

Course Unit	Digital Electronics		Field of study	Electronics and Instrumentation	
Bachelor in	Electrical and Computers Engineering		School	School of Technology and Management	
Academic Year	2022/2023	Year of study	1	Level	1-1
Type	Semestral	Semester	1	ECTS credits	6.0
Workload (hours)		162	Contact hours	T 15   TP 15   PL 30   TC -   S -   E -   OT -   O -	
Code 9112-742-1105-00-22					

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 family;
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 applicable.

### 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 Circuits and Microprocessors - H. Taub, McGraw Hill, 1981
2. Digital Electronics – Tokheim, McGraw Hill, 2007
3. Digital Design With Standard MSI & LSI – Thomas Blakesler, 1979
4. Digital Integrated Circuits – Thomas DeMassa, Zack Ciccone, 1995
5. VHDL Programming by Example – D. Perry, Mc Graw Hill, 2002

### 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 - 60%
  - Final Written Exam - 40%
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 100%

**Language of instruction**

Portuguese

**Electronic validation**

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29-09-2022	16-10-2022	21-10-2022	07-11-2022