Universidad Zaragoza

**Academic Year/course: 2022/23**

# 29503 - Circuits and Fundamentals of Electronics

## Syllabus Information

**Academic Year:** 2022/23
**Subject:** 29503 - Circuits and Fundamentals of Electronics
**Faculty / School:** 175 - Escuela Universitaria Politécnica de La Almunia
**Degree:** 625 - Bachelor's Degree in Industrial Processes' Data Engineering
**ECTS:** 6.0
**Year:** 1
**Semester:** Second semester
**Subject Type:** Basic Education
**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 analog electronic circuits, from basic networks to more complex circuits with diodes, transistors and operational amplifiers.

This requires the understanding and correct use of the most common procedures, obtaining information on electronic components and their applications, and correctly interpreting the technical documentation of the components used as well as computer applications for circuit simulation. The correct handling of the measuring and power supply devices commonly used in the electronics laboratory must also be achieved, as well as the proper interpretation of the measurements made.

The indicators that the objectives have been achieved will be: the ability to interpret electronic circuit diagrams and their basic applications, as well as the ability to perform the mathematical analysis that explains the operation of such circuits, and finally the production of technical reports on the practical activities carried out.

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 subject of **Circuits and Fundamentals of Electronics** is part of the Degree in Data Engineering in Industrial Processes taught by the EUPLA, within the training in Electricity and Electronics. It is a compulsory first-year course located in the second semester (OB), with a study load of 6 ECTS credits.

### 1.3. Recommendations to take this course

The development of the subject of **Circuits and Fundamentals of Electronics**, requires putting into play knowledge and strategies related to:

**Mathematics, Physics, Chemistry, Technical Drawing, Basic Computer Science.**

However, it is not a legal requirement to have passed them in order to take Circuits and Fundamentals of Electronics.

## 2. Learning goals

### 2.1. Competences

- **(CG03):** to apply techniques for the acquisition, management and treatment of data in Engineering.
- **(CG05):** to solve technological problems that may arise in data engineering in industrial processes.
- **(CB2):** students must know how to apply their knowledge to their work or vocation in a professional way and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of ??study.
- **(CB4):** students must be able to transmit information, ideas, problems and solutions to both specialized and non-specialized audiences.
- **(CB5):** students must develop those learning skills necessary to undertake further studies with a high degree of autonomy.
- **(CT03):** to search, select and manage information and knowledge responsibly.
- **(CT04):** to develop critical thinking and reasoning.
- **(CT05):** effective communication of results.
- **(CT07):** to analyze and solve problems autonomously, adapt to unforeseen situations and make decisions.
- **(CE03):** to use concepts and methods of physics and electronics necessary to solve the problems that arise from the acquisition of structured data.

### 2.2. Learning goals

To pass this subject, the student must demonstrate the following results:

? The student must be able to know the fundamentals of electricity and magnetism and their application in different fields of electricity and electronics.

? The student must be able to analyze passive RLC circuits.

? The student must know the basic electronic components.

? The student must be able to perform analysis and synthesis of circuits with diodes and transistors.

? The student must be able to perform analysis and design of circuits with operational amplifiers.

### 2.3. Importance of learning goals

This subject lays the foundations for the knowledge of Electricity and Electronics, within the degree of Data Engineering in Industrial Processes. With a reasonable mathematical base, the student should not have difficulties to achieve good results in the learning of **Circuits and Fundamentals of Electronics**.

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

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

The evaluation of the subject contemplates the continuous evaluation system, as the most appropriate to be in line with the guidelines of the EHEA (Bologna agreements), regarding the degree of involvement and continued work of the student throughout the course.

In order for students to benefit from the continuous assessment system, they will need to attend at least 80% of the classes. The lack of assistance must be adequately justified.

The continuous evaluation system will culminate with the weighted sum of the grade obtained in each of the four blocks contained in the subject:

**FINAL NOTE = Block 1 (40%) + Block 2 (30%) + Block 3 (30%) {+ Block 4 (10%)}**

The subject will be passed when in this weighted evaluation, a score equal to or greater than 5.0 points is obtained, taking into account that, to apply this weight, the minimum mark for each block of the subject will be 4.0 points. When the minimum is not reached in a single block, this average will not be applied and the student will be pending further evaluation. Prior to the first call, the teacher will notify each student whether or not they have passed the subject based on the level demonstrated in the continuous assessment system.

In case of not passing in this way, the student will have two additional calls to do so (global assessment test). The subject of the blocks that have not passed the minimum score of 4.0 will be compulsory, and the subject with higher score is optional, always under the responsibility of the student.

