Universitat Autònoma de Barcelona

2022/2023

Circuit Theory and Electronics

Code: 102709
ECTS Credits: 9

Degree	Type	Year	Semester
2500895 Electronic Engineering for Telecommunication	FB	1	1
2500898 Telecommunication Systems 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

Teachers

Joan García García
Maria Aránzazu Uranga del Monte

Prerequisites

There are no prerequisits

Objectives and Contextualisation

The subject aims at familiarizing the student with the theory, techniques and basic devices used in the analysis of electronic circuits for telecommunications.

Competences

Electronic Engineering for Telecommunication
- Communication
- Develop personal attitude.
- Develop personal work habits.
- Develop thinking habits.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.
- Work in a team.

Telecommunication Systems Engineering
- Communication
- Develop personal attitude.
- Develop personal work habits.
- Develop thinking habits.

- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.
- Work in a team.

Learning Outcomes

1. Assume and respect the role of the different members of a team, as well as the different levels of dependency in the team.
2. Communicate efficiently, orally and in writing, knowledge, results and skills, both professionally and to non-expert audiences.
3. Define the basic concepts of the theory of electrical circuits, electronic circuits, physical principles of semiconductors and logic families, electronic and photonic devices and material technology and their application to solving engineering problems.
4. Develop critical thinking and reasoning.
5. Develop curiosity and creativity.
6. Develop independent learning strategies.
7. Develop scientific thinking.
8. Develop systemic thinking.
9. Develop the capacity for analysis and synthesis.
10. Efficiently use ICT for the communication and transmission of ideas and results.
11. Implement physically and measure the electrical variables of simple electrical and electronic circuits using the typical tools of an electronics laboratory.
12. Maintain a proactive and dynamic attitude with regard to one's own professional career, personal growth and continuing education. Have the will to overcome difficulties.
13. Maintain a proactive and dynamic attitude with regard to one's own professional career, personal growth and continuing education. Have the will to overcome difficulties.
14. Manage available time and resources.
15. Manage available time and resources. Work in an organised manner.
16. Theoretically analyse, with help of computer assisted simulation, the static and dynamic behaviour of field effect transistor based logic gates.
17. Theoretically analyse, with the help of computer assisted simulation, basic circuits based on operational amplifiers both in linear and non-linear applications.
18. Theoretically analyse, with the help of computer assisted simulation, first and second order continuous, transient and permanent electrical circuits.
19. Use and specify A/D and D/A converters in contexts of data acquisition and acting on the environment.
20. Work autonomously.
21. Work cooperatively.

Content

Topic 1. Elements, variables and equations of electric circuits.
1.1. Electrical or electronic circuit: introduction
1.2. Electric variables of a circuit: fundamental and derived variables.
1.3. Circuit elements and criteria of signes.
1.4. Resistors and sources of voltage and current
1.5. Power dissipated and supplied by an element
1.6. Kirchhoff's Laws: KCL and KVL
1.7. Dependent sources. Kirchoff laws with dependent sources
1.8. Equivalent circuits: serial and parallel associations, source transformation, voltage and current divider.

Topic 2. Laws and basic methods of resistive circuit resolution.
2.1 Generating variables and node method
2.2 Some theorems of circuit theory
2.2.1 Superposition
2.2.2 Thevenin and Norton theorems
2.3 Matrix representation of two-port circuits

Unit 3. Circuits in temporary transitory regime: circuits of 1st order
3.1 Capacitors and autoinductions: definition, properties
3.2 Capacitors and autoinductions in series and parallel.
3.3 Equation of a first-order dynamic circuit.
3.4 Analytical solutions for
a) constant excitation
b) constant excitation in sections

Unit 4. Sinusoidal stationary regime.
4.1 Introduction to the sinusoidal stationary circuit.
4.2 Phasors
4.3 Formulation with phasors of the equations of the circuit.
4.3 Impedance and Admittance.
4.4 Power in sinusoidal steady state and definition of the power factor

Unit 5. Introduction to semiconductor and device physics
5.1 Union diode PN
5.2 Simple DC models of PN diode and polarization.
5.3 Circuits with diodes

Unit 6. Operational Amplifier
6.1 Introduction.
6.2 Linear mode and non-linear mode of operation.
6.3 Linear Applications
6.3.1 Non-inverter amplifier
6.3.2 Voltage tracker (buffer)
6.3.3 Inverter amplifier
6.3.4 Adder
6.3.5 Integrator
6.3.6 Differentiator
6.4 Non-Linear Applications: comparators

Laboratory practices

Practice 1: Introduction to the Spice circuit simulator
Practice 2: Basic Passive Components
Practice 3: Basic circuits and passive components: transient and permanent behavior
Practice 4: Active basic components: The diode. Basic circuits
Practice 5: The operational amplifier. Basic circuits

Some of these laboratory practices (1 and 5) may be replaced by simulation work depending on the health situation.

Methodology

In the Theoretical sessions, the concepts necessary to face the rest of the activities of the subject will be presented. These sessions will be reinforced eventually with seminars aimed at deepening specific aspects of the agenda.

The problem classes are intended to put theoretical concepts into practice. They will be held in small groups to encourage interaction between teachers and students.

In the lab sessions, students come into contact with electronic devices and instruments through the implementation of electronic circuits.

