

Course guide

230910 - DE - Electronic Devices

Last modified: 11/04/2025

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR'S DEGREE IN ELECTRONIC ENGINEERING AND TELECOMMUNICATION (Syllabus 2018).
(Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: ISIDRO MARTIN GARCIA

Others: Primer quadrimestre:
ALEXANDRA BERMEJO BROTO - 11, 12, 13
ISIDRO MARTIN GARCIA - 11, 12, 13

PRIOR SKILLS

Mathematics, physics and circuits from first year.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE4. (ENG) GREELEC: comprensió i domini dels conceptes bàsics de sistemes lineals i les funcions transformades i relacionades, teoria de circuits elèctrics, circuits elèctrics, principi físic de semiconductors i hfamilíes lògiques, dispositius electrònics i fotònics, tecnologia dels materials i la seva aplicació per a resolució de problemes per a l'enginyeria. (Mòdul de formació bàsica).

Transversal:

CT6. (ENG) GREELEC: APRENTATGE AUTÒNOM: Detectar deficiències en el propi coneixement i superarles mitjançant la reflexió crítica i l'elecció de la millor actuació per ampliar coneixements.

Basic:

CB3. (ENG) GREELEC: Que els estudiants tinguin la capacitat de reunir i interpretar dades rellevants (normalment dins de la seva àrea d'estudi) per emetre judicis que incloguin una reflexió sobre temes rellevants de caire social, científic o ètic.

TEACHING METHODOLOGY

- Lectures
- Application classes
- Problem deliveries
- Exams with short questions and problems

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:

The aim of this course is to teach students at an introductory level about the physical principles of semiconductor devices and offer them an overview about the reasons why semiconductor devices are the basis of the electronics industry.

In particular we go in depth in the physical foundations, then we will present in detail diodes, MOS and bipolar transistors. Additionally, a brief description and analysis of fundamental properties of basic optoelectronic devices will be done.

Learning results of the subject:

- Ability to analyse and predict the general behaviour of semiconductor devices.
- Ability to quantify the electrical properties.
- Ability to obtain the different electrical models to be applied in circuit analysis and design.

STUDY LOAD

Type	Hours	Percentage
Hours large group	52,0	34.67
Self study	85,0	56.67
Hours small group	13,0	8.67

Total learning time: 150 h

CONTENTS

I. SEMICONDUCTOR FUNDAMENTALS

Description:

- I.1. Semiconductor materials: crystal structure and Miller indices.
- I.2. Atomic model
- I.3. energy bands
- I.4. Current carriers in a semiconductor. Hollow concept.
- I.5. Carrier concentration in a semiconductor
- I.6. Carrier transport: entrainment and diffusion currents
- I.7. Generation and recombination processes
- I.8. Continuity equation.

Full-or-part-time: 14h

Theory classes: 14h

II. P/N JUNCTIONS

Description:

- II.1 P/N junction in equilibrium: band diagram
- II.2 Electrostatics.
- II.3 Direct and reverse currents.
- II.4 Load control model and dynamic behavior
- II.5 Avalanche in reverse.

Full-or-part-time: 10h

Theory classes: 10h

III. BIPOLAR TRANSISTOR

Description:

- III.1 The transistor effect
- III.2 Static current-voltage characteristic
- III.3 Ebers-Moll model
- III.4 Small signal model

Full-or-part-time: 8h

Theory classes: 8h

IV. MOSFET TRANSISTOR

Description:

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- Resultados de traducción
- IV.1 MOS capacitor
- IV.2 Stationary characteristics of the ideal MOS. Simple load control model
- IV.3 Small signal model

Full-or-part-time: 8h

Theory classes: 8h

V. OPTOELECTRONIC DEVICES

Description:

- V.1 Heterojunctions
- V.2 LED's
- V.3 Lasers
- V.4 Photoreceptors

Full-or-part-time: 8h

Theory classes: 8h

GRADING SYSTEM

Lab sessions: 10 %

Partial examinations and controls: 45%

Final exam: 45 %

Laboratory mark (10%) cannot be re-assessed

BIBLIOGRAPHY

Basic:

- Sze, S.M.; Lee, M.K. Semiconductor devices: physics and technology. 3rd. int. stud. version. Singapore: Wiley, 2013. ISBN 9788126556755.
- Prat Viñas, L.; Calderer Cardona, J. Dispositivos electrónicos y fotónicos: fundamentos [on line]. 2a ed. Barcelona: Edicions UPC, 2006 [Consultation: 10/07/2019]. Available on: <http://hdl.handle.net/2099.3/36596>. ISBN 8483018543.

Complementary:

- Tsividis, Y.; McAndrew, C. The MOS transistor. Int. 3rd ed. New York: Oxford University Press, 2012. ISBN 9780199829835.
- Kasap, S.O.; Sinha, R.K. Optoelectronics and photonics: principles and practices. 2nd ed. Boston: Pearson, 2013. ISBN 9780273774174.

