Integrated circuits and microelectronic

Academic Year: (2019 / 2020) **Review date: 04-05-2020**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: PORTELA GARCIA, MARTA

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Digital electronics (1st)
- Electronic Components and Circuits (2nd)

OBJECTIVES

In this subject, students will acquire the basic required knowledge to design integrated circuits:
- Ability to design integrated circuits at a high level, understanding and make an appropriate use of design methodology
- Ability to design, simulate and synthesize digital circuits usign Hardware Description Languages
- Knowledge concerning integrated circuits technology and manufacturing processes
- Ability to analyze and design integrated circuits at physical level
- Knoledge concerning integrated circuit testing and the implications in the design process
- Ability to quantify and improve circuit performance, power usage and reliability.
- Knoledge concerning the computer aided design (CAD) techniques and tools available for digital integrated circuits design.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to integrated circuits. Design methodology
2. VHDL language: introduction and basic concepts
   - Design units: entity and architecture
   - Objects, operators
   - Statements: concurrent and sequential
   - Hierarchy and components
3. Combinational and sequential circuit design using VHDL
   - Description of combinational circuits
   - Description of sequential circuits: registers, counters and Finite State Machines
4. Circuit validation through simulation
   - Suggestions to validate a circuit in a convenient way
   - Description of test benches in VHDL
   - Automatic assessment
   - Simulation models
5. Digital integrated circuit design at the register tranfer level
   - Serial architectures
   - Parallel architectures
   - Pipelined architectures
6. Integrated circuit manufacturing and packaging
   - Design of logic gates at transistor level
   - Manufacturing process
   - Packages
   - Implementation types
   - Practical considerations in integrated circuit designs: clock trees, timing optimization, latch-up effect
7. Integrated circuits at the physisca level
   - Layout design
   - Layout analysis
8. Integrated circuit testing
   - Stuck-at fault model
   - Test vector generation
   - BIST
   - Scan-path

LEARNING ACTIVITIES AND METHODOLOGY

The course will be developed through the following activities:
1. Theoretical lectures. Their objective is to provide students with the required knoledge, and the realization of practical exercises to develop this knoledge in an applied way. Students will receive lecture notes and will have basic refference texts.
2. Practical lectures in informatics rooms and laboratories. They have the objective of guiding students in the develoment of a practical case and the ue of simulation and synthesis tools. A mid-low complexity circuit will be designed and implemented in a programmable circuit.
3. Student work: exercises and complementary readings, sugested by the teacher. Personal work.
4. Exams

ASSESSMENT SYSTEM

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.
- Partial exams: 30%
- Practical case development (classroom and laboratory): 25%
  (Attendance to laboratory sessions is compulsory)
- Exercise to deliver: 5%
- Final exam: 40% (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.

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

BASIC BIBLIOGRAPHY

- Abramovici, M., Breuer, M.A., Friedman, A.D. Digital system testing and testable design, Computer Science Press, 1990
- B. Mealy, F. Tappero "Free Range VHDL. The no-frills guide to writing powerful code for your digital implementations", open-source (http://www.freerangefactory.org/).
- J. M. Rabaey Digital integrated circuits: a design perspective, Prentice Hall.
- R. Jacob Baker "CMOS: Circuit Design, Layout and Simulation", Wiley-IEEE Press, 3rd edition, 2010
- Rubio, A. Altet J., Aragonés X., González J. L., Mateo D., Moll F. Diseño de circuitos y sistemas integrados, Ediciones UPC, 2000
- Smith, D.J. HDL chip design, Doone, 1997
- Weste, N., Eshraghian, K. Principles of CMOS design. A systems perspective, Addison-Wesley, 1985