Course guide
230923 - CEM - Materials Science and Engineering

Last modified: 01/06/2023

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: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Ortega Villasclaras, Pablo Rafael

Others: Voz Sanchez, Cristobal
Puigdollers Gonzalez, Joaquin

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 poguin transmetre informació, idees, problemes i solucions a un públic tant esepecialitzat 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 materrials. Crystallography. Defects
1.3 Electrical properties
1.4 Magnetic properties
1.5 Optical properties
1.6 Mechanical properties

Full-or-part-time: 42h
Theory classes: 21h
Self study : 21h

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. Inductors. Characteristic parameters, electrical models and materials. Transformers
2.5 Batteries. Working principles, characteristic parameters and materials

Full-or-part-time: 42h
Theory classes: 21h
Self study : 21h

3. Technology and materials of the electronics and nanoelectronics

Description:
3.1 Electronic materials. Metals, semiconductors and dielectrics.
3.2 Optical lithography. Electron lithography. Optical lithography limits. Integrated circuits
3.3 Thin film deposition. Evaporation/sublimation, electron-beam, sputtering.Atomic Layer Deposition and electrodeposition.
3.4 Structural material characterization. Electron microscopy (SEM, TEM). X-ray diffraction, atomic force microscopy (AFM)
3.5 Examples
3.5.1 Printed-circuit-Board (PCB) fabrication. Multilayer
3.5.2 Diode fabrication. Encapsulation

Full-or-part-time: 30h
Theory classes: 12h
Self study : 18h

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 Optical properties and optical characterization of materials and devices
P.IV Electrical models and frequency response of passive elements (capacitors and inductors). The transformer

Full-or-part-time: 36h
Laboratory classes: 13h
Self study : 23h

GRADING SYSTEM

The final mark of the course is calculated as:

Course_mark=0.85*CTRL1+0.15*CRTL2;
Final Mark=Max(0.8*Course_mark+0.2*LAB, 0.8*EXAFIN+0.2*LAB)

where
CRTL1: Exam 1 mark (week 10/11)
CRTL2: Exam 2 mark (week 13) or alternatively a homework exercise
LAB: Laboratory mark
EXAFIN: Mark of the Final exam

The continue-course-assessment (Course_Mark) requires both CTRL1 and CTRL2 marks higher than 5.0

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:
- Tilley, R.J.D. Understanding solids: the science of materials. 2nd ed. Chichester, West Sussex: John Wiley & Sons, 2013. ISBN 9781118423462.
- 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.