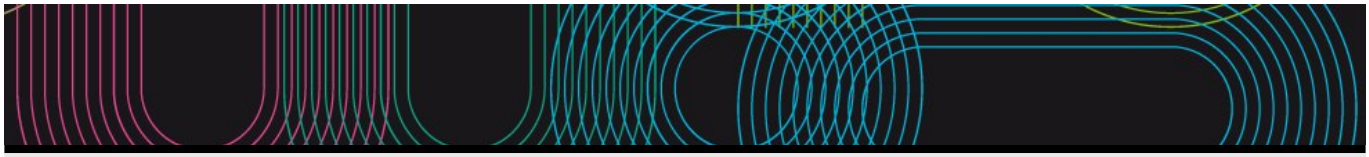

IDENTIFYING DATA				
Physics: Fundamentals of electronics				
Subject	Physics: Fundamentals of electronics			
Code	V05G301V01201			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación (extinción)			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	2nd	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Domínguez Gómez, Miguel Ángel			
Lecturers	Domínguez Gómez, Miguel Ángel Rodríguez Pardo, María Loreto			
E-mail	mdgomez@uvigo.es			
Web	http://moovi.uvigo.gal			
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. Afterwards, 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 it takes place the first contact of students with the electronics labs. Therefore, the main objective of the practical part of the course is for students to acquire the bases for a correct management of the most common instruments in the laboratories of electronics. At the end of the course the student must know how to handle the laboratory instruments, 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. English Friendly subject. International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
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.

Expected results from this subject	
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.
Practice 1: Introduction to the simulation	Simulation of electronic circuits with OrCAD.
Practice 2: Instrumentation I	Use of the voltage source, function generator and multimeter.
Practice 3: Instrumentation II	Use of digital oscilloscope.
Practice 4: Simulation of circuits with diodes	Simulation of circuits with diodes using OrCAD.
Practice 5: Implementation of circuits with diodes	Implementation of circuits with diodes in protoboard and checking of operation using the laboratory instrumentation.
Practice 6: Simulation of circuits with bipolar transistors	Simulation of circuits with bipolar transistors using OrCAD.
Practice 7: Implementation of circuits with bipolar transistors	Implementation of circuits with bipolar transistors in protoboard and checking of operation using laboratory instrumentation.
Practice 8: Simulation of circuits with field effect transistors	Simulation of circuits with field effect transistors using OrCAD.
Practice 9: Implementation of circuits with field effect transistors	Implementation of circuits with field effect transistors in protoboard and checking of operation using laboratory instrumentation.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	1	2
Lecturing	16	27	43
Problem solving	16	36	52
Laboratory practical	22	20	42
Problem and/or exercise solving	2	0	2
Problem and/or exercise solving	2	0	2
Problem and/or exercise solving	2	0	2
Laboratory practice	1	0	1
Laboratory practice	1	0	1
Self-assessment	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 B13 and C4 are developed.

Lecturing	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 C4 is developed.
Problem solving	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 C4 is developed.
Laboratory practical	Activities of application of the theoretical knowledge. It will learn to handle the typical instrumentation of an electronic laboratory and it will implement basic electronic circuits seen in the theory 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 B13 is developed. Software to be used: OrCAD software for students.

Personalized assistance

Methodologies	Description
Lecturing	The students will be able to have personalized tutorials in the schedule that the professors will establish and will publish in the web page of the subject (https://moovi.uvigo.gal/). 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.
Problem solving	The students will be able to have personalized tutorials in the schedule that the professors will establish and will publish in the web page of the subject (https://moovi.uvigo.gal/). 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 practical	The students will be able to have personalized tutorials in the schedule that the professors will establish and will publish in the web page of the subject (https://moovi.uvigo.gal/). 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	
Problem and/or exercise solving	Test 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 the first part of the contents of the subject. These may be test type and/or questions and/or exercises.	23.33		C4
Problem and/or exercise solving	Test 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 the second part of the contents of the subject. These may be test type and/or questions and/or exercises.	23.33		C4
Problem and/or exercise solving	Test 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 the third part of the contents of the subject. These may be test type and/or questions and/or exercises.	23.33		C4
Laboratory practice	Test 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.	12.5	B13	C4
Laboratory practice	Test 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.	12.5	B13	C4
Self-assessment	Techniques aimed to collect data about the participation of the student in the proposed self-assessment tests.	5		

