Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2025/26

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** First year

COURSE

27354 - Electronic Devices & Circuits **Credits, ECTS:** 6

COURSE DESCRIPTION

It is a subject of basic module taught in the 1st year -2nd quarter which aims to introduce students to the study of electronic devices and circuits designed from these. It is, therefore, essential for other subjects of the module common to the branch and for the subjects of the specialty Electronic Systems.

Specifically, this subject can be considered continuation of the subject 1st year - 1st quarter, BASIC ELECTRONICS, completing training in the design of basic electronic circuits, and it serves as an starting point for the development of more complex circuits such as those analyzed in the subject ELECTRONICS OF CIRCUITS, taught in the 3rd year of the degree. It also makes easier the understanding of the circuits and digital systems, serving as the basis for the subjects of 2nd and 3rd year, DIGITAL ELECTRONICS and DIGITAL SYSTEMS, respectively.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

This subject works, partly, competence 4 of basic module: "Understanding and mastery of basic concepts of linear systems and related functions and transforms, theory of electrical circuits, electronic circuits, physical principles of semiconductors and logic families, electronic and photonic devices, materials technology and its application for solving problems of engineering".
As for the learning outcomes, the aim of this subject is that students master the operation of the main electronic devices whose combination is used in most of the current electronic circuits, analyzing their behavior both in static and dynamic. More specifically:
- Analyze the behavior of diodes and transistors in both static and dynamic domains.
- Understand and manage their characteristic curves, equivalent circuits and main parameters governing their operation.
- Solve practical cases and implement circuits incorporating such devices, verifying concepts and approximations .
- Interpret, easily, information in the form of graphs and tables like those often found in manufacturers' datasheets.
- Apply formulas, more or less complex or general, such as calculating the width of the space-charge region, saturation current, etc.
- Solve problems that are not a direct application of theory, but require an understanding of statements and concepts and formulas.

Theoretical and Practical Contents

The subject has a weight of 6 ECTS distributed to 50% between theoretical and practical credits. The latter include problem solving and regulated laboratory practicals. The theoretical part is divided into three sections: pn junction diode, bipolar junction transistor and field effect transistor. Laboratory practicals are also listed.

SET OF THEMES
I. PN JUNCTION DIODE
1. PN junction in thermodynamic equilibrium.
2. PN junction biasing.
2.1. Foward bias.
2.2. Reverse bias.
2.3 Diode I-V characteristic.
3. Resolution of a circuit with diodes.
4. Large-signal models.
5. Circuits with diodes.
5.1. Half-wave rectifier.
5.2. Full-wave rectifier.
5.3. Filtering.
5.4. Clippers.
6. Diode dynamics.
6.1. Small-signal behavior.
6.2. Diode switching times.
7. Different types of diodes: LED, photodiodes, solar cells;

II. BIPOLAR JUNCTION TRANSISTOR (BJT)
8. BJT in the dc domain.
8.1 . BJT structure.
8.2. BJT DC biasing.

8.3. Operation in the active region.
9. Large-signal models.
9.1. Ebers-Moll model.
9.2. Ideal I-V characteristics.
9.3. Static load line.
9.4. Bias stability: self-bias circuit.
10. Deviations from the ideal BJT.
10.1. Early effect.
10.2. Variation of beta with collector current.
11. BJT in the ac domain.
11.1. Small-signal equivalent circuit for the active region.
11.2. The BJT as an small signal amplifier. Dynamic load line.
11.3. The BJT as a switch.
12. The BJT as a quadripole.
12.1. Hybrid parameters.
12.2. Frequency effect.
13. Analysis of amplifier circuits.
13.1. Common-emitter amplifier.
13.2. Common-collector amplifier (emitter follower) .
13.3. Common-base amplifier.
13.4. Comparison between different configurations.
13.5. Common-emitter amplifier with emitter resistor.
III. FIELD EFFECT TRANSISTOR (FET)
14. MOSFET.
14.1. MOS structure.
14.2. Behavior of the MOS structure under a bias voltage: enhancement, depletion and reversing.
14.3. Operation principles of a MOSFET: enhancement.
14.4. I-V characteristics.
14.5. Types of MOSFETs.
15. JFET.
15.1. JFET structure.
15.2. Operating principles.
15.3. Threshold voltage.
15.4. I-V characteristics.
15.5. MESFET.
16. Small-signal equivalent circuit.
17. FET Biasing.
17.1. Source self-bias circuit.
17.2. Bias circuit for an enhancement MOSFET.
17.3. Bias circuit with four resistors.

LAB PRACTICALS
I-Diode I: I-V characteristics and rectifier circuits.
II-Diode II: Zener diodes and regulation.
III-Diode III: Rectification with filtering and ZENER regulation.
IV-BJT I: I-V characteristics. Operating regions.
V-BJT II: Biasing and stability.
VI-BJT III: Current sources.
VII-BJT IV: Basic amplifier circuits in common collector.
VIII-BJT V: Basic amplifier circuits in common emitter.
IX-BJT VI: Push-pull output stage.
X-FET: Biasing and amplifier circuits.

