



## IDENTIFYING DATA

## Fundamentals of electronics for biomedicine

Subject	Fundamentals of electronics for biomedicine			
Code	V12G420V01401			
Study programme	Grado en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Raña García, Herminio José			
Lecturers	Raña García, Herminio José			
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General description	This *asignatura pretends to provide to the *alumnado a basic training, so much theoretical how practical, on the fundamental concepts of the analog electronics.			

## Training and Learning Results

Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
C11	CE11 Knowledge of the fundamentals of electronics.
D2	CT2 Problems resolution.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.

### Expected results from this subject

Expected results from this subject		Training and Learning Results	
New	B3	C11	D2 D9
New	B3	C11	D2 D9
New			D2 D9 D10
New			D2 D9 D10
New			D9 D10
New	B3		D2 D9 D10
New			D9 D10

## Contents

Topic
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Subject 1. Physics of devices.	Fundamental concepts. Introduction to physics of the solid state. Union *PN: balance, direct polarisation, reverse polarisation. Differences between ideal diode and real diode. Models of the diode. I handle of the characteristic leaves. Types of diodes.
Subject 3. Transistors.	Bipolar transistor (*BJT). Transistors of effect field (*JFET and *MOSFET). Models.
Subject 4. Amplification.	Concepts, parameters, classification. Circuits of polarisation. Models in small signal of the transistors. Frequency response.
Subject 5. Binary system and algebra of *Boole	Systems of numbering. Binary codes. Algebra of *Boole. Logical doors and logical functions. Technologies and logical families.
Subject 6. Systems *combinacionales	Synthesis of functions *combinacionales. Design of circuits *combinacionales. Blocks *combinacionales *MSI
Subject 7. Sequential systems	Introduction and classification. *Biestables. Asynchronous sequential systems. Synchronous sequential systems. Blocks *MSI: Counters. Registers of trip. Design of sequential circuits. Memories and concept of microcontroller.
Subject 8. Analog conversion-digital-analog (*CAD/*CDA).	Analog signals and digital signals. The digital analog converter (*CAD). Sampling, quantification and digitalisation. Characteristics more notable: number of bits, speed, rank of conversion and cost The analog digital converter (*CDA). Foundations of sensors.

## Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	0	1	1
Case studies	0	15	15
Lecturing	23	0	23
Problem solving	15	29	44
Autonomous problem solving	0	27	27
Previous studies	0	20	20
Laboratory practical	15	0	15
Essay questions exam	3	0	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	Con antelación al inicio de las sesiones presenciales estará la disposición de los alumnos un listado detallado de conocimientos que deben de adquirir a lo largo de su formación previa y que le serán necesarios para afrontar la materia con éxito.
Case studies	Con antelación a la realización de las sesiones teóricas, los alumnos dispondrán de una serie de materias que han de preparar, pues sobre ellos versarán dichas sesiones.
Lecturing	Se desarrollarán en los horarios fijados por la dirección del centro. Consistirán en una exposición por parte del profesor de aspectos relevantes de la materia que estarán relacionados con las materias que previamente debió trabajar el alumno. De este modo se propicia la participación activa del mismo, que tendrá ocasión de exponer dudas y preguntas durante la sesión. En la medida en que el tamaño de los grupos lo permita se propiciará una participación lo más activa posible del alumno.
Problem solving	Durante las sesiones de aula, cuando resulte oportuno o relevante se procederá a la resolución de ejemplos y/o problemas que ilustren adecuadamente la problemática a tratar.

Autonomous problem solving	Después de cada sesión teórica de aula el alumno debería realizar, de forma sistemática un estudio de consolidación y repaso donde deberían quedar resueltas todas sus dudas con respecto a la materia. Las dudas o aspectos no resueltos deberá exponerlos al profesor a la mayor brevedad, a fin de que este utilice estas dudas o cuestiones como elemento de realimentación del proceso de enseñanza-aprendizaje.
Previous studies	Es absolutamente imprescindible que, para un correcto aprovechamiento, el alumno realice una preparación previa de las sesiones prácticas de laboratorio, para eso se le suministrará indicaciones y material específico para cada sesión con antelación suficiente. El alumno deberá trabajar previamente sobre el material suministrado y también debe tener preparados los aspectos teóricos necesarios para abordar la sesión. Esta preparación previa será un elemento que se tendrá muy en cuenta a la hora de evaluar cada sesión práctica.
Laboratory practical	<p>Durante las sesiones de prácticas los alumnos realizarán actividades del siguiente tipo:</p> <ul style="list-style-type: none"> <li>- Montaje de circuitos.</li> <li>- Manejo de instrumentación electrónica</li> <li>- Medidas sobre circuitos</li> <li>- Cálculos relativos al montaje y/o medidas de comprobación</li> <li>- Recopilación y representación de datos</li> </ul> <p>Al final de cada sesión de prácticas cada grupo entregará las hojas de resultados correspondientes.</p>

### Personalized assistance

Methodologies	Description
Laboratory practical	In the sessions of laboratory will make a follow-up *particularizado of the doubts and incidences to level of group of work.

