

## Materials

**Calendar:** 4th semester

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

**Scientific Area:** Química

### Learning outcomes of the curricular unit

The primordial goal of this curricular unit is that students acquire competences to understand the behavior of different materials, considering its, microstructure and physical-chemistry characteristics. Students should know how to analyze 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 solid state; Phase diagram.

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.

### Demonstration of the syllabus coherence with the curricular unit's objectives

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, and 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.

### Teaching methodologies

In theoretical classes fundamental concepts are exposed, using audio-visual techniques. Illustrative applications of these concepts are solved, stimulating rational thinking and fostering a more critical spirit amongst students. In theoretical/practical classes the students were solving individually and independently application exercises proposed by the teacher.

In the same semester there is a laboratory curricular unit associated (Laboratory IV) in which the students performs several experimental works that exemplifies the applications of the syllabus.

### Demonstration of the coherence between the teaching methodologies and the learning outcomes.

The main goal of this curricular unit is to allow the student to acquire Materials Science basic knowledge that is essential to understand the properties and behavior of the different classes of materials.

For these basic contents to be correctly acquired by the students, that must be taught in a solid and consistent approach. For that purpose it is necessary that basic concepts, the properties and behavior of materials, must be organized and systematized, thus some abstraction of these contents must take place. Consequently, it is essential that in theoretical classes' the fundamental concepts are exposed.

The acquired knowledge can be consolidate by solving relevant amount of exercises and practical problems, either by the teacher or by the student, which is a very important reason for the presence of significant number of practical classes. Finally, the concepts consolidation can be made through laboratorial experiments, results analyses and reports. This fundamental part is achieved in the laboratory curricular unit occurring in the same semester (Laboratory IV).