

## 30121 - Basic principles of electronics

### Información del Plan Docente

<b>Academic Year</b>	2016/17
<b>Academic center</b>	175 - Escuela Universitaria Politécnica de La Almunia 179 - Centro Universitario de la Defensa - Zaragoza
<b>Degree</b>	425 - Bachelor's Degree in Industrial Organisational Engineering 563 - Bachelor's Degree in Industrial Organisational Engineering 457 - Bachelor's Degree in Industrial Organisational Engineering
<b>ECTS</b>	6.0
<b>Course</b>	3
<b>Period</b>	Half-yearly
<b>Subject Type</b>	Compulsory
<b>Module</b>	---

### 1. Basic info

#### 1.1. Recommendations to take this course

In order to be successful in this subject the student must pass the following subjects: Electrical engineering, and its recommended to have Physics and Chemical.

#### 1.2. Activities and key dates for the course

The activities of this subject and its temporal schedule depend on the academic organization proposed by the faculty (Centro Universitario de la Defensa o Escuela Politécnica de la Almunia) and you can read it in section 5, activities and resources.

### 2. Initiation

#### 2.1. Learning outcomes that define the subject

In order to pass the subject, the student should meet the following requirements...

1. Identifies the applications and functions of electronics in Engineering.
2. Recognises basic electronic components and devices used for the different electronic functions.
3. Uses basic techniques for analyses of analog and digital electronic circuits.
4. Is able to design analog and digital electronic circuits at the block level.
5. Manages the tools of a basic electronics laboratory and use electronic simulation tools.

#### 2.2. Introduction

##### Brief introduction to the subject

The subject of Electronics principles develops the fundamentals in technological electronics in order to know the basic principles of electronic devices that are embedded in nowadays technology.

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### 3.Context and competences

#### 3.1.Goals

**The expected result of the subject responds to the following goals**

The main goal of this subject is give to the student the basis foundations in electronics technology. Therefore one of the topics will be the study of digital and analogic electronics components, how they works, how to design and which are the main uses of these devices. We also work in methodological issues to the analysis and design of easy electronics circuits with the help of simulation tools and lab instrumentation.

#### 3.2.Context and meaning of the subject in the degree

Electronic foundations is a common subject in all the industrial engineering degrees and the knowledge of this subject is key to the engineering curricula.

#### 3.3.Competences

**The student must be able to...**

General competencies:

1. Have the ability to solve problems with initiative, take decisions, creativity and critical reasoning
2. Have the ability to communicate and transmit knowledge, abilities and skills in the field of the Spanish language.
3. Have the capability to use technics, skills and tools of engineering in order to be an engineer.

Specific competencies:

4. Knowledge in electronics foundations.

#### 3.4.Importance of learning outcomes

When students reach those competences they will be able to understand the foundations of how to work with several electronic devices and the equations that rule their behavior. They also need to understand the basis of instrumentation electronics. They need to have strong skills in lab equipment which allows reinforcing the theory with practical skills

This subject is the fundament for operational modules

### 4.Evaluation

**The student should demonstrate that s/he has achieved the foreseen learning results by means of the following evaluation activities...**

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1. Practical tasks (30%). These tasks include laboratory practices and problem-solving. At the beginning of each laboratory practices, the students should submit a preliminary study. Its quality will be considered in the evaluation since they are essential to perform the practices in an agile way. A final report should be submitted at the end of each practice. To pass the subject the student must obtain a final note in the laboratory practices equal or greater than 5.
2. A theoretical-practical test (70%) in which some questions and/or problems of the engineering area are proposed to be solved. Its typology and complexity level will be similar to those questions and problems seen in class. The test will be evaluated in terms of the quality and clarity of the solving strategy, of the concepts used to solve the problems, of the absence of errors in the development and solution, and of the correct use of terminology and notation. In each of the theoretical and practically written tests, students must obtain a note equal or greater than 5 to pass the subject.

### 5.Activities and resources

#### 5.1.General methodological presentation

The learning methodology designed for this subject is based on the following:

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There are a strong interaction between teacher and student. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

The current subject Automatic Foundation is conceived as a stand-alone combination of contents, yet organized into three fundamental and complementary forms, which are: the theoretical concepts of each teaching unit, the solving of problems or resolution of questions and laboratory work, at the same time supported by other activities

The organization of teaching will be carried out using the following steps:

- **Theory Classes** : Theoretical activities carried out mainly through exposition by the teacher, where the theoretical supports of the subject are displayed, highlighting the fundamental, structuring them in topics and or sections, interrelating them.
- **Practical Classes** : The teacher resolves practical problems or cases for demonstrative purposes. This type of teaching complements the theory shown in the lectures with practical aspects.
- **Laboratory Workshop** : The lecture group is divided up into various groups, according to the number of registered

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students, but never with more than 20 students, in order to make up smaller sized groups.

