Universidad Zaragoza

Year : 2019/20

28820 - Electronic Technology II

Syllabus Information

Academic Year: 2019/20
Subject: 28820 - Electronic Technology II
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 424 - Bachelor's Degree in Mechatronic Engineering
ECTS: 6.0
Year: 3
Semester: First semester
Subject Type: Compulsory
Module: ---

1.General information

1.1.Aims of the course

The general objective of the course is to provide the necessary knowledge to interpret and solve digital electronic circuits, especially in the areas of combinational circuits and sequential circuits.

This requires the correct use of the most common computer applications for simulation of circuits and of the measuring and feeding instruments commonly used in the electronics laboratory and correctly interpreting the technical documentation of the components used.

Indicators that the objectives have been achieved it, will be: the ability to interpret plans of commercial electronic equipment and applications and the ability to make electronic schemes according to the appropriate regulations and symbols, and finally, the preparation of technical reports on the practical activities carried out.

1.2.Context and importance of this course in the degree

The subject of Electronic Technology II is part of the Mechatronic Engineering Degree taught by EUPLA, framed within the group of subjects that make up the module called Electricity and Electronics. It is a subject of the third course located in the fifth semester and a mandatory character (MC), with a teaching load of 6 ECTS credits.

It is part of the subject Electronic Technology that has six associated subjects, all of them of 6 ECTS credits, of which this is the second one that is proposed in the temporal sequence of the curriculum, its content is focused on Digital Electronics.

It has the subject of Electronics Technology I, also mandatory (MC), which is taught in the fourth semester focused on Analog Electronics, both form the convenient electronic basis to successfully face the set of subjects that give continuity to training electronic courses that are taken in the sixth semester: Programmable Electronic Systems, Power Electronics and Electronic Instrumentation.

In addition, the offer of training in Electronic Technology is completed with an optional subject (OP) called Advanced Instrumentation of the eighth semester.

1.3.Recommendations to take this course

The development of the subject of Electronic Technology II requires putting into play knowledge and strategies, coming from subjects corresponding to the previous courses and semesters of the Degree in Mechatronic Engineering, related to:

Mathematics, Physics, Chemistry, Technical Drawing, Computer Science, Electrical Engineering and Electronic Technology I.

2.Learning goals

2.1.Competences

As generic and specific competence, the student will acquire:

- Knowledge of the fundamentals of electronics (EI05).
- Interpret and solve analog electronic circuits that use operational amplifiers (EE02 and EE04).
- Interpret and solve power supply circuits, adjusting their characteristics to the needs of the application where they are used (EE02 and EE04).
- GI03: Knowledge in basic and technological subjects that enable you to learn new methods and theories, and

provide you with the versatility to adapt to new situations.

- GI04: Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
- GI06: Capacity to handle mandatory specifications, regulations and standards.
- GC02: Interpret experimental data, contrast it with the theoretical and draw conclusions.
- GC03: Capacity for abstraction and logical reasoning.
- GC04: Ability to learn continuously.
- GC05: Capacity to evaluate alternatives.
- GC06: Capacity to adapt to the rapid evolution of technologies.
- GC07: Ability to lead a team as well as being an active member of it.
- GC08: Ability to locate technical information, as well as its understanding and assessment.
- GC09: Positive attitude towards technological innovations.
- GC10: Ability to write technical documentation and to present it with the help of appropriate computer tools.
- GC11: Ability to communicate their reasoning and designs clearly to specialized and non-specialized audiences.
- GC14: Ability to understand the operation and develop the maintenance of mechanical, electrical and electronic equipment and installations.
- GC15: Ability to analyze and apply simplified models to technological equipment and applications that allow forecasting of their behaviour.
- GC16: Ability to configure, simulate, build and test prototypes of electronic and mechanical systems.
- GC17: Capacity for the correct interpretation of plans and technical documentation.

2.2.Learning goals

The student, to pass this subject, must demonstrate the following results:

- Explain the behaviour of digital electronic devices (combinational and sequential), applying fundamental principles and logical laws, using vocabulary, symbols and appropriate forms of expression.
- Analyze the operation of typical electronic circuits, which use digital functions, describing their operation by truth tables, operation tables, input-output waveforms and transfer functions.
- Select and correctly use the components of a digital electronic circuit, both in combinational and sequential applications, detailing its function in the block where they are used.
- Analyze and interpret diagrams and plans of applications and electronic equipment of digital technology, including the function of an element or functional group of elements in the set, based on existing regulations.
- Select and interpret adequate information to raise and evaluate solutions to common technical needs and problems in the field of Digital Electronics, with a level of precision consistent with the various magnitudes involved in them.
- Choose and properly use the typical measuring devices in the Electronic Laboratory, assessing its field of application and degree of precision.
- Know how to use the general methodology and the appropriate software tools to work on applied Digital Electronics.

