Universitat Autònoma de Barcelona

2022/2023

Electricity and Electronics

Code: 102771
ECTS Credits: 9

Degree	Type	Year	Semester
2502441 Computer Engineering	FB	1	1

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: Yes

Other comments on languages

Pot haver algun grup de PLAB en anglès

Teachers

Xavier Oriols Pladevall
Xavier Cartoixa Soler
David Jiménez Jiménez

Prerequisites

The student must be able to use the following mathematical concepts:

- Trigonometric, logarithmic, exponential functions
- Representation of functions
- Derivation and integration of functions
- Complex numbers

Objectives and Contextualisation

- Understand the basic concepts of electricity and electronics, and know the basic elements of electronic circuits.
- Know how to use the laws of circuit analysis to determine the behavior of linear electric circuits.
- Know how to analyze the temporary behavior of circuits with elements that store energy.
- Know how to analyze the frequency response of electrical circuits powered with sinusoidal signals.
- Know the physical basis of electronic devices based on semiconductors. Know the principle of operation of the PN junction diode and the basic applications of this device.
- Know the operation principle of field effect transistors and their basic digital applications.
- Know the operating principle of the operational amplifier and its linear and non-linear applications.
- Know the basic circuits of analog-digital and digital-analog conversion, and know how to describe the electronic elements that are part of the data acquisition systems in a PC.

Competences

- Acquire personal work habits.
- Know the basic materials and technologies to enable the learning and development of new methods and technologies, as well as those that that provide large-scale versatility to adapt to new situations.
- Understand and master the basic concepts of fields, waves and electromagnetism, electrical circuit theory, electronic circuits, physical principles of semiconductors and logic families, electronic and photonic devices, and their application to typical engineering problems.
- Work in teams.

Learning Outcomes

1. Know about electrical circuit theory and be able to apply it to circuit analysis.
2. Know and be able to apply the physical principles of semiconductors, logic ports and electronic devices.
3. Know the principles of physics, especially those related with electricity and electronics.
4. Prevent and solve problems.
5. Recognise and identify physical models in engineering problems.
6. Show an understanding and command of the basic concepts of fields, waves, electromagnetism and photonics.
7. Work cooperatively.

Content

1 - Introduction to electronic circuits. Introduction to the subject. Basic concepts of field, waves, electromagnetism and electricity. Basic elements: voltage and current sources, resistors, capacitors and coils. Power and energy.

2 - Basic laws of circuit analysis. Linear circuits. Basic laws of circuit analysis: Resolution of simple circuits with Kirchhoff laws. Other methods: superposition principle, Thevenin and Norton theorems.

3 - Temporary evolution: transient regime. Transient regime: first order circuits and resolution techniques. First order basic circuits: resolution of simple circuits, such as the RC and RL circuits, among others. Determination of the initial conditions and steady state of a circuit before and after a transient stage.

4 - Permanent sinusoidal regime. Introduction to the permanent regime. Definition of the sinusoidal signal. Introduction to complex notation and definition of the concept of impedance. Determination of the transfer function of a circuit. Study of the frequency response of a circuit: Bode diagram. First order filters.

5 - Introduction to Semiconductors. PN junction diodes and photonic devices. Introduction to semiconductors. Diodes. Circuits with diodes. Introduction to photonic devices.

6 - Logic gates with MOSFET field effect transistors. Structure and types of transistors. I-V curves and operating regions. Digital applications.

7 - The operational amplifier and its applications. The operational amplifier. Linear applications of the operational amplifiers. Non-linear applications of the operational amplifiers.

8 - Introduction to data acquisition systems. Basics of the the analog-digital conversion. Digital-analog and analog-digital converters. Data acquisition cards: architecture and specifications.

Methodology

- During the semester, theoretical and practical classes will be carried out in the classroom. In theoretical classes, we will expose the scientific-technical knowledge of the subject in a structured way. The basic concepts will be shown to the student with instructions on how to complete these contents. In the practical classes in the classroom, in small groups, students must solve problems related to the contents exposed in the lectures, with the support of the teacher. The objective is to complete the

understanding of the contents of the subject. There will be one or several individual and / or group activities that will be scored for the final assessment of the student.

- Several laboratory sessions, of mandatory realization, will be planned. The planning will be published in the CV at the beginning of the academic course. The objective is to promote the student's active learning by working on the implementation and measurement of basic electronic circuits, as well as developing critical reasoning skills and teamwork.

Transversal competences:

The transversal competences assigned in this subject are T02.04 Prevent and solution of problems and T03.01 Work cooperatively. These competences will be worked on in those activities where group work is required, such as laboratory sessions and sessions in classroom when working in small groups. Both competences will be evaluated in the laboratory sessions.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lab sessions	18	0.72	3, 2, 1, 6, 4, 5, 7
Theoretical lessons	42	1.68	3, 2, 1, 6, 5
practical session in the classroom	15	0.6	3, 2, 1, 6, 5
Type: Supervised			
Previous report of lab sessions	21	0.84	3, 2, 1, 6, 5
Problems resolution under the lecturer supervision	4	0.16	3, 2, 1, 6, 5
Type: Autonomous			
Individual study	50	2	3, 2, 1, 6, 5
Resolution of problems (individual or small groups)	35	1.4	3, 2, 1, 6, 5
Searching of information	12	0.48	3, 2, 1, 6, 5

Assessment

Individual theoretical-practical tests:

- For the assessment, two individual partial tests carried out in the classroom with a weight of 45% on the final grade will be taken into account.
- A minimum grade of 3 will be required in the second test and an average of 5 between the two tests is necessary to overcome this part.

