

Course guide

230923 - CEM - Materials Science and Engineering

Last modified: 29/05/2024

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: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: CRISTOBAL VOZ SANCHEZ

Others: Primer quadrimestre:
PABLO RAFAEL ORTEGA VILLASCLARAS - 11, 12, 13
JOAQUIN PUIGDOLLERS GONZALEZ - 11, 12, 13
CRISTOBAL VOZ SANCHEZ - 11, 12, 13

PRIOR SKILLS

Physics fundamentals, basic electronic components and semiconductors

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:

CG7. (ENG) GREELEC: capacitat d'anàlisi i valorar l'impacte social i medioambiental de les solucions tècniques.

Transversal:

CT5. (ENG) GREELEC: ÚS SOLVENT DELS RECURSOS DE LA INFORMACIÓ. Gestionar l'adquisició, l'estructuració, l'anàlisi i la visualització de dades i informació en l'àmbit de l'especialitat i valorar de forma crítica els resultats d'aquesta gestió.

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.

CB4. (ENG) GREELEC: Que els estudiants puguin transmetre informació, idees, problemes i solucions a un públic tant especialitzat com no especialitzat.

TEACHING METHODOLOGY

Classroom lectures
Laboratory

LEARNING OBJECTIVES OF THE SUBJECT

Know the technology as well as the mechanical, thermal, optical, electrical properties of materials involved in the electronic components.



STUDY LOAD

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

Total learning time: 150 h

CONTENTS

1. Physical properties of the matter

Description:

- 1.1 Classification of materials
- 1.2 Crystal structure of the materials. Crystallography. Defects
- 1.3 Electrical properties
- 1.4 Magnetic properties
- 1.5 Optical properties

Full-or-part-time: 49h

Theory classes: 23h

Self study : 26h

2. Application to the electronic components

Description:

- 2.1 Resistors. Characteristic parameters, electrical models and technology
- 2.2 Heat sinks. Thermal models and heat sink design.
- 2.3 Capacitors. Characteristic parameters, electrical models and technology
- 2.4 Batteries. Working principles, characteristic parameters and materials
- 2.5 Inductors. Characteristic parameters, electrical models and materials. Transformers

Full-or-part-time: 49h

Theory classes: 23h

Self study : 26h

3. Technology and materials of the electronics and nanoelectronics

Description:

- 3.1 Optical lithography. Electron lithography. Optical lithography limits. Integrated circuits
- 3.2 Thin film deposition. Evaporation/sublimation, electron-beam, sputtering. Atomic Layer Deposition and electrodeposition.
- 3.3 Structural material characterization. Electron microscopy (SEM, TEM). X-ray diffraction, atomic force microscopy (AFM)
- 3.4 Example. Multilayer printed-circuit-board (PCB) fabrication.

Full-or-part-time: 16h

Theory classes: 6h

Self study : 10h



4. Laboratory

Description:

P.I The light-dependent resistor (LDR). Simulations with the PC1D program of a photoresistance. Design of an alarm circuit based on LDR and piezoelectric buzzer

P.II Temperature sensor with PT1000 resistor. Heat sinks: thermal model and their application to the electronic components

P.III Electrical models and frequency response of passive elements

P.IV Optical properties and optical characterization of materials and devices

Full-or-part-time: 36h

Laboratory classes: 12h

Self study : 24h

GRADING SYSTEM

The final mark of the course is calculated as:

$$\text{Final Mark} = \text{Max}(0.3 \cdot \text{CTRL} + 0.5 \cdot \text{EXAFIN}, 0.8 \cdot \text{EXAFIN}) + 0.2 \cdot \text{LAB}$$

where

CTRL: Exam during the course

LAB: Laboratory mark

EXAFIN: Mark of the Final exam

The reassessment only includes the theory exam of the course with a weight of 80%. Mark related to the laboratory remains the same as the previous assessment with a weight of 20%.

BIBLIOGRAPHY

Basic:

- Callister, W.D.; Rethwisch, D.G. Materials science and engineering: an introduction. 10th ed., SI ed. Hoboken: John Wiley & Sons, 2020. ISBN 9781119453918.
- Quirk, M.; Serda, J. Semiconductor manufacturing technology. Upper Saddle River: Prentice Hall, 2001. ISBN 9780130815200.
- Tilley, R.J.D. Understanding solids: the science of materials. 2nd ed. Chichester, West Sussex: John Wiley & Sons, 2013. ISBN 9781118423462.