Universidad Zaragoza

Academic Year/course: 2022/23

29510 - Digital Electronics

Syllabus Information

Academic Year: 2022/23
Subject: 29510 - Digital Electronics
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 625 - Bachelor's Degree in Industrial Processes' Data Engineering
ECTS: 6.0
Year: 2
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 and sequential circuits.

This requires the correct use of the most common computer applications for circuit simulation and of the measurement and power supply devices commonly used in the electronics laboratory, as well as the correct interpretation of the technical documentation of the components used.

These approaches and objectives are in line with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the course learning outcomes provides training and competence to contribute to their achievement to some degree:

- **4.4** By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.
- **4.7** By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture?s contribution to sustainable development.
- **9.1** Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.
- **9.4** By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.
- **12.2** By 2030, achieve the sustainable management and efficient use of natural resources.
- **12.5** By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

1.2. Context and importance of this course in the degree

The **Digital Electronics** course is part of the **Degree in Data Engineering in Industrial Processes** taught by the EUPLA, framed within the group of subjects that make up the module of Electricity and Electronics. It is a second year course located in the third semester and of compulsory nature (OB), with a course load of 6 ECTS credits.

It is included in the framework of Electronics, which has multiple associated subjects in the curriculum,

all of them of 6 ECTS credits, of which this is the second one proposed in the temporal sequence of the curriculum, being its content focused on Digital Electronics.

It has as a previous subject the subject **Circuits and Fundamentals of Electronics**, also compulsory (OB), which is taken in the second semester focused on Circuit Theory and Analog Electronics. Both form the convenient electronic base to successfully face the set of subjects that give continuity to the electronic training that are taken later on, such as Electronic Instrumentation.

1.3. Recommendations to take this course

The development of the subject of Digital Electronics, requires putting into play knowledge and strategies, coming from subjects corresponding to previous semesters of the Degree of Data Engineering in Industrial Processes, specifically:

Circuits and Fundamentals of Electronics.

In addition, it requires basic knowledge in branches such as:

Mathematics, **Physics** and **Computer Science**.

However, it is not a legal requirement to have passed them in order to take **Digital Electronics**.

2. Learning goals

2.1. Competences

As generic and specific competences the student will acquire:

- **(CG02):** Adequate knowledge and skills to analyze, synthesize, solve and communicate efficiently basic problems related to production processes in industry.
- **(CG03):** apply techniques for data acquisition, management and processing in engineering.
- **(CG05):** solve technological problems that may arise in data engineering in industrial processes.
- **(CB2):** that students know how to apply their knowledge to their work or vocation in a professional manner and possess the skills that are usually demonstrated through the development and defense of arguments and problem solving within their area of study.
- **(CB4):** that students can transmit information, ideas, problems and solutions to both specialized and non-specialized audiences.
- **(CB5):** that students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.
- **(CT03):** to search for, select and responsibly manage information and knowledge.
- **(CT05):** communicate results effectively.
- **(CT07):** analyze and solve problems autonomously, adapt to unforeseen situations and make decisions.
- **(CE07):** Use concepts of analog, digital electronics, instrumentation and programmable electronic systems.

2.2. Learning goals

The student, in order to pass this course, must demonstrate the following **results**:

- Explain the behavior of digital electronic devices (combinational and sequential), applying the fundamental logical principles and laws, using appropriate vocabulary, symbols and forms of expression.
- Analyze the operation of typical electronic circuits, which use digital functions, describing their operation by means of truth tables, operation tables, input-output wave graphs and transfer functions.
- Select and use correctly the components of a digital electronic circuit, both in combinational and sequential applications, detailing their function in the block where they are used.
- Analyze and interpret diagrams and drawings of electronic applications and equipment of digital technology, understanding the function of an element or functional group of elements in the whole, based on the existing regulations.
- Select and interpret adequate information to propose and evaluate solutions to common

needs and technical problems in the field of Digital Electronics, with a level of accuracy consistent with that of the various magnitudes involved in them.

- To choose and to use adequately the typical measuring devices in the Electronic Laboratory, valuing their field of application and degree of precision.
- To know how to use the general methodology and the appropriate software tools to work in applied Digital Electronics.

2.3. Importance of learning goals

Being the second subject taught in Electronics, and that complements the subject **Circuits and Fundamentals of Electronics**, (taught in the previous course and semester) focused on Circuit Theory and Analog Electronics, it is complemented in this new subject with **Digital Electronics**.

To achieve good results in the learning, it will suppose for the student a base level, which will facilitate the study of the other subjects of this module that are given in later semesters and/or courses, especially Electronic Instrumentation.

To apply the descriptive methods of **truth tables**, **state maps** and **chronograms** to the analyzed digital schemes, using correctly 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: datasheets of electronic devices, equipment manuals, standards, regulations, etc.

Analyzing and solving both combinational and sequential circuits are essential elements in the knowledge of Digital Electronics and necessary for any development in the field of Data Engineering, which must be shown by knowing how to select the most appropriate components and functions for the design of digital application circuits.

