

## 26957 - Digital Systems

### Syllabus Information

**Academic Year:** 2021/22

**Subject:** 26957 - Sistemas digitales

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

**Degree:** 447 - Degree in Physics

**ECTS:** 5.0

**Year:** 4 and 3

**Semester:** First semester

**Subject Type:** Optional

**Module:**

### 1. General information

### 2. Learning goals

### 3. Assessment (1st and 2nd call)

### 4. Methodology, learning tasks, syllabus and resources

#### 4.1. Methodological overview

The methodologies applied in the development of the course are:

- ? Participatory master classes
- ? Case-based learning
- ? Master classes in small groups
- ? Problem solving in small groups
- ? Laboratory practices and/or demonstrations
- ? Report writing

These methodologies are intended for the student to acquire skills that enable him/her 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 particular:

- ? Apply Boolean algebra to the analysis and synthesis of basic combinational and sequential logical systems
- ? Know and know how to choose between the different options of the design of digital electronic systems
- ? Understand how a microprocessor architecture works
- ? Design and program digital electronic systems based on microprocessors

Furthermore, the interdisciplinary nature of this subject and transversality of its contents make this course especially relevant for any student of the Physics degree regardless of the chosen curricular itinerary.

#### 4.2. Learning tasks

This is a 5 ECTS course organized as follows:

##### **Training Activity 1**

Acquisition of knowledge about the contents of the subject (3 ECTS)

##### **Training Activity 2**

Resolution of problems related to the contents of the course (1 ECTS)

### **Training Activity 3**

Design and experimental verification of various electronic systems (1 ECTS)

## **4.3. Syllabus**

The course will address the following topics:

### **Section 1. LOGICAL FUNCTIONS**

- 1.1 Definition and properties
- 1.2. Canonical terms. Shannon Theorem
- 1.3. Simplification of functions: algebraic reduction, K-maps, computational methods

### **Section 2. DIGITAL CIRCUITS**

- 2.1. Logic gates. Characterization
- 2.2. Logic diagrams
- 2.3. TTL technology
- 2.4. CMOS technology
- 2.5. Laboratory examples

### **Section 3. COMBINATIONAL SYSTEMS**

- 3.1. General characteristics
- 3.2. Multiplexers, demultiplexers
- 3.3. Decoders and comparators

### **Section 4. BINARY ARITHMETICS**

- 4.1. Basic block: binary adder
- 4.2. Signed sum
- 4.3. Arithmetic-logic unit
- 4.4. Carry lookahead circuits
- 4.5. Binary multiplication

### **Section 5. SEQUENTIAL SYSTEMS**

- 5.1. Definitions
- 5.2. Types of bistable
- 5.3. Synchronous sequential systems, Moore and Mealy architectures

### **Section 6. COUNTERS AND REGISTERS**

- 6.1. Introduction to counters
- 6.2. Asynchronous counter
- 6.3. Synchronous counter
- 6.4. Introduction to the registers
- 6.5. Shift register
- 6.6. Linear Feedback Shift Register (LFSR)

### **Section 7. MEMORIES**

- 7.1. Introduction
- 7.2. Memory configuration, buses
- 7.3. ROM architectures
- 7.4. RAM architectures
- 7.5. Memory maps

### **Section 8. MICROCONTROLLERS**

- 8.1. Basic description, architecture
- 8.2. Microcontroller registers
- 8.3. Peripherals and input/output ports
- 8.4. Interrupts

8.5. Microcontroller programming

## **Section 9. ARDUINO**

9.1. Introduction

9.2. Structure of a program. Configuration

9.3. Basic read/write functions, interrupts

9.4. Communications. Synchronous data transfer

9.5. Laboratory examples

## **Section 10. PERIPHERAL DEVICES**

### **4.4. Course planning and calendar**

The distribution of the different activities will be given according to the academic schedule of the corresponding course. The evaluation sessions are those determined and published every year by the Faculty of Science.

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the [ciencias.unizar.es](http://ciencias.unizar.es) webpage.

### **4.5. Bibliography and recommended resources**

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=26957>