2.3.Importance of learning goals

Being the third subject that is taught in the module of Electricity and Electronics, and that complements the subject Electronic Technology I, (taught in the course and previous semester) centred that in Analogic Electronics, is complemented in this new subject with Electronics Digital.

Achieve good results in learning, will assume a base level for the student, which will facilitate the study of the other subjects of this module that are taught in semesters and/or later courses, especially in Power Electronics, Electronic Instrumentation and Systems Programmable Electronics.

Applying the descriptive methods of truth tables, state maps and timelines to the digital schemes analyzed, correctly using the main magnitudes and electrical units, are essential in the professional practice of the Engineer, for which the ability to interpret technical documentation is also required: data sheets of electronic devices, device manuals, regulations, regulations, etc.

Analyze and solve both combinational and sequential circuits are essential elements in the knowledge of Digital Electronics and necessary for any development in the field of Mechatronics, which must be made clear by knowing how to select the most suitable components and functions for the design of circuits of digital applications.

Know the management of the main electrical measuring devices: voltmeter, ammeter, ohmmeter, wattmeter, oscilloscope, etc. used in the electronics laboratory, as well as the logical analyzers and acquire manual dexterity in practical assemblies, will allow the student to consolidate the concepts taught in this subject as well as in the others that make up the Electricity and Electronics module.

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The Electronic Technology II course is designed as a set of contents but distributed in four blocks. The first block brings together basic concepts of Digital Electronics, numbering systems, etc. The second and third blocks make up the core that the subject must provide to the student's training. The final block gathers further interesting complementary knowledge to complete the training in Digital Electronics.

The first three blocks will be dealt with under three fundamental and complementary ways: the theoretical concepts of each didactic unit, the resolution of problems or questions and lab practice activities, supported in turn by another series of activities such as tutorials and seminars and will be tested individually, regardless of the blocks.

The fourth block will have a different treatment because the students will work in groups only previously assigned sections, they will be able to express their preferences but all the subjects will have to be assigned to some group. They will prepare presentation materials and defend their work with a public presentation, which will be valued by the rest of the students and the teacher.

The teacher/student interaction is carried out in this way, through the distribution of work and responsibilities between students and teachers. However, it must be taken into account that, to a certain extent, students can set the pace of learning according to their needs and availability, following the guidelines set by the teacher.

The organization of teaching involves the active participation of the student, and will be carried out following the following guidelines:

- Lectures: Theoretical activities imparted in a fundamentally expositive way by the teacher, in such a way as to expose the theoretical supports of the subject, highlighting the fundamental, structuring the concepts and relating them to each other.

- Practical lessons: The teacher solves problems or practical cases for illustrative purposes. This type of teaching complements the theory explained in the lectures with practical aspects.

- Seminars: The total group of lectures or practical lessons may or may not be divided into smaller groups, as appropriate. They will be used to analyze cases, solve problems, etc. Unlike what happens with the practical lessons, the teacher is not a protagonist, simply listening, counselling, clarifying, evaluating, assessing. It seeks to encourage student participation, as well as making the continuous assessment of students possible and to learn about the performance of learning.

- Lab Practice: The total group of lectures will be divided into several shifts, according to the number of students enrolled, but never with more than 20 students per shift, so that smaller groups can be formed. Students will carry out assemblies, measurements, simulations, etc., in the laboratories in the presence of the trainee teacher. Three times throughout the semester, they must defend their laboratory work in front of the professor.

- Group tutorials: Programmed activities of learning follow-up in which the teacher meets with a group of students to guide their work of autonomous learning and supervision of works directed or requiring a high degree of advice by the teacher.

- Individual tutorials: These are the ones made through the individual attention of the teacher in the department.

4.2.Learning tasks

The course includes the following learning tasks:

Generic on-site activities:

- **Lectures**: The theoretical concepts of the subject will be explained and illustrative practical examples will be developed as a support for the theory when it is deemed necessary.
- **Practical lessons**: Problems and practical cases will be made as a complement to the theoretical concepts studied.
- **Practical tasks**: Students will be divided into several groups of no more than 20 students, being guided by the tutorial action of the teacher.
- **Defence and presentation of topics:** on the particular contents that are assigned to each group of students, corresponding to Block 4.