Knowing how to use the main electrical measuring devices: voltmeter, ammeter, ohmmeter, wattmeter, oscilloscope, etc. used in the electronics laboratory, as well as logic analyzers and acquiring manual dexterity in practical assemblies, will allow the student to consolidate the concepts taught.

3. Assessment (1st and 2nd call)

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

The student must demonstrate that he/she has achieved the expected learning results through the following evaluation activities:

In a general way the subject is divided into two blocks, whose average in each of the parts will be used for the calculation of the final grade, with the exception of the final work (Block 3).

CONTINUOUS EVALUATION

An evaluation system of continuous monitoring of the course is proposed, consisting of the following sections:

- **Written evaluation tests, of theoretical-practical character**: It will consist of the resolution of two questionnaires (one per subject block), where the student will demonstrate, by means of graphs, texts, equations and/or calculation, his/her mastery of the concepts worked in each subject block. Their combined weight on the grade will be between 50 and 70%.
- **Laboratory practices**: In each one of the practices the dynamics followed for its correct execution and operation will be valued, as well as the problematic raised in its development, being the specific weight of this section of 30% of the total mark of the practice. The remaining 70 % will be dedicated to the qualification of the report presented, that is to say, if the required data are correct and if the questions have been answered correctly. It is an indispensable condition to pass the practices in continuous evaluation, to attend 80% of them. Their combined weight on the grade will be 30%.

  If the laboratory practices could not be carried out in person due to health reasons, they would be carried out telematically, that is to say, they would be carried out in a simulation practice format. It could even be carried out in a "mixed" way.

- **Exercises, theoretical questions and proposed works**: Different exercises/tasks will be proposed in relation to

exposed during the development of the subject. These tasks will refer to the blocks in which the subject is divided. The teacher will be able to reject those assignments where the individual effort of the student is not demonstrated. Their overall weight on the grade will be up to 20%.

Those students whose weighted grade of the theoretical-practical exam, laboratory practices and proposed tasks is at least 5 points will pass the course in continuous evaluation. It is an indispensable condition to pass the subject in continuous evaluation, to attend 80% of the face-to-face activities: classes, technical visits, practices, etc.

GLOBAL EVALUATION

The student who does not pass the continuous monitoring evaluation system or does not wish to do it, will opt for a global evaluation, which is described below.

- **Examination of theoretical-practical contents**: It will consist of the resolution of two questionnaires (one per subject block), where the student will demonstrate, by means of graphs, texts, equations and/or calculations, his/her mastery of the concepts worked on in each subject block. Their combined weight on the grade will be 70%.
- **Laboratory practices**: In the case of not being able to attend the laboratory continuously for personal reasons or not passing the practices by the method of continuous evaluation. There will be an exam of practices that could be a test in the laboratory where a practice of similar difficulty to those realized in the laboratory during the course will be realized. If the professor considers it appropriate, this test in the laboratory can be substituted by a written test where the student will be asked to demonstrate that he/she knows the procedures, methodologies and assemblies carried out in the laboratory. The date of these exams will be fixed according to the availability of the laboratories of the center. Their combined weight on the grade will be 30%.

  If the laboratory practices could not be carried out in person due to health reasons, they would be carried out telematically, that is to say, they would be carried out in a simulation practice format. It could even be done in a "mixed" way.

Those students whose weighted grade of the theoretical-practical exam and the laboratory practices is at least 5 points will pass the course in global evaluation.

In general, the grades obtained in each of the blocks may be promoted to the following call/s within the same academic year as long as a grade equal to or higher than 4 points has been achieved.

On the first day of class, there will be a presentation of the subject where the evaluation models will be explained.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process designed for this course is based on the following:

- The teaching methodology is based on a strong teacher/student interaction. This interaction is materialized through a division of work and responsibilities between students and teachers. However, it should be taken into account that to a certain extent the students will be able to set their own pace of learning according to their needs and availability, following the guidelines set by the teacher.

The approach, methodology and assessment of this guide are intended to be the same for any teaching scenarios. They will be adapted to the social-health situation at any particular time, as well as to the instructions given by the authorities concerned.

4.2. Learning tasks

The program offered to the student to help him/her achieve the expected results comprises the following activities:

Classroom activities:

Theoretical classes: the theoretical concepts of the subject will be explained and practical examples will be developed.

Problem classes: The professor solves problems or practical cases for illustrative purposes. This type of teaching complements the theory exposed in the lectures with

practical aspects.

Tutored problem solving: Students will develop examples and carry out problems or practical cases related to the theoretical concepts studied.

Laboratory Practices: The total group of theoretical classes may or may not be divided into smaller groups, as appropriate. The students will carry out assemblies, measurements, simulations, etc. in the laboratories in the presence of the practical teacher.

Tutored autonomous activities: These activities will be tutored by the subject's teachers.

Reinforcement activities: Through a virtual teaching portal (Moodle) various activities will be conducted to reinforce the basic contents of the course. Their completion will be controlled through the same.

