Universidad Zaragoza

**Academic Year/course: 2024/25**

# 30315 - Digital Electronics

## Syllabus Information

**Academic year:** 2024/25
**Subject:** 30315 - Digital Electronics
**Faculty / School:** 110 - Escuela de Ingeniería y Arquitectura
**Degree:** 438 - Bachelor's Degree in Telecommunications Technology and Services Engineering
581 - Bachelor's Degree in Telecommunications Technology and Services Engineering
**ECTS:** 6.0
**Year:** 2
**Semester:** Second semester
**Subject type:** Compulsory
**Module:**

## 1. General information

The objective of the subject is to train the student in the fundamentals of digital electronics. The aim is to achieve the capacity of analysis, design and maintenance of digital electronic systems.

## 2. Learning results

In order to pass this subject, the students shall demonstrate they has acquired the following results:

- Understand the fundamentals of digital abstraction that allows the implementation of systems that process digital signals, considering the different technological aspects: power supply, delay, consumption, logic levels, high impedance.
- Be capable of designing and verifying logic systems using combinational and sequential digital electronic circuits.
- Understand the functionality and interface of the digital subsystems at the temporal and physical logic level.
- Be capable of designing digital systems using programmable logic devices.
- Apply CAD tools to capture and simulate simple digital circuits.
- Understand HDL modeling of simple synchronous sequential and combinational circuits, using different levels of abstraction.
- Verify digital blocks of implementations of a certain complexity

## 3. Syllabus

**Theoretical agenda:**

*UNIT 1. Digital design in PLDs using VHDL.*

Topic 1: Hardware Implementation of Logic Systems.

- Implementation options.
- Introduction to Programmable Logic Devices (PLDs). FPGAs.
- Hardware description language VHDL: Basic elements, structure of a VHDL file, statements, test environments.
- Design of digital electronic systems: Methodology, tools and design flow.

Topic 2: VHDL modeling of digital systems.

- Combinational building blocks: Code converters. Information distributors. Tri-state adaptor. Parity generators/checkers. Arithmetic operators. Look-up table (ROM).
- Sequential building blocks: Flip-flops. Registers. Counters.
- Digital circuit design rules, HW oriented VHDL description.

Topic 3: RTL design.

- RTL architecture.
    - Control: Finite State Machines (FSM).
    - Input/output interface: AXI4-Stream interface.
    - Data path: Sequential iterative circuit.

*UNIT 2. Digital I.C. Technologies*

Topic 4: Digital circuit technologies.

- Device technology. CMOS technology.
- Special Input/Output structures.
- Operational characteristics and basic parameters of digital i.c.
- Interconnection.
- Implementation technologies: Fixed function integrated circuits. Programmable logic devices (SPLD, CPLD and FPGA).

**Practical topics:**

- Introduction to design tools. Simple Computer ALU.
- Combinational building blocks. 6 bits multiplier.
- Sequential building blocks. Asynchronous serial transmission.
- Finite state machines. Asynchronous serial reception.
- Input/output interface. Sine generator with AXI4-Stream interface.
- Design exercise.

## 4. Academic activities

1.- Block A: 2.4 ECTS (60 hours)

1) Lectures (45 classroom hours).

1.1) Theoretical classes: Expository and explanatory sessions of contents. The concepts and fundamentals of digital systems will be presented and illustrated with real examples. The participation of the studentwill be encouraged through questions and brief discussions.

1.2) Problem solving classes: Problems and cases will be developed with the participation of the students, coordinated at all times with the theoretical contents. The student is encouraged to pre-work the problems.

2) Laboratory practicals (15 classroom hours).

It will consist of the implementation of applications in a development system, where the methodology of design, the operation of the application and the use of the tools will be assessed. The student will have a script for each practical, which they will have to prepare before its development in the laboratory.

2.- Block B: 3.6 ECTS (90 hours)

1) Teaching assignments (24 hours). This section includes the elaboration of the previous work required in the preparation of the laboratory practices, as well as the elaboration of the reports of the practices carried out.

2) Study (60 hours). The continuous work of the student will be encouraged through the homogeneous distribution throughout the semester of the various learning activities. The tutorials allow direct attention to the student, identification of learning problems, guidance in the subject, attention to exercises and assignments..

3) Assessment tests (6 hours) In addition to the grading function, the evaluation is also a tool of learning with which the student checks the degree of understanding and assimilation achieved.

## 5. Assessment system

**The student must demonstrate that they have achieved the intended learning results through the following assessment activities:**

Laboratory Practices (20%): They will be graded by observation and analysis of the students' work and of the practice reports elaborated. To pass the internship during the teaching period it is necessary to complete all the practices and obtain a minimum score of 5 points.

Theoretical-practical exam (80%): Composed of theoretical-practical questions and problems, to be carried out at the official.

GLOBAL TEST (OFFICIAL CALLS)

The student's global assessment will be carried out in the two official exams.

- Theoretical-practical exam: *CT* grade from 0 to 10 points (80%).

- Laboratory exam: *CL* grade from 0 to 10 points (20%). It should only be taken by students who have not passed the practice during the teaching period. The exam will consist of the implementation of digital circuits similar to those developed during the course in the laboratory practice sessions.

The final grade will correspond to the weighted average between the grade of the practical part (CL, 20%), and the grade of the corresponding final exam (CT, 80%). However, it will be necessary to obtain a minimum grade of 4 points in each of the parts in order to pass the subject.

## 6. Sustainable Development Goals

7 - Affordable and Clean Energy
13 - Climate Action