INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Biomaterials			Field of study	Biomatrials and Biomechanics		
Bachelor in	Biomedical Technology			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	2	Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9600-752-2201-00-23		

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. Know and understand the properties of various materials used in biomedical engineering
2. Relate structure and properties of materials
3. Know on the latest applications of biomaterials in biomedical engineering
4. Relate the materials and their properties in order to propose new applications and new materials in biomedical engineering

Prerequisites

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

Course contents

Introduction to science and engineering materials. Mechanisms for modification of properties of materials. Mechanical properties of materials. Corrosion and degradation of the material. Alloys. Polymer materials, ceramics, composite. Technical surface. Bioimplants. Selection of biomaterials and design considerations. Economic, social and environmental considerations in engineering materials. Selection of biomaterials and design considerations.

Course contents (extended version)

1. Introduction to materials science and engineering
   - Materials and engineering. Classes of material used in medicine
2. Mechanical properties of metallic materials.
   - Processing alloys metals.
   - Strain deformation. Stretching Test diagram and nominal strain -extension .
   - Hardness and toughness test.
   - Plastic deformation of single crystals metal. Plastic deformation of polycrystalline materials.
   - Hardening of metals in solid solution.
   - Recovery and recrystallization of plasticity deformed metals.
   - Fracture of metals. Fatigue of metals. Fluency and break under stress from metal.
3. Phase Diagrams
   - Phase Diagrams of pure substances. Gibbs Rule. Isomorphs binary systems.
   - Non-equilibrium solidification alloys. binary systems, Reactions invariant.
   - Eutectic, peritéticos nomothetic in binary systems. Invariant reactions.
   - Diagrams of phase with intermediate compounds. Ternary Diagrams
4. Corrosion and degradation of the material and biomaterial
   - Galvanic series. Speed (kinetic) of corrosion. Types of corrosion.
   - Factors that control the corrosion. Forms of corrosion. Oxidation of metals.
   - Control of corrosion. Corrosion of ceramic. Degradation of polymers and biopolymers
5. Metal alloys
   - Carbon Iron alloy, steels. Aluminum alloys. Copper alloys. Application in medicine. Super alloys.
   - Magnesium alloys, titanium and nickel. Noble metals.
   - Selection of alloys for applications in bioengineering
6. Polymer materials
   - Deformation and strengthening of plastics. fluency and fracture. Biomaterials Selection .
7. Ceramics
   - Structure and properties of ceramic.
   - Applications and processing of bioceramics. Glass.
8. Composite materials.
   - Fibers for reinforcement.
   - Fiber reinforced plastics. sandwich structures.
   - Composites metal-matrix and ceramic matrix composites.
9. Engineering Surfaces
   - Metrology surface. Coatings and surface treatments
10. Bioimplants
   - Natural and artificial biomaterials. Morphology of tissues.
   - Classes of materials used in implants.
   - Analysis of the biocompatibility and functionality. Testing biomaterials.
   - Organic reactions to biomaterials. Fatigue and degradation of biomaterials. Applications. .
   - Selection of biomaterials and design considerations

Recommended reading

1. Buddy D. Ratner, Allan Hoffman, Frederick Schoen, Jack Lemons, Biomaterials Science An Introduction to Materials in Medicine, Academic Press, 2013
2. Lucas Silva, Jorge Lino, Torres Marques, Materiais de Construção, Engebook, 2013
3. William F SMITH, Principles of Materials Science and Engineering, McGraw-Hill, 1996
4. Rodrigo Lambert Oréfice, Biomateriais: Fundamentos e Aplicações, Rio de Janeiro, Cultura Médica, 2006
5. John Enderle, Susan Blanchard, Joseph Bronzino, Introduction to Biomedical Engineering, Academic Press, 2015

Teaching and learning methods

Theoretical classroom. Laboratory work and reporting. In no presence environmental, resolution of problems and practical work.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
   - Reports and Guides - 10%
   - Practical Work - 10%
   - Laboratory Work - 10%
   - Intermediate Written Test - 60% (Two tests conducted in a virtual environment (if possible) Weight of 50% each Minimum score 7/20)
   - Work Discussion - 10%
2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 60%
   - Reports and Guides - 40%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

João da Rocha e Silva	João Eduardo Pinto Castro Ribeiro	Joana Andrea Soares Amaral	José Carlos Rufino Amaro
16-02-2024	19-02-2024	15-03-2024	24-03-2024