Course guide
390455 - MPBS - Properties of Materials in Biological Systems

Last modified: 26/05/2026

Unit in charge: Barcelona School of Agri-Food and Biosystems Engineering
Teaching unit: 748 - FIS - Department of Physics.
702 - CEM - Department of Materials Science and Engineering.

Degree: **Academic year:** 2026 **ECTS Credits:** 6.0
Languages: English

LECTURER

Coordinating lecturer: Ventura Casellas, Heura
Pineda Soler, Eloy
Prats Soler, Clara
Ardanuy Raso, Monica

Others: Rodríguez Rius, Daniel

TEACHING METHODOLOGY

Lectures, discussion sessions, laboratory sessions and seminars.

LEARNING OBJECTIVES OF THE SUBJECT

This course will first introduce basic knowledge of materials properties, types of materials, microstructure and basic characterization methods. The main bulk and surface properties of different materials will be presented and related to engineering applications. Some basic concepts on aging, degradation, durability and reusability of materials will be also presented. The principles of materials selection in engineering applications will be also discussed.

Secondly, several examples of biomaterials and biological materials will be presented. These examples include the study of structure and properties of natural materials, the synthesis and analysis of biopolymers or the properties of certain living tissues. The interaction between materials and biological systems will be also discussed, presenting some examples of biomaterials for bioprocessing and medical applications.

STUDY LOAD

Type	Hours	Percentage
Hours large group	60,0	40.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Materials properties and characterization

Description:
1.1 Introduction to materials properties and characterization.
1.2 Bulk and surface properties. Functional and structural properties.
1.3 Classes of materials. Microstructures. Synthesis and techniques of characterization.
1.3 Ageing, fatigue and corrosion. Durability and reusability of materials.
1.5 How to choose the right material? Merit indices and selection of materials in engineering design.

Related activities:
Lectures
Team work

Full-or-part-time: 50h
Theory classes: 14h
Laboratory classes: 6h
Self study : 30h

Biopolymers

Description:
2.1 Natural materials for engineering applications: biopolymers. Definition, classification and examples. Characterization techniques.
2.2 Comprehensive description of PLA, PHA and other bio-based polymers. Structure, properties, and applications.
2.3 Biocomposites. Definition and properties. Natural fibers and nanoparticles as reinforcements in biocomposites. Biocomposites production techniques and applications.

Related activities:
Lectures.
Seminars
Laboratory: Biopolymer characterization
Team work

Full-or-part-time: 50h
Theory classes: 11h
Laboratory classes: 9h
Self study : 30h

Living tissues and biomaterials

Description:
3.1. Structure and mechanical properties of living tissues. The role of collagen and elastine. Structure and main properties of connective, muscle, nervous and epithelial tissues. Examples.
3.2. Structure and mechanical properties of eukaryotic cell. Cell membrane and cytoskeleton as a mechanical unit. Cytoskeleton: actin filaments, intermediate filaments and microtubules. Elasticity of cell membrane. Determination of the membrane tension.
3.3. Biomaterials in medicine. Interaction of microorganisms with biomaterials and tissues: biofilms. Biofilms formation, structure and characteristics. Biofilms and chronic infections.

Related activities:
Lectures
Seminars
Team work

Full-or-part-time: 50h
Theory classes: 15h
Laboratory classes: 5h
Self study : 30h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

N1: Written report and oral presentation of the course project.
N2: Practicum reports.
N3: Summaries of the attended seminars and written tests.
Nfinal = 0.40 N1 +0.35 N2 +0.25 N3

BIBLIOGRAPHY

Basic:
- Agrawal, C. Mauli. Introduction to biomaterials : basic theory with engineering applications. Cambridge: Cambridge University Press, 2014. ISBN 9780521116909.