

## 26957 - Digital Systems

### Syllabus Information

**Academic year:** 2024/25

**Subject:** 26957 - Digital Systems

**Faculty / School:** 100 - Facultad de Ciencias

**Degree:** 447 - Degree in Physics

**ECTS:** 5.0

**Year:**

**Semester:** First semester

**Subject type:** Optional

**Module:**

### 1. General information

This subject presents the design and characterization techniques of the digital electronic systems that constitute the fundamental core of the measuring and calculation equipment used in the study of experimental phenomena in the laboratory.

The theoretical formulation of the common combinational and sequential blocks is presented, insisting on concepts such as memory or state of a system.

The microcontroller concept and its programmability (C, Python) will be developed as the most flexible and powerful element in the design of complex digital systems.

Due to the transversality of the contents of the subject, it can be applicable to all areas of experimental physics.

### 2. Learning results

- Obtain and simplify the logic functions that correspond to the truth tables and state diagrams that define a digital system.
- Know the basic combinational and sequential systems and their integration in more complex systems.
- Analyse the characteristics of the functional blocks of a microcontroller.
- Understand the internal electronic architecture and operation of microinstructions.
- Realize the necessary software for the control of the various devices and input/output ports of a microcontroller

The skills acquired in this subject enable the student to understand in depth the structure and operation of digital electronic systems included in any laboratory instrumentation used in experimental measurement systems, computers and other current electronic devices.

In addition, the interdisciplinary nature of this subject and the transversal nature of its contents make it especially relevant for any student of the Degree in Physics degree, regardless of the curricular itinerary chosen.

### 3. Syllabus

#### LOGIC FUNCTIONS

- Definition
- Canonical terms
- Simplification of functions

#### DIGITAL CIRCUITS

- Logic gates
- Logic diagrams
- Electronic technologies
- Laboratory examples

#### COMBINATIONAL SYSTEMS

- Features
- Multiplexers, demultiplexers
- Decoders and comparators

## **BINARY ARITHMETIC**

- Binary adder
- Signed sum
- Arithmetic-logic unit
- Advanced adders
- Multiplication

## **SEQUENTIAL SYSTEMS**

- Definitions
- Bistables
- Synchronous systems

## **COUNTERS AND REGISTERS**

- Introduction
- Asynchronous and synchronous counter
- Introduction to registers
- Linear Feedback Shift Registers

## **MEMORY**

- Introduction
- Configuration of a memory
- ROM and RAM architectures
- Memory maps

## **MICROCONTROLLERS**

- Architecture
- Registrations
- Peripherals, ports
- Interruptions
- Microcontroller programming

## **ARDUINO**

- Introduction
- Program structure. Configuration
- Basic functions, interruptions
- Communications. Synchronous data transfer
- Laboratory examples

## **4. Academic activities**

### **The activities developed in the subject are:**

- Participative master classes.
- Case-based learning.
- Problem solving in small groups.
- Practical and/or laboratory demonstrations.
- Preparation of reports.

### **The training activities used are:**

- Acquisition of knowledge of the contents of the subject (3 ECTS)
- Resolution of problems and cases related to the subject (1 ECTS)
- Design and experimental verification of various electronic systems (1 ECTS)

## 5. Assessment system

Laboratory experiences (40%). Evaluation of continuous and individual work in the laboratory and reports submitted. Its realization is mandatory. Reports should include the rationale for the experimental system, detailed description and graphical evidence of its operation in the laboratory, to be submitted in a suitable electronic format.

Final project (60%). Chosen from a list provided by the teachers of the subject or proposed by the student. Its development will require the application of theoretical and experimental knowledge, as well as skills acquired in the subject. The student will deliver a report of the project, in electronic support, which will include a descriptive exposition based on the theoretical-practical principles on which it is based, analysis by blocks and experimental results obtained. The evaluation will be carried out by peers, through the presentation of the results to the rest of the peers. This grade may be modulated by the teacher on the basis of the submitted report and laboratory evidences.

### **Passing the subject by means of a single global test:**

There will be a written test with theoretical and practical questions (30%) and a laboratory practice exam (70%) on the contents developed throughout the term.

## 6. Sustainable Development Goals

4 - Quality Education

8 - Decent Work and Economic Growth