UAB
Universitat Autònoma de Barcelona

# Electronic Circuits and Components

Code: 102689
ECTS Credits: 6

2025/2026

| Degree | Type | Year |
|---|---|---|
| Telecommunication Systems Engineering | OB | 2 |
| Electronic Engineering for Telecommunication | OB | 2 |

## Contact

Name: Enrique Alberto Miranda Castellano

Email: enrique.miranda@uab.cat

## Teachers

David Jimenez Jimenez

Enrique Alberto Miranda Castellano

## Teaching groups languages

You can view this information at the end of this document.

## Prerequisites

The student should know:

.- Circuit Theory (solve linear circuits with resistances, capacitors and inductances)
.- Basic Electrostatics (concepts of field, potential, etc.)
.- Mathematics (complex numbers, basic differential equations, etc.)

## Objectives and Contextualisation

- The cental objective of this course is to provide a general overview of basic electronic devices, mainly diodes and transistors and of the basic models used for the analysis and design of circuits.
- Understanding of the physical principles behind the operation of semiconductors, and electron and photonic devices.
- Relate the technological processes, the performance and the operation of electron devices in circuits using analytic and phisical models and numerical simulations.

## Competences

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.
- Resolve problems with initiative and creativity. Make decisions. Communicate and transmit knowledge, skills and abilities, in awareness of the ethical and professional responsibilities involved in a telecommunications engineer's work.
- Work in a multidisciplinary group and in a multilingual environment, and communicate, both in writing and orally, knowledge, procedures, results and ideas related with telecommunications and electronics.
- Work in a team.

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.
- Resolve problems with initiative and creativity. Make decisions. Communicate and transmit knowledge, skills and abilities, in awareness of the ethical and professional responsibilities involved in a telecommunications engineer's work.
- Work in a multidisciplinary group and in a multilingual environment, and communicate, both in writing and orally, knowledge, procedures, results and ideas related with telecommunications and electronics
- 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 physical principles of semiconductors and logic families, electronic and photonic devices, material technology and their application to problem-solving in engineering.
4. Develop critical thinking and reasoning.
5. Develop curiosity and creativity.
6. Develop independent learning strategies.
7. Develop the capacity for analysis and synthesis.
8. Draft brief reports on the inherent structure of telecommunication and electronics projects.
9. Efficiently use ICT for the communication and transmission of ideas and results.
10. 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.
11. 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.
12. Manage available time and resources.
13. Manage available time and resources. Work in an organised manner.
14. Use analogue and digital electronic, analogue-digital conversion, radiofrequency, power supply and electrical energy conversion circuits in telecommunication and computation applications.
15. Use communication and computer applications to support the development and exploitation of telecommunication and electronic networks, services and applications.
16. Use computer tools to research bibliographic resources and information on electronics.
17. Use computer tools to simulate telecommunication and electronic circuits and systems.
18. Use different sources of energy and especially solar, photovoltaic and thermal, as well as the basics of electrical engineering and power electronics.
19. Use different sources of energy as well as the fundamentals of power electronics.
20. Work autonomously.

21. Work cooperatively.

## Content

Tema1. Semiconductor physics and electron transport

1.1 Introduction to semiconductors. Carrier concentration.
1.2 Properties of carrier transport.
1.3 Charges and fields. Band diagrams.

Tema 2. PN junction

2.1 Electrostatics of PN junction
2.2 Out of equilibrium conditions. Current.
2.3 Application to circuits: rectifiers, filters, etc.

Tema 3. Bipolar transistor

3.1 Classification of transistors. Band diagrams.
3.2 Current-voltage characteristics.
3.3 Application to circuits: polarization, amplifiers, etc.

Tema 4. MOS transistor

4.1 The MOS structure.
4.2 Long channel MOS transistor.
4.3 MOSFET scaling. Short channel effects.
4.4 Application to circuits: logic gates, CMOS circuits

Tema 5. Photonic devices

5.1 Light properties and interaction with matter.
5.2 LEDs (Light Emitting Diode) and LASERs (Light amplification by stimulated emission of radiation)
5.3 Light detectors and solar cells
5.4 Application to circuits

## Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Directed | 12 | 0.48 | 1, 3 |
| Directed | 12 | 0.48 | 3, 7, 4 |
| Directed | 26 | 1.04 | 3, 7, 4 |
| Type: Supervised | | | |
| Supervised | 12 | 0.48 | 3, 6, 20 |
| Type: Autonomous | | | |
| Autonomous | 8 | 0.32 | 3, 5 |

| | | | |
|---|---|---|---|
| Autonomous | 68 | 2.72 | 3, 6, 13 |

Directed activities:

Classes of theory

Classes of problems

Laboratory

Supervised activities:

The student can contact the professor for additional explanations.