**Type of tests and evaluation criteria:**

For each of the indicated content blocks (unless expressly indicated), the types of activities described below will be controlled, applying the assessment criteria indicated:

- **Exercises, theoretical questions and proposed works:** Their approach and correct development, the writing and coherence of the treated will be valued, as well as the achievement of results and the final conclusions obtained. The qualification of the proposed theoretical-practical exercises will be taken into account.
- **Laboratory practices:** In each one of the practices the dynamics followed for its correct execution and operation will be valued, as well as the problems raised in its development. In the proposal of Tasks for each Practice Block (to be published in Moodle) the aspects of individual and group work to be carried out are indicated. The qualification of the report presented will assess whether the data required is correct and the questions asked have been answered correctly. The final grade for each block will be from 0 to 10. The suspended or not completed practices will be evaluated in a laboratory exam for which the appropriate dates will be enabled.
- **Written assessment test (for Blocks 1 to 3):** It will consist of solving theoretical / practical questions and problems, with reduced space for answers, where the student will demonstrate, through drawings, graphics, texts, equations and / or calculation, their mastery of the concepts worked on in each subject block. The mark of the partial block will be calculated as the average of the obtained in the topics covered.
- **Individual activities in Moodle Forums (for Blocks 1 to 3):** The active participation of the student will be taken into account, responding to the proposals made by the teacher in the corresponding forums.
- **Group activities in class (for Block 4):** This block will evaluate the defense and public exposure of the part of the subject assigned to each group of students as well as the technical report presented in this regard.

The weighting of the qualification process, of the different activities, in which the continuous evaluation process of the subject has been structured will be as follows:

**SECTIONS 1, 2 and 3:**

- Class activities, exercises and proposed work, Moodle activities: Maximum 20%.
- Laboratory practices: 30%.
- Written assessment tests: 50% -70%.

**SECTION 4:**

- Activity memory: 30%.
- Public defense of activity: 70%.

**The percentages presented for all the blocks assume that the minimum mark (4.0 points) has**

**been exceeded in each part of the subject: theory blocks 1 to 3, exposition of works from block 4 and laboratory practices in each block.**

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

### 4.1. Methodological overview

The subject of **Circuits and Fundamentals of Electronics** is conceived as a set of contents distributed in four blocks. The first block gathers the basic concepts of components, laws and analysis methods in Circuit Theory. The second and third blocks form the main core of the subject that the subject must contribute to the student's training in Analog Electronics: semiconductors, diodes, transistors and operational amplifiers. The final block includes some of the applications of Circuits and Fundamentals of Electronics, without pretending to cover all the fields of application of this discipline.

**The first three blocks** will be worked under three fundamental and complementary forms: the theoretical concepts of each didactic unit, the resolution of problems or questions and the laboratory practices, supported in turn by another series of activities such as tutorials and seminars and will be submitted to Individual, independent exam test for each of the blocks.

**The fourth block** will have a different treatment, since the students will work (voluntarily) in a group only the sections previously assigned to them, they will be able to express their preferences but all the topics will have to be assigned to a group. They will prepare presentation materials and defend their work with a public presentation, which will be evaluated in a weighted way by the rest of the students and the teacher.

**The teacher / student interaction** is thus materialized, through a distribution of work and responsibilities between students and teachers. However, it will be taken into account that to a certain extent the students will be able to set the pace of learning based on 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. If classroom teaching were not possible due to health reasons, it would be carried out on-line.
- **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. If classroom teaching were not possible due to health reasons, it would be carried out on-line.
- **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 do assemblies, measurements, simulations, etc., in the laboratories in the presence of the teacher. If classroom teaching were not possible due to health reasons, it would be carried out on-line.

Practical activities are carried out in groups of two /three students per shift, although for the reports students of two or more shifts can be grouped. For each subject block, guidelines for practical tasks will be given (compulsory and optional); In addition, the reporting rules will be specified in a guidance document, which will be handed out at the beginning of the practical activities.

- **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. They aim to help solve the doubts that students come across, particularly those who for various reasons cannot attend group tutorials or need more personalized attention. These tutorials can be in person or virtual.

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

**Generic on-site activities:**

? **Theoretical classes**: The theoretical concepts of the subject will be explained and illustrative practical examples will be developed to support the theory when necessary.

? **Practical classes**: Problems and practical cases will be carried out as a complement to the theoretical concepts studied.

