



## IDENTIFYING DATA

### Physics: Fundamentals of Electronics

Subject	Physics: Fundamentals of Electronics			
Code	V05G300V01305			
Study programme	Degree in Telecommunications Technologies Engineering			
Descriptors	ECTS Credits 6	Choose Basic education	Year 2nd	Quadmester 1st
Teaching language	Spanish			
Department				
Coordinator	Domínguez Gómez, Miguel Ángel			
Lecturers	Domínguez Gómez, Miguel Ángel Pérez López, Serafín Alfonso Raña García, Herminio José Rodríguez Pardo, María Loreto			
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**General description** The main purpose of this course is to provide students the basis for understanding and mastery of the principles of operation of devices and electronic circuits. It begins with a brief introduction to electronics in order to provide students with a global vision. After, basic concepts about devices and electronic circuits are taught:

- Diodes and circuits with diodes, including concepts such as load line, ideal diodes, rectifiers, shaping circuits, logic circuits, voltage regulators and devices physics.
- Characteristics of bipolar transistors, analysis of load line, large-signal models, polarization, amplification and small-signal equivalent circuits.
- Study of the FET similar to the previous highlighting the MOSFET.
- Check the circuit designs studied using SPICE. Mounting and verification using laboratory electronic instrumentation.
- Basic concepts about logic digital circuits.

On the other hand, in the framework of the course takes place first contact of students with the electronics lab. Therefore, the main objective of the practical part of the course is that the student acquires the bases for a correct management of the most common instruments in the laboratories of electronics. The student, at the end of the course, must know handle the laboratory instruments, should distinguish and characterize the different components, and have practical skills in assembly and measurement. Students will also start with simulation of circuits, in order to introduce them to computer-aided design.

## Competencies

Code	
B13	CG13 The ability to use software tools that support problem solving in engineering.
C4	CE4/FB4: Comprehension and command of basic concepts in linear systems and their related functions and transforms; electric circuits theory, electronic circuits, physical principles of semiconductors and logical families, electronic and photonic devices, materials technology and their application to solve Engineering problems.

## Learning outcomes

Expected results from this subject	Training and Learning Results
Understanding and control of the basic concepts of the physical principles of semiconductors.	C4
Understanding and control of the basic concepts of operation of the electronic and photonic devices.	C4
Understanding and control of simple electronic circuits based on the electronic and photonic devices and their applications.	C4

Understanding and control of the basic concepts of the logic families.	C4
Basic knowledges on CAD (Computer Aided Design) tools for the simulation of electronic circuits.	B13
Capacity utilization of CAD tools for designing simple electronic circuits.	B13

## Contents

Topic	
Subject 1: Introduction	Electronic systems. Design process. Integrated circuits.
Subject 2: Diodes and circuits with diodes	Characteristics of the diode. Zeners. Analysis of the load line. Ideal model of the diode. Circuits with diodes (rectifiers, clipping and voltage regulator circuits). Small signal equivalent linear circuits. Basic concepts of semiconductors. Physics of the diode. Capacity effects. LED and laser diodes. Photodiodes.
Subject 3: Principles of amplification	General aims: Voltage, current and power gains. Ideal amplifier. Amplifier Models. Limits. Introduction to amplifier frequency response.
Subject 4: Bipolar Junction Transistors (BJT)	Operation of the npn Bipolar Junction Transistor (BJT). Load-Line Analysis of a Common-Emitter Amplifier. The pnp Bipolar Junction Transistor. Models of circuits. Analysis of circuits with BJTs. Phototransistors and optocouplers.
Subject 5: Analysis of amplifiers with Bipolar Junction Transistors	Small-Signal Equivalent Circuits. Analysis in medium frequencies: the Common-Emitter amplifier, the Emitter-Follower amplifier, the Common-Collector amplifier and the Common-Base amplifier.
Subject 6: Field Effect Transistors (FET)	NMOS Transistor. Analysis of the load line of a simplified NMOS amplifier. Polarization circuits. JFET and depletion MOSFET transistors and channel p devices.
Subject 7: Analysis of amplifiers with Field Effect Transistors	Small-Signal Equivalent Circuits. Analysis in medium frequencies: the Common-Source amplifier and the Source Follower amplifiers.
Subject 8: Digital logic circuits	Digital logic circuits. Basic concepts. Electrical specifications of the logic gates. The inverter CMOS. CMOS gates NOR and NAND.

## Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	4	6
Master Session	13	24	37
Troubleshooting and / or exercises	14	33	47
Laboratory practises	14	30	44
Troubleshooting and / or exercises	8	0	8
Practical tests, real task execution and / or simulated.	5	0	5
Self-assessment tests	0	3	3

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

	Description
Introductory activities	Presentation of the subject. Presentation of the laboratory practices and the instrumentation and software to be used. Through this methodology the competencies CG13 and CE4 are developed.
Master Session	Exposition of contents. Later personal work of the student reviewing the concepts seen in the classroom and preparing the subjects using the proposed bibliography. Identification of doubts that require to be resolved in personal tutorships. Through this methodology the competency CE4 is developed.
Troubleshooting and / or exercises	Activity to formulate and resolve problems and/or exercises related with the subject. Complement of the theoretical sessions. Personal work of the student with resolution of problems and/or exercises proposed in the classroom and extracted of the bibliography. Identification of doubts that require to be resolved in personal tutorships. Through this methodology the competency CE4 is developed.
Laboratory practises	Activities of application of the theoretical knowledges. It will learn to handle the typical instrumentation of an electronic laboratory and it will implement basic electronic circuits seen in the theoric sessions. Also they will purchase skills of handle of simulation tools. Personal work of the student preparing the practices using the available documentation and reviewing the theoretical concepts related. Development and analysis of results. Identification of doubts that require to be resolved in personal tutorships. Through this methodology the competency CG13 is developed.

## Personalized attention

Methodologies	Description
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Master Session	The students will be able to attend to personalised tutorials in the professor's office in the schedule that the professors will establish and will publish in the web page of the subject. Here, they will be able to resolve their doubts about the contents given in the Master Sessions and will be oriented about how to deal with them.
Troubleshooting and / or exercises	The students will be able to attend to personalised tutorials in the professor's office in the schedule that the professors will establish and will publish in the web page of the subject. Here, they will be able to resolve their doubts about the problems and/or exercises proposed and resolved in the classroom as well as other problems and/or exercises that can appear along the study of the subject.
Laboratory practises	The students will be able to attend to personalised tutorials in the professor's office in the schedule that the professors will establish and will publish in the web page of the subject. Here, they will be able to resolve their doubts about the development of the laboratory practices, the handle of the instrumentation, the setting of the electronic circuits and the software of simulation.

## Assessment

	Description	Qualification	Training and Learning Results
Troubleshooting and / or exercises	Tests will be carried out in the classroom throughout the year to evaluate the competencies of the student to resolve problems and/or the exercises over a part of the contents of the subject.	60	C4
Practical tests, real task execution and / or simulated.	Tests will be carried out in the laboratory along the course about management of instrumentation, mounting of electronic circuits and simulation. The skills acquired by the student about the contents of the subject laboratory practices will be evaluated.	35	B13 C4
Self-assessment tests	Techniques aimed to collect data about the participation of the student in the proposed self-assessment tests.	5	

## Other comments on the Evaluation

### 1. Continuous evaluation

A system of continuous evaluation will be offered to the students following the guidelines of the bachelor and the agreements of the academic commission. Students who take the first test of resolution of problems and/or exercises deem to opt for continuous evaluation. Those students who do not take the first test of resolution of problems and/or exercises deem to renounce to the continuous evaluation and they will only have the possibility to take the final exam. Students who do not follow the continuous evaluation and do not take the final exam will be considered "not presented".

#### 1.a Self-assessment tests

The professors will evaluate the execution of the proposed self-assessment tasks, getting the student a rating from 0 to 10 (AE).

The final mark of self-assessment tests (NAE) will be:

$$NAE = 0.05 \cdot AE$$

#### 1.b Theory

Students will carry out 3 exams (multiple choice test and/or short answer test and/or resolution of problems and/or exercises) properly programmed along the course (PT1, PT2 and PT3). PT1 will be about themes 1 and 2 (block 1), PT2 about themes 3, 4 and 5 (block 2) and PT3 about themes 6, 7 and 8 (block 3). These exams will be valued from 0 up to 10 and the final mark will be the average (NPT -> Mark of theory exams):

$$NPT = (NPT1 + NPT2 + NPT3)/3$$

It is necessary to obtain a minimum of 3 points out of 10 in each of these exams ( $NPT1 \geq 3$ ,  $NPT2 \geq 3$  and  $NPT3 \geq 3$ ) to pass the subject.

The final mark of theory (NT) will be:

$$NT = 0.6 \cdot NPT$$

The exams are not recoverable, that is to say, if a student cannot assist the day they are scheduled, the professors do not have obligation to repeat them. The mark of the missed exams will be 0.

#### 1.c Practical

Students will carry out 2 practical tests properly programmed along the course. These tests will be valued from 0 up to 10 and the final mark of the practical (NP) will be:

$$NP = 0.35 * [(NP1 + NP2) / 2]$$

The practical tests are not recoverable, that is to say, if a student cannot assist the day they are scheduled, the professors do not have obligation to repeat them. The mark of the missed tests will be 0.

