Computer Technology

Academic Year: (2020 / 2021) **Review date: 14-01-2021**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: ENTRENA ARRONTES, LUIS ALFONSO

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 2

Branch of knowledge: Engineering and Architecture

OBJECTIVES

The general objective of this course is to understand the basic building blocks of digital electronics and the operation of combinational and sequential circuits that are used inside a computer.

To achieve this goal, the following competences will be acquired:

1. BASIC COMPETENCES

CB1

Students have demonstrated knowledge and understanding in an area of studies that is the part of the base of general secondary education, and is typically at a level, that, whilst supported by advanced textbooks, includes some aspects that will imply the knowledge of the forefront of their field of study.

In secondary school Industrial Technologies II is studied. They studied
- Numbering systems
- Boolean Algebra
- Combinational circuits
- Sequential circuits (flip-flops)

Much of the course is devoted to this: 60%.
It is evaluated in all the tests

2. GENERAL COMPETENCES

CGB2

Understanding and mastering the basics of fields and waves and electromagnetism, electrical circuit theory, electronic circuits, basic principles of semiconductors and logic families, electronic and photonic devices, and its application for solving problems of engineering

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Digital electronic circuits are studied: Logic gates, flip-flops, PLDs and memory, and its application to solving problems.
Assessed in exam (memories, PLDs and application) and practices (applications).

CGB5

Knowledge of the structure, organization, operation and interconnection of computing systems, the basics of programming and its application to solving engineering problems

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Topics 1, 8 and 9: structure of computers, connection
Assessed in exam (problems of memories, questions on the system under test)

3. COMMON COMPETENCES
CERCI1
Ability to design, develop, select and evaluate applications and computing systems, ensuring their reliability, safety and quality, according to ethical principles and the legal and regulatory norms

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Practice 4 (application) and exam (design exercise)

DESCRIPTION OF CONTENTS: PROGRAMME

1. Information representation in digital systems
1.1. Introduction to digital systems
1.2. Number systems. Conversions between number systems
1.3. Binary codes
2. Boolean Algebra and logic functions
2.1. Postulates and fundamental properties of Boolean Algebra
2.2. Boolean functions and expressions
2.3. Logic gates. Characteristics of logic gates.
2.4. Implementation of logic functions with logic gates
3. Introduction to digital circuit design using VHDL
3.1. Introduction to Hardware Description Languages. The VHDL language
3.2. Basic concepts of VHDL design
3.2.1. Entities and architectures
3.2.2. Ports and signals
3.2.3. Concurrent and sequential statements
3.2.4. Basic data types
4. Basic combinational circuits and VHDL description
4.1. Encoders
4.2. Decoders
4.3. Multiplexers
4.4. Demultiplexers
4.5. Combinational circuit description in VHDL
4.5.1. Conditional statements
4.5.2. Rules for the design of combinational circuits in VHDL
4.5.3. Application examples
5. Arithmetic combinational circuits and VHDL description
5.1. Representation of signed numbers
5.2. Binary arithmetics
5.2.1. Addition and substraction
5.2.2. Multiplication and division
5.3. Representation of real numbers
5.4. Arithmetic circuits
5.4.1. Adders and substractors
5.4.2. Multipliers
5.4.3. Arithmetic Logic Units (ALUs)
5.5. Implementation of arithmetic circuits in VHDL
5.5.1. UNSIGNED and SIGNED types
5.5.2. Use of arithmetic operators
6. Flip-flops
6.1. Asynchronous latches
6.2. Synchronous flip-flops
6.3. Timing characteristics
6.4. Synchronous circuits
6.5. Circuits with flip-flops: waveforms
7. Synchronous sequential circuits and VHDL description
7.1. Registers
7.2. Counters
7.3. Design of sequential circuits in VHDL
7.3.1. Flip-flops and registers
7.3.2. Rules for the design of sequential circuits
7.3.3. Counter design
7.4. Finite State Machines (FSMs)
7.4.1. Moore and Mealy models
7.4.2. Analysis of synchronous sequential circuits
7.4.3. Design of FSMs in VHDL
8. Memories and VHDL description
8.1. Types of memories
8.2. Characteristics of memories
8.3. Memory access waveforms
8.4. Extension of memory size
8.5. Implementation of logic functions with memories. FPGAs
8.6. Modeling of memories in VHDL. Application examples
9. Introduction to digital systems and microprocessors
9.1. Structure of a digital system: data path and control
9.2. Characteristic components of a digital system

9.3. Digital system design at the Register Transfer level
9.4. Architecture of a basic microprocessor
9.5. Basic operation of a microprocessor. Instructions

LEARNING ACTIVITIES AND METHODOLOGY

1. Lectures: 1 ECTS. Intended to reach the specific competences of the course. Students will receive class notes and reference books in order to work and get in-depth knowledge on the course contents. (PO: a,b,c,e,k)
2. Practice: 1 ECTS. Design and development of digital circuits with the aid of the professor. Intended to develop the procedural competences and most of the general competences. They will also contribute to develop the attitudinal competences.
3. Student work: 3.5 ECTS
 - Exercises and complementary lectures proposed by the professor.
 - Personal study
4. Exercises and exam: 0.5 ECTS

ASSESSMENT SYSTEM

The objective of the evaluation is to measure the achievement. Student's work will be evaluated continuously through exercises and exams, practical work and other academic activities, with the following weights:

Partial exam (CB1): 40%
Lab Practice (CB1,CGB2,CECRI1): 20% (assistance is compulsory)
Final Exam (CB1,CGB2,CGB5,CECRI1): 40% (minimum score required)

For those students not taking the continuous assessment system, the final exam will represent 60% of the total mark in the ordinary exam, and 100% in the extraordinary exam.

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

BASIC BIBLIOGRAPHY

- FLOYD, T.L. "Fundamentos de Sistemas Digitales (Digital Systems Fundamentals)", Prentice-Hall.
- HAYES, J.P. "Introducción al Diseño Lógico Digital (Introduction to Digital Logic Design)", Addison-Wesley.