TEACHING METHODS

This subject has a weight of 6 ECTS distributed to 50% between theoretical and practical credits. The latter include problem solving and regulated laboratory practicals so that the methodology used is adapted to the different teaching modalities:
The 30 hours of theory are used for the transmission of knowledge with special emphasis on analysis, synthesis, induction and critical capacity. In general, the concepts are first qualitatively introduced, and then, their mathematical formulation is given.
Both problem-solving classes and laboratory practicals are interspersed with lectures and performed individually or in groups. The purpose of these is to apply the theoretical knowledge on assumptions and varied situations. Also, on a reciprocal basis, the practical results will be used to explain theoretical concepts especially with respect to deviations from the real behavior of electronic devices compared to the ideal device. The practical sessions require from the student:

previous preparation; presenting the difficulties found in the resolution or execution of the practical, and, finally, making a report of laboratory practicals.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		7,5	22,5					
Horas de Actividad No Presencial del Alumno/a	45		11,25	33,75					

Legend:
M: Lecture-based
S: Seminar
GA: Applied classroom-based groups
GL: Applied laboratory-based groups
GO: Applied computer-based groups
GCL: Applied clinical-based groups
TA: Workshop
TI: Industrial workshop
GCA: Applied fieldwork groups

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Written test: 70% of the overall mark. It will be obtained by means of an individual final test consisting of two parts:
- First part: Theoretical concepts. ELIMINATORY TEST. A minimum mark of 3 will be required for the second part of the written test to be corrected.
- Second part: Problem solving.
The most important aspects to be evaluated are:
* Correct answers with appropriate reasoning.
* Correct approach and reasoning of the exercises or problems in the search of the solution.
* Correct development and absence of serious conceptual mistakes.
* Obtaining and analyzing the solution
Laboratory practicals: 30% of the overall mark. Practicals are regulated and assistance is mandatory. The laboratory mark corresponds to the preparation, execution and report of various practical sessions, which will be carried out by groups, and an individual test that will be held at the end of the quarter. Full list of the different aspects to evaluate is detailed in the Student Guide.

To pass the subject in the ordinary call, in addition to obtaining an average mark equal to or higher than 5, it is necessary to pass the laboratory practicals and to obtain at least a 4.5 in the individual final written test (as long as the minimum mark required in the eliminatory part of the final written exam is exceeded).

If, in the ordinary call, a student does not pass the subject but he/she passes one of the two parts of the subject, the mark of the passed part (final individual written test and/or laboratory practicals) will be saved for the extraordinary call. In this case, the maximum mark that can be achieved will be 4.5.

In order to waive the ordinary call it will be enough not to attend the final individual written test.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call, the evaluation of the subject will consist of :
- Written test: 70% of the overall mark. It will be obtained through an individual final test consisting of two parts:

- First part: Theoretical concepts. ELIMINATORY TEST. A minimum mark of 3 will be required for the second part of the written test to be corrected.
- Second part: Problem solving.
- Individual laboratory test with a weight of 30%.
To pass the subject in the extraordinary call, in addition to obtaining an average mark equal to or higher than 5, it is necessary to pass the laboratory test and to obtain at least a 4.5 in the individual final written test (as long as the minimum mark required in the eliminatory part of the final written exam is exceeded).

If in the ordinary exam the student has NOT passed the final individual written test, in order to waive the extraordinary exam it will be sufficient not to take the final individual written test.

If in the ordinary call the student HAS passed the final individual written test but NOT the laboratory practicals, in order to waive the extraordinary call it will be enough not to take the laboratory test. laboratory, in order to waive the extraordinary call it will be enough not to take the final individual laboratory test.

MANDATORY MATERIALS

The teaching staff the subject has elaborated:
- Book of laboratory practicals
- Teaching book

This educational material is available at the Publications Service of the School and also in the eGela platform, where it is complemented with datasheets of the devices used in the lab sessions, instructions for preparation of practicals, self-evaluation exercises and solutions of exams from previous years.
This eGela platform and the personalized mail will be used as a means of intercommunication between the students and the teaching staff.

BIBLIOGRAPHY

Basic bibliography

Textbooks

[1] Norbert R. Malik, "Electronic Circuits. Analysis, Simulation and Design", Prentice Hall International Editions.
[2] Gerold W. Neudeck, "PN Junction Diode", Addison - Wesley Iberoamericana, 1993.
[3] Gerold W. Neudeck, "Bipolar Junction Transistor", Addison - Wesley Iberoamericana, 1994.
[4] Robert F. Pierret, "Field Effect Devices", Addison - Wesley Iberoamericana, 1994.
[5] R. L. Boylestad & L. Nashelsky, "Electronic Devices and Circuits Theory", Prentice Hall 2003.
[6] A. S. Sedra K. C. Smith, "Microelectronic Circuits", Mc Graw Hill, 2006.
[7] A. R. Hambley, "Electronics", Prentice Hall, 2001.

Detailed bibliography

Journals

Web sites of interest

OBSERVATIONS