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			
Theoretical classes	60	2.4	17, 18, 16, 3, 7, 8, 6, 9, 5, 4, 15, 13
Type: Supervised			
Problem classes	70	2.8	17, 18, 16, 1, 2, 3, 7, 8, 6, 9, 5, 4, 10, 15, 11, 13, 21, 20, 19
Type: Autonomous			
Laboratory sessions	38	1.52	17, 18, 16, 1, 2, 3, 6, 15, 11, 20, 19

Assessment

The evaluation of the subject will be carried out through three types of clearly differentiated activities: lab sessions, two partial exams and a final exam.

Lab sessions

The practical part consists of five compulsory individual practices and a lab exam. In the case of face-to-face practices in the laboratory, they will be evaluated with a previous report (30% of the practice grade) and a practice report (70% of the practice grade).

All lab sessions must be completed.

Up to 2 lab sessions will be allowed outside the scheduled time as long as the non-attendance at the lab has a sufficiently justified cause. In this case, the grade of these two practices will be replaced by the grade resulting from the evaluation of specific works and / or activities proposed by the teachers.

Unjustified non-attendance at any of the planned labs will imply the suspension of the lab (and consequently of the subject).

At the end of the 5 practices, there will be a practice exam that will be scored with a grade that will represent 50% of the final practice grade

Two parcial exams

Two partial exams will be carried out, including each of them approximately half of the syllabus of the subject (part A and B respectively).

These exams will last 2 hours. They will result in the partial N_{PA} and N_{PB} notes between 0 and 10 points.

Final exam

It will be done at the end of the semester.To participate in the final exam (recovery exam) it is necessary to have passed the lab sessions and to have a minimun grade of 2, corresponding to the two partial exams.

The exam will consist oftwo parts corresponding to the matters included in parts A and B.

Both parts will consist of problems. Each student mustcomplete the part of the examthat is suspended (N_{PA} and/or N_{PB} <5). Students who have both parts approved, will not need to take the exam, unless they want to

raise the grade. In these cases the students renounce the previous marks and will use the grade obtained in the final exam to obtain the final grade of the subject.

To pass the synthesis exam, a global average of the exam of 5 is required.

After this final exam, all students will have a grade between 0 and 10 in parts A and B, either obtained in the partials exams, in this final exam, or in a combination of the two exams.

Final mark of the subject.

The final grade of the subject is calculated as the weighted average of the marks of the partial or final exams and lab sessions where the lab sessions weight is 30% and the exams 70%. To be able to make an average with the lab session it is necessary that the grade of the final exam is greater than or equal to 5.

Without prejudice to other disciplinary measures deemed appropriate, and in accordance with current academic regulations, irregularities committed by a student that may lead to a variation of the grade will be scored with a zero (0). For example, plagiarizing, copying, letting copy, ..., an evaluation activity, will imply failing this evaluation activity with a zero (0). The evaluation activities qualified in this way and by this procedure will not be recoverable. If it is necessary to pass any of these evaluation activities to pass the subject, this subject will be suspended directly, without the opportunity to recover it in the same course.

Special qualifications

Only if the student does not present anyreport of practices or work done at home, the note will be Not Evaluable. Otherwise, the final grade will be calculated based on the weights of each evaluation activity.

For each subject of the same curriculum, the Honor Cards resulting from calculating the five percent or fraction of the students enrolledin all the teaching groups of the subject can be grantedglobally. It will only be awarded to students who have obtained a final grade equal to or greater than 9.00, and whenever the teacher considers it appropriate (depending on the excellence of the student).

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Questionnaires done during the lab session	70% of each lab session grade	22	0.88	17, 18, 16, 1, 2, 3, 7, 8, 6, 9, 5, 4, 10, 15, 11, 13, 21, 20, 19
Final theoretical exam	Until 100% of the theory mark (70% of the final subject grade)	5	0.2	17, 18, 16, 2, 3, 7, 8, 6, 9, 5, 4, 15, 11, 13, 20, 19
Lab exam	50% of the final lab session grade	2	0.08	17, 18, 16, 11, 20
Previous lab report	30% of the lab session grade	18	0.72	17, 18, 16, 1, 2, 3, 7, 8, 6, 9, 5, 4, 10, 14, 15, 11, 12, 13, 21, 20, 19
Two partial exams	each partial exam has a weight of 35% of the final grade	10	0.4	17, 18, 16, 2, 3, 7, 8, 6, 9, 5, 4, 14, 15, 11, 20

Bibliography

Main books:

- R. Boylestad y L. Nashelsky. "Introducción al análisis de Circuitos", Prentice Hall
- R. Boylestad y L. Nashelsky. "Teoría de Circuitos y dispositivos electrónicos", Prentice Hall.

Other interesting books:

- A.Bruce Carlson. Teoría de circuitos. Thomson-Paraninfo. 2002. (IBSB: 84-9732-066-2)
- J. David Irwin. Análisis básico de circuitos en Ingeniería. Prentice Hall Hispanoamericana.1997. (ISBN:968-880-816)
- Allan R. Hambley, "Electrónica", Segunda Edición, Prentice Hall, 2001
- C. J. Savant Jr., Martin S. Roden, Gordon L. Carpenter, "Diseño Electrónico, Circuitos y sistemas", Tercera Edición, Prentice Hall, 2000.
- Norbert R. Malik, "Circuitos Electrónicos, Análisis, simulación y diseño", Prentice may, 2000.

Software

Pspice 9.1 student edition