Course guides
230923 - CEM - Materials Science and Engineering

Last modified: 12/05/2020

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: 2020 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Pablo R. Ortega

Others: Cristobal Voz
Joaquim Puigdollers

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 theory
Laboratory

LEARNING OBJECTIVES OF THE SUBJECT

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

STUDY LOAD

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

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 Thermal properties
1.7 Mechanical properties
1.8 Alloys, phase diagrams, soldering and corrosion
1.9 Characterization techniques

Full-or-part-time: 61h
Theory classes: 21h
Self study : 40h

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: 49h 40m
Theory classes: 17h
Self study : 32h 40m

3. Technology and materials of the electronics and µ-electronics

Description:
3.1 Semiconductor substrates for electronics
3.2 Crystal growth and epitaxies. From the ingot to the wafer
3.3 Material deposition techniques. Thermal oxidation.
3.4 Diffusion and ion implantation
3.5 Photolithography and etching. Example: the printed circuit board (PCB)
3.6 From the wafer to the device. Typical encapsulation packages
3.7 Integrated circuits. Classification and applications
3.8 Examples of discret and integrated devices. Parasitic elements

Full-or-part-time: 26h 20m
Theory classes: 14h
Self study : 12h 20m

4. Laboratory

Description:
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
II. Temperature sensor with PT1000 resistor. Heat sinks: thermal model and their application to the electronic components
III. Optical properties and optical characterization of materials and devices
IV. Electrical models and frequency response of passive elements (capacitors and inductors). The transformer

Full-or-part-time: 12h
Laboratory classes: 12h

GRADING SYSTEM

The final mark is calculated as:
Final Mark=Max(0.5*CTRL1+0.25*CRTL2+0.25*LAB, 0.75*EXAFIN+0.25*LAB)
where
CRTL1: Control 1 mark
CRTL2: Control 2 mark
LAB: Laboratory mark
EXAFIN: Mark of the Final exam

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.