Materials (B)

Calendar: 4th day semester

Contact Hours: T 30,0h; TP 22,5h; OT 7,5h

Scientific Area: Chemical and Industrial Engineering

Intended learning outcomes (knowledge, skills and competences to be developed by the students):

The primordial goal of this curricular unit is that students acquire competences to understand the different materials behavior, considering its microstructure and physical-chemistry characteristics. Students should know how to analyses the materials behavior, with an organized and systematic methodology, allowing them to estimate entire classes of materials behavior.

The students should acquire the following competences:

To understand the properties and behavior of ferrous alloys, namely the carbon-steels ones, cast iron materials and alloy steels, as well as the nonferrous alloys ones.

To understand the microstructure and chemical composition influence on the characteristics and applications of the polymers and ceramic materials.

Know how to differentiate the different composites materials and respective reinforced characteristics, identifying them as resulting of the chemical, structural and reinforcement type of the components.

Syllabus:

Chapter 1 - Foundations: Crystalline structure and crystal geometry; Crystalline defects; Diffusion in solidstate; Phase diagram (revision).

Chapter 2 - Mechanical properties: Deformation types; Hardness; Plastic deformation; Fracture; Fatigue; Creep; bending; Forming operation of metal and alloys.

Chapter 3 - Other properties: Electrical properties; Thermal properties; Optical properties.

Chapter 4 - Polymers: Polymerization; Polymers classifications; Thermoplastic structure; Polymers defects; Temperature effect; Mechanical properties; Elastomers; Others properties; Applications.

Chapter 5 - Metals and alloys: Ferrous alloys - Carbon-steels; Alloy steels; Cast irons. Non-ferrous alloys - Aluminium alloys; Copper alloys.

Chapter 6 - Ceramics: Synthesis and processing; Heat treatment; Mechanical properties; Applications.

Chapter 7 - Composites: Definitions; particles and fiber reinforced composites; Structural composites; Applications.

Evidence of the syllabus coherence with the curricular unit's intended learning outcomes:

Considering the fundamental objective of this curricular unit it was divided into two major parts, one with general subjects, where the focus are the fundamentals contents, and the other part with more specific subjects in which these fundamentals contents are applied to the study of each class of material.

Chapters 1, 2 and 3 seek to introduce general concepts, applicable to all kinds of materials, in an organized and systematic manner, especially for properties such as mechanical, thermal, electrical, optical, among others, ant to the microstructure study of solid materials and its influence on their general behavior.

These basic chapters will allow a more insightful, coherent and systematic analysis of each class of materials, that are deeply studied in Chapters 4, 5, 6 and 7, relatively to polymeric materials, metals and alloys, ceramic and composite, respectively.

It also aims to develop the use of the English language.

References:

1. William F. Smith, "Princípios de Ciência e Engenharia dos Materiais", McGraw Hill, 3ª Edição (1998), ISBN: 9728298684

2. William D. Calister, Jr., David G. Rethwisch,"Ciência e Engenharia dos Materiais: Uma Introdução", Nova Guanabara, 8ª Edição (2007), ISBN: 9788521621249

3. Donald R. Askeland, Pradeep P. Phulé, "The Science and Engineering of Materials", Thomson (2006), ISBN: 0495288822

4. ASHBY, Michael, JONES, D. R., J.K., "Engineering Materials: An Introduction to Microstructures, Processing and Design", Butterworth-Heinemann, 3ª Edição (2005); ISBN: 0750663812

5. H.K.D.H. Bhadeshia, R.W.K. Honeycombe, "Steels: Microstructure and Properties", CIMA Publishing (2006), ISBN: 0750680849

6. J.A. Brydson, “Plastics Materials”, Butterworth-Heinemann, 7ª Edição (2004), ISBN: 750641320

7. Erik Lokensgard — Industrial Plastics: Theory and Applications, Thomson Delmar Learning, 4th edition (2004), ISBN: 1401804691