INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Digital Electronics			Field of study	Electronics and Instrumentation								
Bachelor in	Electrical and Computers Engineering			School	School of Technology and Management								
Academic Year	2023/2024	Year of study	1	Level	1-1	ECTS credits	6.0						
Type	Semestral	Semester	1	Code	9112-742-1105-00-23								
Workload (hours)	162	Contact hours	T 15	TP 15	PL 30	TC -	S -	E -	OT -	O -			

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): João Paulo Coelho, Luis Fernando Piardi

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Simplify logical functions using both analytical and graphical methods;
2. Know the principal electrical characteristics of the TTL and CMOS familly;
3. To design application specific combinatory digital circuits;
4. Design counters for non-monotonic and non-consecutive sequences;
5. Design multiple input and multiple output sequential machines;
6. Understand the structure and operation of electronic memories and digital programming devices;
7. To gain the necessary skills on digital hardware description using VHDL;
8. Synthesise simple logic systems, in a programmable digital device, from a VHDL circuit description.

Prerequisites

Before the course unit the learner is expected to be able to:
Not appliable.

Course contents

Number Systems and Binary Codes. Logic Gates and Boolean Algebra. Logical Operations using electrical signals. Combinatory Integrated Circuits. Sequential Logic Circuits. Modelation and Simulation of Digital Systems with VHDL. Memories, SPLDS, CPLDS and FPGAS. Digital Systems Synthesis.

Course contents (extended version)

1. Number Systems and Binary Codes
   - Conversion between the binary, octal and hexadecimal number system
   - Signed Number Representation
   - Arithmetic Operations
   - Binary Codes
   - Introduction to data transmission
2. Logic Gates and Boolean Algebra
   - Boolean Variables
   - Elementary Logic Operations
   - Canonical form of a logical expression
   - Other logical operations
   - Logical Gates and Logical diagrams
   - The NAND and NOR functions as universal modelling operators
   - Theorems and properties of Boole's Algebra
   - Logical Expression Simplification
3. Logical Operations using electrical signals
   - Logical Integrated Circuits (IC)
   - Logical IC Families
   - Switching Dynamics
4. Combinatory Integrated Circuits
   - Coders and decoders
   - Multiplexers and Demultiplexers
   - Logical function modellation using multiplexers
   - Code converters
   - Adders, subtractors and ALU's
5. Sequential Logic Circuits
   - Multivibrators
   - Latches and Flip-Flop's
   - Counters
   - Digital counter design
   - Registries
   - State machines
   - Design of synchronous sequential circuits
6. Modelation and Simulation of Digital Systems with VHDL
   - Abstraction and Hierarchical Decomposition
   - Hardware behaviour description
   - Basic VHDL concepts
   - Concurrent Systems vs. Sequential Systems
   - Digital Systems Modelation

Recommended reading

1. Digital Electronics – Tokheim, McGraw Hill, 2007
2. Digital Design With Standard MSI & LSI – Thomas Blakesler, 1979
3. Digital Integrated Circuits – Thomas DeMassa, Zack Ciccone, 1995
4. VHDL Programming by Example – D. Perry, Mc Graw Hill, 2002
5. Digital Circuits- WiKiBOOKS . https://en.wikibooks.org/wiki/Digital_Circuits

Teaching and learning methods

Most of the topics will be introduced, by the teacher, in presential classes. The concepts will be further investigated: - On presential sessions where the concepts are introduced and laboratory assignments are developed. - On non-presential time where the topics are further exploited by means of application exercises or group

Teaching and learning methods

work assignments.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Laboratory Work - 50%
   - Final Written Exam - 50%
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100%

Language of instruction

Portuguese

Electronic validation

João Paulo Coelho	José Luís Sousa de Magalhaes Lima	Orlando Manuel de Castro Ferreira Soares	José Carlos Rufino Amaro
01-10-2023	11-10-2023	14-10-2023	31-10-2023