Activities carried out in supervised sessions:

- The resolution of problems assisted by the teacher in the classroom will be taken into account for the student assessment with a weight of 25%.

Evaluation of work carried out and presented by the student:

- In the laboratory sessions (which are mandatory), the student must complete a questionnaire that will be evaluated by the teacher, except in simulation sessions with SPICE. In this case, the report must be delivered at the beginning of the next session.The grade corresponding to the laboratory sessions (which are not recoverable) has a weight of 30% on the final grade, and a minimum score of 5 is required so that they can be considered for the evaluation of the student. In the case of repeaters who have passed the laboratory sessions in the three previous academic courses, it will not be necessary to do them again during this academic year and they will keep the grade obtained in the course that passed them. In these laboratory sessions transversal competences will be evaluated.

- In case of having reached the minimum grade of each section, the final grade of the subject will be obtained by weighting the grades with their corresponding weight. If the minimum grade is not reached in the individual theoretical-practical tests or a minimum of 5 in the final grade of the course, the student will have a second chance (as long as they have completed and passed the laboratory sessions) by taking a final exam of all the contents of the subject with a weight of 70% (this exam will include the corresponding evaluation of the individual theoretical-practical tests as well as the activities carried out in supervised sessions). A minimum score of 5 will be required in the final exam grade to average with the rest of the obtained grades.

- In case that the minimum grade set for each of these sections has not been reached, the student won't pass the subject. The final grade will correspond to the individual theoretical-practical tests if it is less than 5. If it exceeds 5, the final grade of the subject will be 4.5.

- For the assessment activities, a place, date and time of review will be indicated allowing students to review the activity with the lecturer. In this context, students may discuss the activity grade awarded by the lecturers responsible for the subject. If students do not take part in this review, no further opportunity will be made available.

- In order to pass the course with honours, the final grade must be a 9 or higher. Because the number of students with this distinction cannot exceed 5% of the number of students enrolled in the course, this distinction will be awarded according to the lecturers of the subject.

- A "non-assessable" grade will be assigned only to students who have not carried out any of the individual theoretical-practical partial tests and the final exam.

- Continuous-assessment dates will be published on Campus Virtual and may change when necessary. Any such modification will always be communicated to students through Campus Virtual, which is the usual communicationplatform between lecturers and students.

- Notwithstanding other disciplinary measures deemedappropriate, and in accordance with the academic regulations in force, assessment activities will receive a zero whenever a student commits academic irregularities that may alter such assessment. Assessment activities graded in this way and by this procedure will not be re-assessable. If passing the assessment activity or activities in question is required to pass the subject, the awarding of a zerofor disciplinary measures will also entail a direct fail for the subject, with no opportunity to re-assess this in the same academic year. Irregularities contemplated in this procedure include, among others:

- the total or partial copying of a practical exercise, report, or any other evaluation activity;
- allowing others to copy;
- presenting group work that has not been done entirely by the members of the group;
- presenting any materials prepared by a third party as one's own work, even if these materials are translations or adaptations, including work that is not original or exclusively that of the student;
- having communication devices (such as mobile phones, smart watches, etc.) accessible during theoretical-practical assessment tests (individual exams)

In future editions of this subject, the student who has committed irregularities in an assessment activity, any of the assessment activities carried out will not be validated.

In summary: copy, allowing other to copy or plagiarize (or attempt) in any of the assessment activities is equivalent to a fail for the subject, not compensable and without validation of parts of the subject in subsequent courses.

In case of failing the subject due to having committed any of these irregularities in an assessment activity, the final grade will be the lower value between 3.0 and the average of the individual theoretical-practicaltests (and therefore it willnot be possible to pass the subject by compensation).

To attend any exam it will be necessary to identify yourself with DNI.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Activities carried out in supervised sessions	25	4	0.16	3, 2, 1, 6, 5
Evaluation of work carried out and presented by the student	30	18	0.72	3, 2, 1, 6, 4, 5, 7
theoretical-practical test	45	6	0.24	3, 2, 1, 6, 5

Bibliography

- A.P. Malvino, *Principios de Electrónica*, McGraw-Hill, 2007
- A.B. Carlson, *Teoria de circuitos*, Thomson 2002
- R.L. Boylestad, Introducción al análisis de circuitos, Pearson Education,
- J.Millman*. Microelectrònica. Circuits i sistemes analògics i digitals*. Hispano europea. 1991
- L. Prat i altres, *Circuitos y dispositivos electrónicos. Fundamentos de Electrónica.* Edicions UPC. 1999

OTHERS:

- C.A. Holt, *Circuitos electrónicos digitales y analógicos.* Reverté, 1985.
- A.R. Hambley, *Electrónica*, Prentice Hall.
- M.H. Rashid, *Circuitos microelectrónicos*, Thomson, 2002
- J.F. Wakerly *, Diseño digital*, Prentice Hall, 2001
- R.E. Thomas i A.J. Rosa, *Circuitos y señales*, Reverté.

Software

In some laboratory sessions PSPICE and KiCad will be used.