

**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 prerequisites

**Objectives and Contextualisation**

The subject aims to familiarize 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 ones own professional career, personal growth and continuing education. Have the will to overcome difficulties.
13. Maintain a proactive and dynamic attitude with regard to ones 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. Circulation 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 Knot method
- 2.2 Knot method when there are voltage sources
- 2.3 Some theorems of circuit theory
  - 2.3.1 Superposition
  - 2.3.2 Thevenin and Norton theorems
- 2.4 Two-port resistive elements: representation of two-port elements with parameters  $r$  and  $g$

### Topic 3. Circuits in temporary transitory regime

#### 3.1 Dynamic circuits of 1st order

##### 3.1.1 Capacitors and autoinductions: definition, properties

##### 3.1.2 Capacitors and autoinductions in series and parallel.

##### 3.1.3 Equation of a first-order dynamic circuit.

##### 3.1.4 Analytical solutions for

a) constant excitement

b) constant excitement in sections

c) time function excitation and general solution

### Unit 4. Sinusoidal stationary regime.

#### 4.1 Introduction to the sinusoidal stationary circuit.

#### 4.2 Phasors

#### 4.3 Formulation with fasore of the equations of the circuit.

#### 4.3 Impedance and Admittance.

#### 4.4 Power in sinusoidal steady state and definition of the power factor

### Topic 5. Introduction to semiconductor and device physics

#### 5.1 Metal and insulation

#### 5.2 Intrinsic and extrinsic semiconductor

#### 5.3 Union diode PN

#### 5.4 Simple DC models of PN diode and polarization.

#### 5.5 Circuits with diodes

### Topic 6. Operational Amplifier

#### 6.1 Introduction.

#### 6.2 Linear mode and non-linear mode of operation. Shmidt's Trigger

#### 6.3 Non-inverting amplifier

#### 6.4 Voltage follower (unit gain buffer )

#### 6.5 Inverting amplifier

#### 6.6 Adder

#### 6.7 Integrator

#### 6.8 Differentiator

### Laboratory practices

Practice 1: Introduction to the Spice circuit simulator

Practice2: Basic Components Passive

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

## Methodology

In the Theory sessions, the theoretical 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.

## Activities

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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 lab sessions consists of five compulsory practices that are evaluated with a previous report and a lab report, done during the lab session. The previous report weight is 30% of the grade of each practice and the practice report weight ( done during the lab session) is 70%.

All the practices must be done compulsorily.

It will be admitted to do up to 2 practices outside of their expected time as long as the non-attendance at the lab session has a sufficiently justified cause. In this case, the mark of these two practices will be replaced by the score resulting from the evaluation of specific works and activities proposed by the teacher.

The unjustified absence of any of the planned practices will imply the fail of the practices (and therefore of the subject).

At the end of the 5 practices, a hands-on exam will be carried out that will be graded with a grade that will represent 50 percent of the final lab mark.

### 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 be carried out tentatively during the weeks of November 13 and December 18, although they will be notified at least one week in advance. These exams will last 2 hours and will consist of theoretical questions and problems. They will result in the partial NPA and NPB 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 minimum mark of 2, corresponding to the two partial exams.

The exam will consist of two parts corresponding to the matters included in parts A and B. For each part there will be 2 hours, so that the maximum duration of the exam can be up to 4 hours.

Both parts will consist of problems and theoretical issues. Each student must complete the part of the exam that is suspended (NPA and / or NPB <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 any report 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 enrolled in all the teaching groups of the subject can be granted globally. 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 mark	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 mark)	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 mark	2	0.08	17, 18, 16, 11, 20
Previous lab report	30% of the lab session mark	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 mark	10	0.4	17, 18, 16, 2, 3, 7, 8, 6, 9, 5, 4, 14, 15, 11, 20

## Bibliography

- R. Boylestad y L. Nashelsky. "Introductory Circuit Analysis", 9ª Ed., Prentice Hall.

Other interesting books:

- A. Bruce Carlson. Teoría de circuitos. Thomson-Paraninfo. 2002. (ISBN: 84-9732-066-2)
- J. David Irwin. Análisis básico de circuitos en Ingeniería. Prentice Hall Hispanoamericana. 1997. (ISBN: 968-880-816)
- R.C. Dorf, J.A. Svoboda. Introduction to electric circuits. John Wiley & Sons. 1996 (ISBN: 0-471-12702-7)
- 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.
- HORENSTEIN, M. N. "Microelectrónica: circuitos y dispositivos", Prentice-Hall, 2ª de., 1997
- C.J. Savant, M.S. Roden y G.L. Carpenter, "Diseño Electrónico. Circuitos y Sistemas", Ed. Addison-Wesley Iberoamericana, 1992.
- Norbert R. Malik, "Circuitos Electrónicos, Análisis, simulación y diseño", Prentice may, 2000.