published on the virtual campus, if they have not been approved in the call. The same evaluation criteria will be applied as in the ordinary call.

Specifications for the second resit / retake exam:

If the laboratory has been approved in the previous course, the 'final exam' may be made up by an examination on a date set by the Sub-directorate of Studies. Otherwise, the student will have to take two exams, one of theory and another of laboratory, on the date fixed by the subdirectorate of studies, with the same weighting as the ordinary and extraordinary call.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Writing of reports or projects [AUTÓNOMA][Guided or supervised work]	32
Final test [PRESENCIAL][Assessment tests]	2
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	63
Writing of reports or projects [AUTÓNOMA][Individual presentation of projects and reports]	10

General comments about the planning: The themes will be taught consecutively, adapting to the actual timetable for the semester in which the module takes place. At the beginning of the semester, the weekly planning of the course will be published on the virtual campus of the subject. The planning will also be adapted according to the progress of the course.

Unit 1 (de 6): Introduction to the design of analog and mixed integrated circuits.

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	7.25
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2.25

Unit 2 (de 6): Verification of behavior: simulation.

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1.5

Unit 3 (de 6): Manufacture, testing and encapsulation of integrated circuits.

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2.75
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1.25

Unit 4 (de 6): Introduction to nanoelectronics.

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.5

Unit 5 (de 6): Optoelectronics and Photonics.

Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.5

Unit 6 (de 6): Practices.

Activities	Hours
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	18

Global activity

Activities	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	18
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	6
Writing of reports or projects [AUTÓNOMA][Individual presentation of projects and reports]	10
Writing of reports or projects [AUTÓNOMA][Guided or supervised work]	32
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	18
Final test [PRESENCIAL][Assessment tests]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	63
Individual tutoring sessions [PRESENCIAL][Other Methodologies]	1
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Behzad Razavi	Design of Analog CMOS Integrated Circuits	McGraw Hill		978-0072380323	2000	
George I. Bourdopoulos, Aristodemos Pnevmatikakis, Vassilis Anastassopoulos,	Delta-Sigma modulators: Modeling, Design and Applications	Imperial College Press		978-1860943690	2003	

Theodore L. Deliyannis R. Jacob Baker	CMOS: Circuit Design, Layout, and Simulation	Wiley-IEEE Press. 3rd Edition	978-0470881323	2010
Santosh K. Kurinec, Krzysztof Iniewski	Nanoscale Semiconductor Memories: Technology and Applications (Devices, Circuits, and Systems	CRC Press. Taylor & Francis Group	978-1466560604	2013
Jan M.Rabaey, A. Chandrakasan and B. Nikolic.	Digital Integrated Circuits. A Design Perspective	Addison-Wesley Publishing Company. 2nd Edition.	978-0130909961	2003
Jan M.Rabaey, A. Chandrakasan and B. Nikolic.	Digital Integrated Circuits. A Design Perspective	Addison-Wesley Publishing Company. 2nd Edition.	978-0130909961	2003
Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer,	Analysis and Design of Analog Integrated Circuits	John Wiley & Sons	978-0470245996	2009
Neil Weste and David Harris	CMOS VLSI Design: A Circuits and Systems Perspective	Addison-Wesley Publishing Company. 4th Edition.	978-0321547743	2010