? **Laboratory practices**: Students will be divided into several groups of no more than 20 students, being guided by the teacher's tutorial action.

? **Defense and presentation of topics**: on the specific content assigned to each group (volunteer) of students, corresponding to Block 4.

**Generic off-site activities:**

? Study and assimilation of the theory presented in the lectures.

? Understanding and assimilation of cases solved in practical classes.

? Preparation of seminars, solving proposed problems, etc.

? Participate in Forums / Moodle of the subject, to provide information links.

? Prepare and prepare the corresponding scripts and reports.

? Prepare the continuous assessment tests and the global assessment test.

**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 articulated based on four blocks (numbers 1 to 4). Each of the blocks is made up of weekly assignment topics, one for each of the weeks of the course; these topics collect the necessary content for the acquisition of predetermined learning outcomes.

**Theoretical contents:**

**Block 1: FOUNDAMENTALS AND THEORY OF CIRCUITS**

**1.-** Notions on electromagnetism and Maxwell's equations.
**2.-** Components and basic laws of Circuit Theory.
**3.-** Methods and theorems of circuit analysis.

**Block 2: DIODES AND TRANSISTORS**

**4.-** Semiconductors.
**5.-** Diodes and circuits with diodes.
**6.-** Transistors and circuits with transistors.

**Block 3: OPERATIONAL AMPLIFIERS**

**7.-** Amplification and amplifiers.
**8.-** Basic stages.

**9.-** Active filters and other applications.

**Block 4: APPLICATION CIRCUITS**

10.- Linear and switched power supplies.

11.- AD and DA conversion.

12.- Other fields of application of Circuits and Fundamentals of Electronics.

**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 develop, these Practices will be raised, preferably in class and also through the Moodle platform.

The practices to be carried out in the Laboratory are indicated below, which will be carried out by the students in sessions of approximately one hour and a half in duration.

**PRACTICAL BLOCK 1: ASSOCIATED WITH BLOCK 1**

? Basic electronic components. Basic measuring devices. Basic electronic circuits.

**PRACTICAL BLOCK 2: ASSOCIATED WITH BLOCK 2**

? Semiconductor components: diodes, transistors and operational amplifiers. Basic stages in assembly and / or simulation.

**PRACTICAL BLOCK 3: ASSOCIATED WITH BLOCK 3**

? Operational amplifiers: Basic configurations, active filters.

**PRACTICE 4: ASSOCIATED WITH BLOCK 4**

? Assembly, adjustment and documentation of one of the applications related to topics 10 to 12, depending on what is assigned for theoretical defense and the availability of suitable components.

### 4.4. Course planning and calendar

**Temporary distribution of a teaching week:**

The subject is defined in the Bachelor's Degree Verification Report with a low experimental grade, so the 10 hours per week are distributed as follows:

? **Theoretical-practical classes**: 2.5 hours per week (blocks 1, 2 and 3) / 5 hours per week (block 4).

**? Practices**: 1.5 hours per week.

? **Other activities**: 6 hours a week (blocks 1, 2 and 3) / 4 hours a week (block 4).

The 6 ECTS credits correspond to 150 student hours, which will be distributed as follows:

? **42 hours of theory class**: 70% approx. concept exposition and 30% approx. problem-solving-type, at a rate of 3 hours per week except in the weeks with a control test, which will be reduced by one hour and in the final weeks, which will be increased by two hours.
? **21 hours of tutored laboratory practices**: weeks 3 to 14 sessions of 1.5 hours.
? **15 hours of seminars and group tutorials**: to complete the practical activities of each block and especially for the preparation of block 4
? **66 hours of personal study**: at a rate of 5 hours in each of the 1st to 12th weeks, reducing to 2 hours in the final three weeks, to prepare work, perform exercises, study theory, etc ...
? **6 hours of control tests** (3 controls of 2 hours), which will be carried out in the weeks: 4th, 9th and 14th (approximately).

? To this calculation of 150 hours, 3 hours of global evaluation test will be added, in two calls.

In the continuous assessment process, the written (partial) assessment tests will be related to the following topics:

? **Partial 1:** Topics 1, 2 and 3 (Block 1).

? **Partial 2**: Topics 4, 5 and 6 (Block 2).

? **Partial 3**: Topics 7, 8 and 9 (Block 3).

In addition, in the third week a practical work will be assigned (Block 4), to be carried out preferably in

a group, which must be completed before the fourteenth week, in order to make a presentation / public defense to the rest of the students in the last week of the course.

### 4.5. Bibliography and recommended resources

**http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=29503**