Generic off-site activities:

- Study and assimilation of the theory explained in the lectures.
- Understanding and assimilation of solved cases in practical lessons.
- Preparation of seminars, solving suggested problems, etc.
- Participation in Forums of the subject via Moodle, to provide links of information on the Internet.
- Preparation and development of scripts and corresponding reports.
- Preparation of written continuous assessment tests, and global assessment tests.

Autonomous tutored activities:

Although they will be done on-site, they have been taken into account separately because of their particular features, they will be focused mainly on seminars and tutorials under the supervision of the teacher.

Reinforcement activities:

Off-site activities preferably, via the virtual portal of teaching (Moodle), will be designed to reinforce the basic contents of the subject. These activities can be personalized or not.

4.3.Syllabus

The theoretical contents are divided into four blocks (numbers 1 to 4) preceded by a block 0 of introduction to Digital Electronic Technology. The choice of the content of the blocks has been made looking for the express clarification of the final objective, so that with the union of incidental knowledge, the student obtains a structured knowledge, easily assimilated for the Mechatronics Engineers.

Each of the blocks is composed of topics, on a weekly basis, one per course week. These topics include the contents necessary for the acquisition of predetermined learning outcomes.

Theoretical contents

Block 0: INTRODUCTION

? Overview of Digital Technology. Components, Functions, Manufacturing techniques, Integration levels.

? Conceptual maps

Block 1: INTRODUCTION TO DIGITAL TECHNIQUES

1.- Basic elements of digital technology

? Numbering systems

? Binary codes

? Boolean Algebra

? Logical doors

2.- Digital Integrated Circuits

? Techniques and manufacturing processes

? Digital technologies and families. Interface

? Technical parameters. Logic levels, delays, speed, etc.

3.- Combinational Logical Design Methods

? Logical gates: Karnaugh methods.

? Integrated circuits with logic gate function

? Integrated circuits with O-Exclusive function

? O-Exclusive Function: Venn Boards

? Application design and implementation

Block 2: ANALYSIS AND DESIGN OF COMBINATIONAL LOGIC CIRCUITS

4.- Encoders and Decoders

? Integrated circuits with encoder-decoder functions

? Decoder: Summations and positive-negative logic

? Application design and implementation

? 7-segment BCD and ASCII decoders

5. Multiplexers and Demultiplexers

? Integrated circuits with Multiplexor-Demultiplexor functions

? Multiplexers: State setting tables

? Application design and implementation

6.- Other Combinational Functions

? Comparators

? Arithmetic circuits

? Parity Generators-detectors

Block 3: ANALYSIS AND DESIGN OF SEQUENTIAL LOGIC CIRCUITS

7.- Basic and synchronized bistables

? RS bistable and other performances

? Status maps and symbols

? Design and time schedules

? Synchronization by levels and flanks

? JK / Master-Slave

? D / Edge-Triggered

? T-mode behaviours

8.- Digital Counters and Digital Records

? Asynchronous counters and synchronous counters

? Account Modes. Design Processes

? Sequencer counters. Universal counter

.

? Storage and displacement records

? Serial / parallel inputs. Serial/parallel outputs

? Left / right shift.

? Universal Record. Accumulating Record.

9.- P.L.D and A.S.I.C. Matrix architectures

? Programmable Logic Devices (PLD)

? Evolution of PLDs: PAL, PLA, GAL, Macro-cells, ...

? FPGA, LCA-RAM, EPLD, CPLD, ...

? Development processes with PLD

? Hardware description languages ??(HDL)

? Application-Specific Integrated Circuits (ASIC)

? Gate-Array, Standard-Cell, Full-Custom

Block 4: HIGH-DIGITAL INTEGRATION OF DIGITAL DEVICES

10.- Semiconductor memories

? Architecture: Cells, Addressing

? Volatile memories: Statics and Dynamics

? Non-volatile memories: from ROM to Flash

11.- A / D and D / A Converters

? Direct Digital-Analog Converters

? Feedback Analog Digital Converters

? Digital Analog Converters

12.- Computer Systems

? Microcomputers

? Microprocessors

? Programmable Logic Controllers (PLCs)

5.3.2. Practical contents

Each block exposed in the previous section has associated practices in this regard, either through practical assumptions and/or physical or simulated assembly work leading to obtaining results and their analysis and interpretation. As the topics are developed, these Practices will be proposed, preferably in the classroom and also through the Moodle platform.