- **Individual Tutorials** : Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

### Defence

The contents of the subject will be presented using an active methodology based on problem-based learning. The evaluation of the involved activities is designed for encouraging the autonomous work of the student. During laboratory sessions, students will learn to recognize the basic electronic compounds and devices and to handle the basic instrumentation. Electronic simulators will be also introduced to reinforce the techniques of analysis of electronic circuits.

### 5.2.Learning activities

**The syllabus offered to the student to help to achieve the proposed results consists of the following activities...**

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Involves the active participation of the student, in a way that the results achieved in the learning process are developed, not taking away from those already set out, the activities are the following:

&mdash; **Face-to-face generic activities** :

&#9679; **Theory Classes** : The theoretical concepts of the subject are explained and illustrative examples are developed as support to the theory when necessary.

&#9679; **Practical Classes** : Problems and practical cases are carried out, complementary to the theoretical concepts studied.

&#9679; **Laboratory Workshop** : This work is tutored by a teacher, in groups of no more than 20 students.

&mdash; **Generic non-class activities** :

&#9679; Study and understanding of the theory taught in the lectures.

&#9679; Understanding and assimilation of the problems and practical cases solved in the practical classes.

&#9679; Preparation of seminars, solutions to proposed problems, etc.

&#9679; Preparation of laboratory workshops, preparation of summaries and reports.

&#9679; Preparation of the written tests for continuous assessment and final exams.

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The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the trimester, in other words, 10 hours per week for 15 weeks of class.

A summary of a weekly timetable guide can be seen in the following table. These figures are obtained from the subject file in the Accreditation Report of the degree, taking into account the level of experimentation considered for the said subject is moderate.

Activity	Hours per week
Lectures	3
Laboratory workshop	1
Other activities	6

Nevertheless the previous table can be shown into greater detail, taking into account the following overall distribution:

&mdash; 44 hours of lectures, with 50% theoretical demonstration and 50% solving type problems.

&mdash; 12 hours of laboratory workshop, in 1 or 2 hour sessions.

&mdash; 4 hours of written assessment tests, one hour per test.

&mdash; 40 hours of teamwork divided up over the 15 weeks of the semester.

&mdash; 50 hours of personal study, divided up over the 15 weeks of the semester.

### Defence

Theoretical classes will consist on the explanation of the contents by the teacher encouraging the involvement of students. Practical classes will consist on problem resolution by applying the techniques of circuit analysis.

As an exception, the 6th lesson (Fundamentals of Digital Electronics) will be dealt with by the students on their own, having the support of specific material, a collection of problems with solution and recommended bibliography.

Regarding lessons 2 to 6, activities will be proposed through the platform Moodle. Thus, students can carry out a constant and autonomous work and teachers can visualize the performance of students.

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Electronic simulators will be used for studying the behaviour of circuits which will be implemented in lab sessions. Furthermore, that tools can be employed to facilitate the understanding of the behaviour of proposed circuits to the students.

The recommended material and a collection of problems for each lesson, besides the material related to the lab sessions, will be available at Moodle (<http://moodle.unizar.es>) at the beginning of the course. This platform will be also used to deliver and evaluate the proposed activities along the course. Finally, students can apply individual tutorials to the teachers through the platform YouCanBookMe <https://youcanbook.me/>.

### 5.3.Program

#### Specialization in Business

Topic 1. Semiconductors. The diode

Topic 2. The bipolar transistor

Topic 3. The unipolar transistor

Topic 4. Operational amplifiers

Topic 5. Digital systems (combinational & sequential)

Topic 6. Introduction to programmable logic devices and VHDL

A detailed guide will be available at the beginning of the course in ADD: <http://moodle.unizar.es> .

#### Materials

The different teaching materials will be provided in ADD: <http://moodle.unizar.es> .

#### Defence

The content of the course is divided into the following lessons:

Lesson 1. Introduction to Electronics

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### Electrical signals

- Time domain
- Frequency domain
- Analog / Digital Electronics
  - AD and DA conversion
- Applications
  - Signal processing
  - Telecommunications
  - Control electronics
  - Power electronics

### Lesson 2. Semiconductors

- Insulators / conductors
- Covalent band model
- Band theory
- Conductivity

### Lesson 3. Diodes

- PN junction
- Types of diodes
- Large signal models
- Applications of diodes
  - Rectifier

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- Clipper
- Voltage regulator
- Optoelectronics

### Lesson 4. Transistors

- BJT
- MOSFET
- Biasing
- Switch circuits
- Small signal models
- Amplifier circuits

### Lesson 5. Operational amplifier

- Ideal OA
- Comparator circuits
- Amplifier circuits

### Lesson 6. Fundamentals of digital electronics

- Boolean Algebra
- Logic gates
- Logic functions
- Simplification of logic functions
- Binary codes
- Binary arithmetic





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Topic 2			3	3												9
Topic 3					3	3										6
Topic 4							3	2								6
Topic 5									3	3	3	4				5
Topic 6													4	2		6
Laboratory 1		1	1	1												2
Laboratory 2					1	1	1									4
Laboratory 3									1	1	1					2
Test 1								2								2
Test 2														2		2
Teamwork <sup>3</sup>	3	3	3	3	3	3	3	3	0	3	3	3	3	3	1	40
Personal <sup>3</sup> study	3	3	3	3	3	3	3	3	6	3	3	3	3	3	5	50
<b>Total</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>150</b>

The dates of the final exams will be those that are officially published at <http://www.eupla.es/secretaria/academica/examenes.html>.