Autonomous activities:

Study at home

Solving additional problems

In this course, the use of Artificial Intelligence (AI) technologies is not allowed at any stage.

Any work that includes fragments generated by AI will be considered an act of academic dishonesty and may result in partial or total penalties on the grade for the activity, or more severe sanctions in serious cases.

Platform: Virtual Campus

This course does not provide for a unique evaluation system.Without prejudice to other disciplinary measures deemed appropriate, any irregularities committed by the student that may lead to a variation in the grade of an assessment act will be graded as zero. Therefore, copying, plagiarism, cheating, allowing others to copy, etc. in any of the assessment activities will result in failing that activity with a zero.

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.

## Assessment

## Continous Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Evaluation (first exam) | 37.5% | 2 | 0.08 | 3, 8, 15, 14, 19, 18, 16, 17 |
| Evaluation (second exam) | 37.5% | 2 | 0.08 | 1, 2, 3, 6, 7, 5, 4, 9, 12, 13, 10, 11, 21, 20, 15, 14, 19, 18, 16, 17 |
| Laboratory | 25% | 6 | 0.24 | 1, 3, 7, 4, 8, 21, 15, 14, 19, 18, 16, 17 |
| Seminar | 0 | 2 | 0.08 | 3, 7, 4 |

.- 1st Partial written: 37.5% of the GRADE

.- 2nd Partial written: 37.5% of the GRADE
.- Practices: 25% of the GRADE
Each exam must be approved with a minimum of 5 points. Both partials c
Lab practices are compulsory (all of them) and are not recoverable, so ai
In case of not passing the three parts of the subject, the final grade will b
Value = 0.25 * NPractice + 0.375 * NP1 + 0.375 * NP2, where NPractice
If Value> = 5, then the final grade will be 4.8
If Value <5, then the final grade will be equal to Value

Repeater students can validate the practices carried out by mantaining the obtained grade.

Not valuable: if the student does not present any activity.

## Bibliography


Basic:

Luis Prats Viñas y Josep Calderer Cardona, Dispositius electrònics i fotònics. Fonaments. Edicions UPC, 2001

T. Floyd, Electronic Devices. Seventh Edition, Prentice Hall, 2005

Advanced:

R.F.Pierret, Semiconductor fundamentals (1988) / Fundamentos de semiconductores (1994)

Gerold W. Neudeck,. The PN Junction Diode (1989) / El diodo PN de unión (1993)

G.W.Neudeck, The Bipolar Junction Transistor (1989) / El transistor bipolar de unión (1994)

R.F. Pierret, Field effect devices (1990) / Dispositivos de efecto de campo (1994)

J.Wilson Optoelectronics: an introduction. Editorial Prentice Hall


## Software

The simulation programs to be used during the course are of standard use and are installed in the practice labora

## Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

| Name | Group | Language | Semester | Turn |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| (PAUL) Classroom practices | 311 | Spanish | first semester | morning-mixed |
| (PAUL) Classroom practices | 312 | Spanish | first semester | morning-mixed |
| (PAUL) Classroom practices | 331 | Spanish | first semester | afternoon |
| (PLAB) Practical laboratories | 311 | Catalan | first semester | morning-mixed |
| (PLAB) Practical laboratories | 312 | Catalan | first semester | afternoon |
| (PLAB) Practical laboratories | 313 | Catalan | first semester | morning-mixed |
| (PLAB) Practical laboratories | 314 | Catalan | first semester | morning-mixed |
| (PLAB) Practical laboratories | 315 | Catalan | first semester | afternoon |
| (PLAB) Practical laboratories | 316 | Catalan | first semester | afternoon |
| (PLAB) Practical laboratories | 317 | Catalan | first semester | morning-mixed |
| (PLAB) Practical laboratories | 319 | Catalan | first semester | afternoon |
| (TE) Theory | 31 | Spanish | first semester | morning-mixed |
| (TE) Theory | 51 | Spanish | first semester | afternoon |