#### 1.d Final mark of the subject

It must get a minimum of 4 points out of 10 in theory ( $NT \geq 2.4$ ) and practices ( $NP \geq 1.4$ ) to pass the subject. Also it is necessary to get a minimum of 3 points out of 10 in each of the 3 theory exams ( $NPT1 \geq 3$ ,  $NPT2 \geq 3$  and  $NPT3 \geq 3$ ).

The final mark (NF) will be:

$$\text{If } NT \geq 2.4 \text{ and } NP \geq 1.4 \text{ and } NPT1 \geq 3 \text{ and } NPT2 \geq 3 \text{ and } NPT3 \geq 3 \Rightarrow NF = NAE + NT + NP$$

$$\text{If } NT < 2.4 \text{ or } NP < 1.4 \text{ or } NPT1 < 3 \text{ or } NPT2 < 3 \text{ or } NPT3 < 3 \Rightarrow NF = \min \{4.5; NAE + NT + NP\}$$

#### 2. Final exam

The students who do not follow the continuous evaluation or had a final mark lower than 5 (failed) in the continuous evaluation, will be able to present to a final exam.

The final exam will have a theoretical part and a practical one. The theoretical part will be carried out in the dates established by the School and it will consist in an exam (multiple choice test and/or short answer test and/or resolution of problems and/or exercises). This exam will have 3 parts, one for each block specified in section 1.b. Each part will be evaluated from 0 up to 10 and the final mark of theory (NT) will be the average multiplied by 0.6. It is necessary to get a minimum of 3 points in each of these parts ( $NPT1 \geq 3$ ,  $NPT2 \geq 3$  and  $NPT3 \geq 3$ ) and a minimum of 4 points out of 10 in theory ( $NT \geq 2.4$ ) to pass the subject.

The practical exam will be carried out in the laboratory in the dates established by the School and it will consist in a practical test which will be evaluated from 0 up to 10 and the final mark of practices (NP) will be the points of the test multiplied by 0.4. It must get a minimum of 4 points out of 10 in the practical exam ( $NP \geq 1.4$ ) to pass the subject.

By reasons of organisation of the groups of examination, the professors will open a period so that the students inscribe to the final exam of practices. Only those students who have inscribed in due time and form, according to the rules indicated by the professors in the corresponding announcement, will be able to take the final exam of practices.

The students who have opted for the continuous evaluation and have failed and present to the final exam, can do it only to the theoretical part or to the practical one or both. They will conserve the mark got in the continuous evaluation of the missed part if the minimums specified in the continuous evaluation process were achieved. The students who take the theoretical part will be able to carry out the blocks they want. The mark of the continuous evaluation of the missed blocks ( $NPT1$ ,  $NPT2$  and  $NPT3$ ) will be kept. If they do not take the practical part, the practice note (NP) of the continuous evaluation is recalculated multiplying by 0.4 instead of by 0.35.

The final mark (NF) will be:

$$\text{If } NT \geq 2.4 \text{ and } NP \geq 1.6 \text{ and } NPT1 \geq 3 \text{ and } NPT2 \geq 3 \text{ and } NPT3 \geq 3 \Rightarrow NF = NT + NP$$

$$\text{If } NT < 2.4 \text{ or } NP < 1.6 \text{ or } NPT1 < 3 \text{ or } NPT2 < 3 \text{ or } NPT3 < 3 \Rightarrow NF = \min \{4.5; NT + NP\}$$

#### 3. Recovery

The recovery call will have a theoretical part and practical one with the same format as the final exam.

The students who present to this call can do it only to the theoretical part, the practical one or both. They will conserve the mark got in the ordinary call (continuous evaluation or final exam). The students who take the theoretical part will be able to carry out the blocks they want. The mark of the ordinary call (continuous evaluation or final exam) of the missed blocks will be kept. The calculation of the final mark of the subject will be as described in section 2.

The final mark of the subject will be the best of the ordinary call and the recovery one.

By reasons of organisation of the groups of examination, the professors will open a period so that the students inscribe to the recovery practices exam. Only those students who have inscribed in due time and form, according to the rules indicated by the professors in the corresponding announcement, will be able to take this exam.

#### 4. Validity of the qualifications

The qualifications of the student of the theoretical and practical parts of the subject will be valid only for the academic course in which they was got.

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#### **Sources of information**

##### **Basic Bibliography**

Hambley, A. R., **Electrónica**, 2ª ed., Prentice Hall, 2001

Quintáns, C., **Simulación de circuitos electrónicos con OrCAD 16 Demo**, Marcombo, 2008

##### **Complementary Bibliography**

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#### **Recommendations**

##### **Subjects that continue the syllabus**

Digital Electronics/V05G300V01402

Electronic Technology/V05G300V01401

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##### **Subjects that it is recommended to have taken before**

Physics: Analysis of Linear Circuits/V05G300V01201