### Assessment

	Description	Qualification	Training and Learning Results	
Laboratory practical	<p>Laboratory practices will be evaluated continuously (session by session). The evaluation criteria are:</p> <ul style="list-style-type: none"> <li>- A minimum attendance of 80%.</li> <li>- Punctuality.</li> <li>- Previous preparation of the practices.</li> <li>- Performance and achievement during the session.</li> <li>- The practical sessions will be carried out in groups of two students. The statements of the practices will be available to students in advance.</li> <li>- The students will present the results on a set of sheets, which they will deliver at the end of the practice. These sheets will serve to justify attendance and assess achievement.</li> </ul>	20	C11	D10
Essay questions exam	<p>It will consist of two tests related to thematic blocks. The first one will be done, if possible, by telematic means and will consist of multiple choice questions, closed-ended questions and analysis problems with numerical answers.</p> <p>The second test, written, individual and face-to-face, which will be carried out at the end of the semester, at the times established by the center's management, may consist of a combination of the following types of exercises:</p> <ul style="list-style-type: none"> <li>- Multiple choice questions.</li> <li>- Short answer questions.</li> <li>- Analysis problems.</li> <li>- Resolution of practical cases.</li> </ul> <p>Each test will be scored between 0 and 10 points, and the final grade will be the weighted average of the tests that exceed 3 points. It is necessary to reach this minimum (3 out of 10) in both tests.</p> <p>Once the course is over, the grades obtained in these tests lose their validity.</p>	80	B3	C11 D2 D9

### Other comments on the Evaluation

CONDITION TO PASS: MINIMUM TOTAL AND MINIMUM IN THEORY TESTS:

To pass the subject, the student must obtain 5 points out of 10, but also in the theory part it is necessary to have obtained at least a mark of 3 out of 10 in each of the two tests (both first partial test -first block of content- and the final exam - second block of content-) for the case of continuous evaluation. In order for this limitation to be reflected in the mark, in the case of students who do not meet the minimum of 3 in both parts, the theory mark (80% of the total mark) will be the minimum of 2.5 out of 10 and the average of the mark of both tests. For this average, the mark in a test the student did not

attend is zero. When applying this procedure for the calculation of the theory mark, the result is that a maximum limit of 2.5 is applied to this mark, to express that the student has not fulfilled the requirement of both minimums, even though he could have a very high average mark between both tests. [In this way, for example if the student reaches the maximum mark in practices, but does not meet the minimum of both theory tests, then the maximum total mark that could be obtained is limited to 4 ( $2.5 \times 0.80 + 10 \times 0.20 = 4$ )].

Recommendations: The students will have the option to consult to the teacher any question related to the activities assigned to the work group to which they belong or the contents of the subject in the office hours or through the ways related in the Student Service section.

Students must inexcusably meet the deadlines established for the different activities.

In the different tests, students are advised to justify all the results they achieve. When scoring them, no result will be given as known by default and the method used to reach the proposed solution will be taken into account.

It is recommended, in the presentation of the various exercises, not to present misspellings and illegible characters or symbols, because they will affect the final score.

Class notes or documents cannot be brought nor used during the tests and mobile phones must be turned off and, only in the case

that is previously authorized, may notes or other support material be used.

Guidelines for improvement and recovery:

In the event that a student does not pass the subject in the first call, he or she has a second call in the current academic year.

The corresponding final grade for this second call will be obtained as the sum the following marks:

- 1.- The mark obtained in the evaluation of the laboratory practices in the first call, with a weight of 20% of the final grade.
- 2.- The mark obtained in the evaluation of the individual and face-to-face written test. The test will evaluate contents of the entire subject. The weight of this grade is 80% of the final grade.

To pass the subject in this second call it is necessary to obtain a final score equal to or greater than 5 points out of 10.

After the end of this academic year. the marks obtained in the evaluations of the thematic blocks and the mark obtained in the evaluation of the final exam lose their validity.

The marks obtained in the practical evaluations will be maintained during the two academic years following the current course, unless the student wishes to do them again.

Evaluation of students who waive continuous evaluation:

Students who are officially granted by the center the waiver of continuous assessment, will have to take a written test similar to the long-answer individualized test and a practical laboratory test. Both tests will have a maximum score of 10 points. The final mark will be the weighted average, as stipulated (80% - 20%), of the marks of the two tests. To pass the course you will have to obtain a grade equal to or greater than 5 points. The written test will be held at the end of the semester, at the times established by the center's management. The practical test on a date close to the previous one and that will be proposed depending on the availability of the laboratories.

Ethical commitment: The student is expected to present appropriate ethical behavior. In the case of detecting unethical behavior (copying, plagiarism, use of unauthorized electronic devices, and others) it will be considered that the student does not meet the necessary requirements to pass the subject. In this case, the overall mark in the current academic year will be a fail (0.0).

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## Sources of information

### Basic Bibliography

Malik N.R., **Circuitos Electrónicos. Análisis, simulación y diseño**, Prentice-Hall, 1996

Malvino, A; Bates, D., **Principios de Electrónica**, 7º, McGraw-Hill, 2007

Rashid, M.H., **Circuitos microelectrónicos. Análisis y diseño**, Thomson, 2002

### Complementary Bibliography

Pleite Guerra, J., Vergaz Benito, R., Ruíz de Marcos, J.M., **Electrónica analógica para ingenieros**, McGraw-Hill, 2009

Hambley, A.R., **Electrónica**, Prentice-Hall,, 2001

Boylestad, R.L., Nashelsky, L., **Electrónica: Teoría de circuitos y dispositivos electrónicos**, Prentice-Hall, 2009

Millmann, J, **Microelectrónica. Circuitos y sistemas analógicos y digitales**, Hispano Europea, 1988

Coughlin, R.F., Driscoll, F.F, **Amplificadores operacionales y circuitos integrados lineales**, Prentice-Hall, 1999

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## **Recommendations**

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

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Physics: Physics I/V12G420V01102

Physics: physics II/V12G420V01202

Computer Science: computer science for engineering/V12G420V01203

Mathematics: calculus I/V12G420V01104

Mathematics: calculus II and differential equations/V12G420V01204

Fundamentals of electrotechnology/V12G420V01305

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