INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Materials Science			Field of study	Physics/Chemistry		
Bachelor in	Renewable Energy Engineering			School	School of Technology and Management		
Academic Year	2021/2022	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9910-743-1202-00-21		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	30	-	-	-	-	-	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): João da Rocha e Silva

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Acquiring knowledge and understanding the properties of materials used in engineering.
2. Relate structure and properties of materials used in engineering.
3. Acquiring knowledge on the latest materials used in engineering and its applications.
4. Relate the materials and properties in order to propose new materials and new applications.

Prerequisites

Before the course unit the learner is expected to be able to:
Not Applicable

Course contents

Introduction to materials science and engineering.
Crystalline structure and geometry of crystals.
Mechanical properties of metallic materials.
Electrical properties, optical properties and superconducting materials.
Metals and metal alloys
Polymeric materials
Magnetic materials
Ceramic materials and composite materials.
Economic, social and environmental considerations in materials engineering.

Course contents (extended version)

1. Introduction to materials science and engineering.
   - Material classes. Future trends in the use of materials.
2. Crystal structure and crystal geometry
   - Crystal structure and crystal geometry
   - Solidification, crystalline defects and diffusion in solids. crystalline defects
   - Industrial applications of diffusion processes. Effect of temperature on diffusion in solids
   - Displacement theory and hardening mechanisms. Displacement and plastic deformation
3. Mechanical properties of metallic materials
   - Processing of metals and alloys. Strain stress in metallic materials
   - Tensile test and rated voltage diagram. Nominal extension. Hardness and hardness test
   - Plastic deformation of single crystals
     Plastic deformation of polycrystalline materials
   - Recovery and recrystallization
   - Metal fracture. Metal fatigue. Creep and rupture under stress of metals
4. Electrical properties, optical properties and superconducting materials
   - Electrical conduction in metals. Electric conduction energy bands model
   - Light and the electromagnetic spectrum. refraction of light
   - Absorption, transmission and reflection. Stimulated emission of radiation and lasers. Optical fibers
   - Superconducting materials
5. Metals and Metal Alloys
   - Iron-Carbon Alloys, Steels. Aluminum alloys. Copper alloys. stainless steels
   - Selection of metal alloys for engineering applications
6. Polymeric materials
   - Structure of polymers. Polymerization reactions. Industrial polymerization processes
   - Characteristics, applications and processing of polymers. plastics processing
   - Behavior of polymers in solution. Thermosetting plastics. elastomers
   - Deformation of plastics. Selection of plastic materials
7. Magnetic materials
   - Magnetic fields and magnetic quantities
   - Types of magnetism
   - Effect of temperature on ferromagnetism
   - Ferromagnetic domains
   - Types of energy that determine the structure of magnetic domains
   - Magnetization and demagnetization of a ferromagnetic metal
   - Soft magnetic materials
   - Hard magnetic materials
   - Ferrites
8. Ceramic materials and composite materials
   - Structure and properties of ceramics. Simple ceramic structures.
   - Ceramic applications and processing. Mechanical properties of ceramics. Glasses
9. Economic, social and environmental considerations in materials engineering

Recommended reading

1. Smith, W. F., & Hashemi, J. (2013), Fundamentos de Engenharia e Ciência dos Materiais. Mc Graw Hill
2. William D. Callister (2016), Ciência e Engenharia de Materiais - Uma Introdução, LTC Editora
3. ASM International Handbook Committee (2018), Engineered materials handbook
4. RWK Honeycombe (2006), Aços micro estrutura e propriedades, Fundação C. Gulbenkian
5. De Lucas Filipe Martins da Silva, Fernando Jorge Lino Alves e António Torres Marques (2014), Materiais de Construção, Engebook

Teaching and learning methods

Theoretical and theoretical-practical classes. Problem solving and practical cases. The interrogative method is used, questioning the students so that they can discover the important points.
Laboratory work of analysis of metallic and fiber-reinforced plastic samples and reports.
In asynchronous environment, it is proposed to solve problems.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
   - Practical Work - 10%
   - Intermediate Written Test - 60% (Minimum score 7 points)
   - Experimental Work - 10%
   - Laboratory Work - 10%
   - Case Studies - 10%
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

João da Rocha e Silva	João Eduardo Pinto Castro Ribeiro	Ana Maria Alves Queiroz da Silva	Paulo Alexandre Vara Alves
14-03-2022	21-03-2022	22-03-2022	22-03-2022