Other comments on the Evaluation

1. Ordinary exam (continuous assessment)

A system of continuous assessment will be offered to the students following the guidelines of the bachelor and the

agreements of the academic commission. Students who take some of the tests of problem and/or exercise solving or laboratory practice deem to opt for continuous assessment. Those students who take any of those tests deem to renounce to the continuous assessment and they will have the possibility to take the global assessment. Students who have opted for continuous assessment and have not passed the subject can take to the global assessment. Students who do not follow the continuous assessment and do not take the global assessment 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*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). The schedule of these exams will be approved in "CAG" (Degree Academic Commission) and will be made public at te beginning of the corresponding term. 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 >= 3, NPT2 >= 3 and NPT3 >= 3) to pass the subject.

The final mark of theory (NT) will be:

NT = 0.7*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

Attendance to practical sessions is not compulsory.

Students will carry out 2 practical tests properly programmed along the course. The schedule of these tests will be approved in "CAG" (Degree Academic Commission) and will be made public at te beginning of the corresponding term. These tests will be valued from 0 up to 10 and the final mark of the practical (NP) will be:

NP = 0.25*[(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 >= 2.8) and practices (NP >= 1.) 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 >= 3, NPT2 >= 3 and NPT3 >= 3).

The final mark (NF) will be:

If NT >= 2.8 and NP >= 1 and NPT1 >= 3 and NPT2 >= 3 and NPT3 >= 3 => NF = NAE + NT + NP

If NT < 2.8 or NP < 1 or NPT1 < 3 or NPT2 < 3 or NPT3 < 3 => NF = min {4.5; NAE + NT + NP}

2. Ordinary exam (global assessment)

The students who do not follow the continuous assessment or had a final mark lower than 5 (failed) in the continuous assessment, 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 0.7. It is necessary to get a minimum of 3 points in each of these parts (NPT1 >= 3, NPT2 >= 3 and NPT3 >= 3) and a minimum of 4 points out of 10 in

theory (NT >= 2.8) 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 0.3. It must get a minimum of 4 points out of 10 in the practical exam (NP >= 1.2) to pass the subject.

By reasons of organization of the groups of examination, the professors will open a period so that the students could enroll for the final 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 the final exam.

The students who have opted for the continuous assessment and have failed and present to the final exam, can only do the theoretical part or to the practical one or both. They will keep the mark got in the continuous assessment of the missed part if the minimums specified in the continuous assessment 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 assessment 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 assessment is recalculated multiplying by 0.3 instead of by 0.25.

The final mark (NF) will be:

If NT >= 2.8 and NP >= 1.2 and NPT1 >= 3 and NPT2 >= 3 and NPT3 >= 3 => NF = NT + NP

If NT < 2.8 or NP < 1.2 or NPT1< 3 or NPT2 < 3 or NPT3 < 3 => NF = min {4.5; NT + NP}

3. Extraordinary exam

It will have a theoretical part and practical one with the same format as the global assessment.

The students who take this call can only do the theoretical part, the practical one or both. They will keep the mark got in the ordinary exam (continuous or global assessment). The students who take the theoretical part will be able to carry out the blocks they want. The mark of the ordinary exam (continuous or global assessment) 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 and extraordinary exam.

By reasons of organization of the groups of examination, the professors will open a period so that the students could enroll for the extraordinary 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. End-of-program exam

This exam will be the same as the extraordinary exam.

5. Validity of the marks

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

If a cheating case is detected, the final mark will be FAIL (0) and the case will be communicated to the School Management.

Sources of information

Basic Bibliography

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

Hambley, Allan R., **Electronics**, 2nd ed., Prentice Hall, 2000

Quintáns Graña, Camilo, **Simulación de circuitos electrónicos con OrCAD 16 Demo**, Marcombo, 2008

Quintáns Graña, Camilo, **Simulación de circuitos electrónicos con OrCAD PSpice**, 2ª edición, Marcombo, 2021

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Electronic technology/V05G301V01206

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G301V01108