Integrated circuits and microelectronics

Academic Year: (2023 / 2024) **Review date: 03/05/2023 12:17:27**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: LOPEZ ONGIL, CELIA

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Electronics Engineering Fundamentals
- Digital Electronics (MANDATORY)

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG4. Knowledge and ability to apply current legislation as well as the specifications, regulations and mandatory standards in the field of Industrial Engineering.
CG5. Adequate knowledge of the concept of company, institutional and legal framework of the company. Organisation and management of companies.
CG6. Applied knowledge of company organisation.
CG8. Knowledge and ability to apply quality principles and methods.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA3. Engineering Design: To be able to design industrial products that comply with the required specifications, collaborating with professionals in related technologies within multidisciplinary teams.
RA4. Research and Innovation: To be able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.
RA6. Transversal Skills: To have the necessary skills for the practice of engineering in today's society.

OBJECTIVES

This subject aims to provide the student with the basic knowledge necessary to design integrated circuits.
- Knowing the design methodology of integrated circuits. Levels of abstraction.
- Designing, simulating and synthesizing digital circuits by using Hardware Description Languages.
- Knowledge and use of computer aided design (CAD) techniques and tools for integrated circuits.
- Knowledge of the technology and manufacturing processes of integrated circuits.
- Analyzing and designing integrated circuits at the physical level either analog or digital circuits.

DESCRIPTION OF CONTENTS: PROGRAMME

Firstly, there is a block dedicated to the design of digital circuits of medium-high complexity by means of hardware description languages. Second, microelectronics is studied, including transistor level design and design level for both analog and digital blocks. This second block presents current manufacturing technologies and CMOS manufacturing processes. Aspects related to the integration of mixed signal circuits are also included. Finally, there is a third block dedicated to the special considerations of IC design.

1. Introduction to integrated circuits and microelectronics. Design methodology

2. Design of digital integrated circuits and validation using hardware description languages
   - Design of medium-high complexity digital circuits with VHDL
   - Types of digital architectures: serial, parallel, pipelined
   - Validation, simulation models

3. Microelectronics. Digital Integrated Circuit Design
   - Introduction to existing manufacturing technologies. CMOS technology.
   - Transistor level design of logic gates and functions.

4. Manufacture of integrated circuits
   - Manufacturing processes
   - Layout

5. Microelectronics. Analog integrated circuit design.
   - Transistor level
   - Layout level

6. Practical considerations of manufacturing integrated circuits

LEARNING ACTIVITIES AND METHODOLOGY

The course will be carried out through the following activities:
1. Theoretical classes: they aim to present the knowledge that students must acquire, as well as carrying out practical exercises to develop this knowledge in an applied way. To facilitate their development, students will receive class notes and can use basic reference texts that allow them to complete and study in depth those units in which they are most interested.
2. Classes of exercises and practices. The objective is to develop a complete practical case and to assimilate the use of simulation and synthesis tools.
3. Student study: exercises and complementary readings proposed by the teacher. Personal study.
4. Exams and other assessment tests

ASSESSMENT SYSTEM

% end-of-term-examination/test:	35
% of continuous assessment (assigments, laboratory, practicals…):	65

The objective of assessment is to know the grade of accomplishment of learning objectives. Student work will be assessed in a continuous way, through exercises, practical work and exams.

- Mid-term exam: 20%

% end-of-term-examination/test:	35
% of continuous assessment (assigments, laboratory, practicals…):	65

- Practical case development (classroom and laboratory): 35%
  (Attendance to laboratory sessions is compulsory)
- Exercise to deliver: 10%
- Final exam: 35% (minimum mark, 4 out of 10)

Students not following the continuous assessment process, the exam will have a value of 60% for the ordinary exam and 100% for the extraordinary exam, following the university rules.

BASIC BIBLIOGRAPHY

- A. Rubio, J. Altet, X. Aragonés, J.L. González, D. Mateo, F. Moll Diseño de circuitos y sistemas integrados, Ediciones UPC, 2000

- J. M. Rabaey, A. Chandraskasan, B. Nikolic Digital integrated circuits: a design perspective, Prentice Hall.

- M. Abramovici, M.A. Breuer, A. D. Friedman Digital system testing and testable design, Computer Science Press, 1990

ADDITIONAL BIBLIOGRAPHY

- D. J. Smith HDL chip design, Doone, 1997

- N. H. Weste, D. M. Harris CMOS VLSI Design. A circuits and systems perspective, Addison-Wesley, Pearson, 2011

- R. J. Baker CMOS Circuit Design, Layout and Simulation, Wiley, 2011