The written assessment tests will be related to the following topics:

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&mdash; **Test 1** : Topic 1, 2, 3 & 4

&mdash; **Test 2** : Topic 5, 6

At the end of every topic, the student can find some reinforce exercises in order to guide him in their personal homework.

### Defence

The course's content is distributed in approximately 4 hours per week of classroom activities, which include lectures, problem classes and laboratory work, and 6 hours per week of non-contact activities, including self-study, completion of deliverable activities and the required previous study of the laboratory practices.

Three laboratory sessions are proposed:

- Applications of diodes
  - o Characterization of rectifiers and clippers
- Amplifiers
  - o Characterizations of amplifiers based on operational amplifier or common-emitter topology
- Applications of operational amplifier (OA)
  - o Characterization of an active circuit based on OAs

You can also find additional information through the website of the University Centre for the Defence: <http://cud.unizar.es>.

## 5.5. Bibliography and recommended resources

### Specialization in Business

- BB Boylestad, Robert L.. Electrónica : teoría de circuitos y dispositivos electrónicos / Robert L. Boylestad, Louis Nashelsky ; traducción, Rodolfo Navarro Salas ; revisión técnica, Francisco Rodríguez Ramírez . - 10ª ed. México [etc.] : Prentice Hall, 2009
- BB Mano, Moshe Morris. Diseño digital / M. Morris Mano ; traducción, Roberto Escalona García ; revisión técnica, Gonzalo Duchén Sánchez. - 3ª ed. México [etc.] : Pearson Educación, 2003
- BC Coughlin, Robert F.. Amplificadores operacionales y circuitos integrados lineales / Robert F. Coughlin, Frederick F. Driscoll ; traducción, Raúl Bautista Gutiérrez ; revisión técnica, Agustín Suárez Fernández . - 5ª ed. México : Prentice-hall hispanoamericana, cop. 1999
- BC Ercegovac, Milos Dragutin. Digital systems and hardware-firmware algorithms / Milos D. Ercegovac, Tomás Lang New York [etc.] : John Wiley and Sons, cop. 1985
- BC Floyd, Thomas L.. Dispositivos electrónicos / Thomas L. Floyd . - 1a ed. en español México : Limusa, cop. 1996
- BC Malvino, Albert Paul. Principios de electrónica / Albert Malvino, David J. Bates ; traducción Vuelapluma . - 7ª ed Madrid [etc] : McGraw-Hill, D. L. 2006
- BC Millman, Jacob. Electrónica integrada : Circuitos y sistemas analógicos y digitales / Jacob Millman, Christos C. Halkias ; Prólogo de Juan Peracaula . - 9a. ed., 2a. reimp. Barcelona : Editorial Hispano Europea, 1995
- BC Sánchez, Fermín.. Características deseables en un procesador pedagógico para la enseñanza básica de Arquitectura de Computadores. A: Jornadas de Enseñanza Universitaria de la Informática. "VII Jornadas de Enseñanza Universitaria de la Informática"/Fermín Sánchez.. - 1ªedición Palma de Mallorca: Universitat de les Illes Balears, 2001.
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- BC Circuitos y dispositivos electrónicos : Fundamentos de electrónica / Lluís Prat Viñas... [et al.] . - 6ª ed. Barcelona : Edicions UPC, 1999
- BC LogicWorks 5 : interactive circuit design software / Capilano Computing Systems, Ltd. Upper Sadle River, NJ : Pearson Prentice Hall, cop. 2004
- BC Malvino, Albert Paul. Principios de electrónica / Albert Malvino, David J. Bates ; traducción Vuelapluma . - 7ª ed Madrid [etc] : McGraw-Hill, D. L. 2006
- BC Razavi, Behzad. Fundamentals of microelectronics / Behzad Razavi Hoboken : John Wiley & Sons, cop. 2008
- BC Roth, Charles H. Fundamentos de diseño lógico / Charles H. Roth ; revisión técnica, Sebastián Dormido Bencomo, Mª Antonia Canto Díez, Sergio Soto Hidalgo. - 5ª ed. Madrid [etc.] : Thomson, D.L. 2004
- BC Wakerly, John F. Diseño digital principios y prácticas / John F. Wakerly ; Traducción Raymundo Hugo Rangel Gutierrez ; Revisión técnica Isabel Quintas. - 1a ed. en español, trad. de 3rd english ed. México [etc] : Pearson, 2001