

Academic Year: (2023 / 2024)

Review date: 21-04-2023

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: GARCIA VALDERAS, MARIO

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Fundamentals of Electronic Engineering

OBJECTIVES

By the end of this subject, students will be able to have:

- A systematic understanding of the key aspects and concepts of their branch of engineering in digital electronics.
- Coherent knowledge of their branch of engineering including some at the forefront of the branch in digital electronics.
- The ability to apply their knowledge and understanding of digital electronics to identify, formulate and solve engineering problems using established methods.
- The ability to apply their knowledge and understanding to develop and realise designs of digital circuits to meet defined and specified requirements.
- An understanding of methodologies for the design and description of digital circuits, and an ability to use them.
- Workshop and laboratory skills.
- The ability to select and use appropriate equipment, tools and methods, as FPGAs, hardware description languages, simulation and logic synthesis tools for digital circuits.
- The ability to combine theory and practice to solve problems of digital electronics.
- An understanding of applicable techniques and methods in digital electronics, and of their limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

- 1 . Representation of information in digital systems
 - Numbering systems
 - Conversions between numbering systems
 - Binary codes
- 2 . Boolean algebra and logic gates
 - Fundamental postulates and properties of Boolean algebra
 - Boolean functions and expressions
 - Logic gates. Logic functions implementation and minimisation
3. Introduction to digital circuit design and implementation
 - Technologies for the implementation of digital circuits
 - Hardware description languages
 - Design flow: simulation and automatic synthesis
 - Basic design concepts in VHDL
4. Combinational circuits
 - Encoders and decoders
 - Multiplexers and demultiplexers
 - Comparators
 - Association of combinational circuits
 - Implementation of logical functions with combinational circuits
5. Arithmetic combinational circuits and description in VHDL
 - Representation of signed numbers: Sign-Magnitude, 1-Complement and 2-Complement systems
 - Binary arithmetic: addition, subtraction, multiplication
 - Representation of real numbers
 - Addition, subtraction and multiplication circuits
 - Arithmetic-Logic Units (ALU)
6. Bistables
 - Asynchronous and synchronous bistables
 - Bistable control logics

- Time characteristics
- Synchronous circuits
- Circuits with bistables: chronograms
- 7. Registers and counters
 - Registers
 - Counters
 - Applications with counters
- 8. Synchronous sequential circuits
 - Finite state machines: Moore and Mealy models
 - Counters as state machines
 - Analysis of synchronous sequential circuits
 - Synthesis of synchronous sequential circuits
- 9. Memories
 - Types and characteristics of memories according to their technology
 - Types and characteristics of memories according to their functionality
 - Description in VHDL.
- 10. Simulation and synthesis of digital circuits described in VHDL.
 - VHDL for simulation and synthesis
 - Test benches and simulation models
 - Synthesis. Resources and timing. Constraints
- 11. Digital systems: structure and implementation
 - Structure: data path and control
 - Programmable logic devices (FPGA)
 - Custom integrated circuits (ASICs)
 - Microprocessors

LEARNING ACTIVITIES AND METHODOLOGY

Lectures: 50%, 1 session/week (2 hours)
 Practice: 36%, 1 session/week (2 hours)
 Lab. Practice: 14%, 4 sessions, (2 hours each)
 Personal assistance, as scheduled by the teacher

ASSESSMENT SYSTEM

Continuous evaluation system based on:

- 1st partial exam: 20%
- 2nd partial exam: 20%
- Lab practice work (compulsory): 15%
- Final exam: 45%, minimum mark 3.5/10.

% end-of-term-examination:	45
% of continuous assessment (assignments, laboratory, practicals...):	55

BASIC BIBLIOGRAPHY

- . FPGA Manufacturers web pages. Xilinx: www.xilinx.com; Altera: www.altera.com; , ..
- 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/>).
- R. Tokheim Digital Electronics, McGraw-Hill.
- Smith, D.J. HDL chip design, Doone, 1997
- T. L. Floyd Digital Fundamentals, Prentice-Hall (several editions).

ADDITIONAL BIBLIOGRAPHY

- D. D. Gajski Principios de Diseño Digital, Prentice-Hall.
- J. F. Wakerly Digital Design Principles and Practices, Pearson Education.