Non-attendance activities:

- Study and assimilation of the theory exposed in the master classes.
- Understanding and assimilation of problems and practical cases solved in the practical classes.
- Preparation of seminars, resolution of proposed problems, etc.
- Preparation of the laboratory practices, elaboration of the corresponding scripts and reports.
- Preparation of the written tests of continuous evaluation, and global evaluation test.

Teaching organization:

- **Lectures:** Theoretical and/or practical activities given by the professor in a fundamentally expository way.
- **Laboratory practices:** Practical activities carried out in the laboratories. The total group of theoretical classes may or may not be divided into smaller groups, as appropriate. The students will be guided by the tutorial action of the professor.
- **Group tutorials:** Scheduled learning follow-up activities in which the professor meets with a group of students to guide their work of autonomous learning and tutoring of directed work or work that requires a very high degree of advice from the professor.
- **Individual tutorials:** These are those carried out through personalized attention, on an individual basis, and may be face-to-face or virtual.

The course consists of 6 ECTS credits, which represents 150 hours of student work in the course during the semester. Forty percent of this work (60 hours) will be done in the classroom, and the rest will be autonomous. A semester will consist of 15 teaching weeks.

Overall time distribution:

The subject consists of 6 ECTS credits, which represents 150 hours of student work in the subject during the semester, i.e. 10 hours per week during 15 teaching weeks, which are distributed as follows:

- **44 hours of theoretical class:**50% of exposition of concepts and 50% of resolution of type-problems, at a rate of 4 hours per week, except in the weeks of practices or the weeks with control test that will be reduced by two hours.
- **12 hours of supervised laboratory practices:**weeks 1ª to 15ª sessions of 2 hours in alternate weeks.
- **4 hours of control tests** (2 controls of 2 hours), to be carried out (approximately) in the 8th and 15th weeks.
- **30 hours of group work:** spread over the 15 weeks of the semester.
- **60 hours of personal study:** at a rate of 4 hours in each of the 15 weeks of duration of the semester, to elaborate works, to carry out exercises, to study theory, etc...

Temporal distribution of one week of classes:

The subject is defined in the Verification Report of the Undergraduate Degree with a low experimental degree, so the 10 hours per week are distributed as follows:

- **Theoretical-practical classes:** 3 hours per week.
- **Laboratory practices:** 1 hour per week
- **Other activities:** 6 hours per week**.**

4.3. Syllabus

The theoretical contents are articulated on the basis of two blocks (numbers 1 to 2) 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 terminal objective, so that, with the union of incident knowledge, the student obtains a structured knowledge, easily assimilated by the Data Engineer.

Each one of the blocks is formed by topics, with a temporal assignment of one or two weeks of the course, these topics gather the necessary contents for the acquisition of the predetermined learning results, according to the following relation:

Theoretical contents

***Block 0:*INTRODUCTION: DIGITAL TECHNIQUES**

***Block 1:*ANALYSIS AND DESIGN OF LOGIC AND COMBINATIONAL CIRCUITS**

1.- Basic elements of digital technology and integrated circuits 2.
2.- Combinational Logic Design Methods
3.- Combinational Logic Circuits (Encoders and Decoders, Multiplexers and Demultiplexers and other Combinational functions).

***Block 2*: ANALYSIS AND DESIGN OF SEQUENTIAL LOGIC CIRCUITS**

4.- Basic and Synchronized Bistables
5.- Digital Counters and Digital Registers
6.- P.L.D and A.S.I.C. matrix architectures / Semiconductor memories

Practical contents

Each block exposed in the previous section, has practical exercises associated to it, by means of practical assumptions and/or physical or simulated assembly works, leading to the obtaining of results and their analysis and interpretation.

As the topics are developed, these Practical Exercises will be presented, preferably in class and also through the Moodle platform, they will be carried out by the students in weekly sessions of one hour duration, during the time dedicated to each Block.

4.4. Course planning and calendar

Schedule of face-to-face sessions and presentation of works

The schedule of the theory and problem classes, as well as the computer practice sessions, will follow the schedule established by the EUPLA, which can be consulted on its web page.

Each professor will inform about their tutoring schedules.

The dates of the final exams will be published officially at https://eupla.unizar.es/asuntos-academicos/examenes. The definitive calendar for the corresponding academic year will be available on the school's website https://eupla.unizar.es/.

The class schedules, as well as the distribution of groups for practices will be transmitted to the students by the professor at the beginning of the academic year, will be published on the Moodle platform as well as on the university center's website (https://eupla.unizar.es/).

The dates of other activities: (evaluative tests, seminars, compulsory practices, delivery of work ...) will be published in advance by the teacher both in class and through the Moodle platform.

Schedule of tests

For the evaluation tests, described in the continuous evaluation process, the following *approximate* schedule is proposed:

- **Test 1**: Topics 1, 2 and 3 (Week 7).
- **Test 2**: Topics 4, 5 and 6 (Week 13).

The weekly schedule of the course will be published in http://www.eupla.es/**.**

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=29510