Practices to be developed in the Laboratory are given below. They will be carried out by the students in one-hour sessions, except in the final practice, in which the three hours of Block 4 are accumulated

PRACTICE 1: ASSOCIATED WITH BLOCK 1

Exercise 1: Code Changing and Multisim Simulator handling

Use of the logic converter instrument

Use of the word-generating instrument

Using the Logical Analyzer Instrument

Exercise 2: Consultation and interpretation of technical information of digital integrated circuits

Date Query of digital components in PDF

Access to the library data of the simulator Multisim

Measurement of logic levels and delay times in logic inverters

Exercise 3: Design and Simulation Exercises by Karnaugh and O-Exclusive

Logical design processes with the Karnaugh method

The capture of NAND / NOR gates in the simulator.

Logical design processes with the O-Exclusive method

Schemes of NAND / NOR and O-Ex gates in the Multisim simulator

Simulation in Multisim, compiling and checking on Digilent Basys-2

PRACTICE 2: ASSOCIATED WITH BLOCK 2

Exercise 1: Decoder Design and Simulation Exercises

Logical design processes with the Decoder method

Capturing NAND / NOR and Decoder gates in the simulator.

Simulation in Multisim, compiling and checking on Digilent Basys-2

Exercise 2: Designing and Simulating Exercises by Multiplexers

Logical design processes with the Multiplexers method

Capturing diagrams with multiplexers in the simulator.

Simulation in Multisim, compiling and checking on Digilent Basys-2

Diagram Mounting with Multiplexers and Checking the Operation

Exercise 3: Simulation and/or assembly of other combinational functions

(One among the following)

Digital Comparators

Adder / Subtractor. ALU

BCD / 7-segment decoder

Parity_Detector_Generator

PRACTICE 3: ASSOCIATED WITH BLOCK 3 exercises

Exercise 1: Bistable Design, assembly and simulation

Assembling the RS bistable with NAND and/or NOR gates and checking

Verification of level synchronized bistables (RS-clock, D-clock)

Connection of D-latch bistables (storage register)

Checking JK / Master-Slave and D-Edge-Triggered bistables

JK bistable Cascade mounting in T-mode.

Simulation in Multisim, compiling and checking on Digilent Basys-2

Exercise 2: Counter and Register Application Design and Assembly

Digital Counter Connection such as timer or clock

Checking Universal Counter Functions

Shift Register Architecture

Serial / parallel and parallel / serial conversion

Checking universal register functions

Simulation in Multisim, compiling and checking on Digilent Basys-2

Exercise 3: Application Development with programmable logic devices

HDL Description for Digital Application

Compilation and simulation

Recording of the PLD. Physical verification of operation

PRACTICE 4: ASSOCIATED WITH BLOCK 4

Assembly, setting and documentation of one of the applications related to topics 10 to 12, depending on what is assigned for theoretical defence, so that most of the digital functions studied are used.

4.4.Course planning and calendar

Temporary distribution of a teaching week:

The subject is defined in the Verification Report of the Degree with a low experimental grade so that the 10 hours a week are distributed as follows:

? Theory-practical classes: 3 hours a week (blocks 1, 2 and 3)

5 hours per week (block 4)

? Practice tasks: 1 hour per week

? Other activities: 6 hours per week (blocks 1, 2 and 3)

4 hours per week (block 4)

Test schedule

For the assessment tests, described in the continuous assessment process, the following schedule is suggested:

? Week 3: Test 1 (Topics 1, 2 and 3)

? Week 7: Test 2 (Topics 4, 5 and 6)

? Week 12: Test 3 (Items 7, 8 and 9)

Presentation-Defense of Works

The ones belonging to Block 4 (Digital devices of the high scale of integration), will be tested orally during the three final weeks of the course, depending on the number of students and the specific development of the preparatory tasks.

4.5.Bibliography and recommended resources

Resources:

Theory Notes, PWP presentations, typical problems and Web links, all related to the syllabus, will be provided through the Moodle page of the subject.

Digital circuit simulation software and PLD development (Multisim) and manuals for their use, will be installed in a computer

room or Laboratory PCs. Download and installation in the personal computers of students will be allowed.

PCs, Multimeters, Oscilloscopes, Function Generators, Power Supplies, discrete and integrated electronic components, must be part of the Electronics Lab equipment.