Course guide
390461 - PAMB - Properties and Applications of Biological Materials

Last modified: 20/01/2026

Unit in charge: Barcelona School of Agri-Food and Biosystems Engineering
Teaching unit: 745 - DEAB - Department of Agri-Food Engineering and Biotechnology.

Degree: BACHELOR'S DEGREE IN BIOSYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN FOOD ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN AGRONOMIC SCIENCE ENGINEERING (Syllabus 2018). (Optional subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Pineda Soler, Eloy

Others: Pineda Soler, Eloy
Oliver Ortega, Helena
Claramunt Blanes, Jose
Rodríguez Rius, Daniel
Prats Soler, Clara

TEACHING METHODOLOGY

Theoretical classes. Discussions on the concepts introduced in the master classes. Laboratory practical sessions. Presentations in English by the students.

LEARNING OBJECTIVES OF THE SUBJECT

Knowledge of the properties and structure of biological materials is key in many aspects of agri-food engineering and biotechnology. The texture and viscosity of food substances, the mechanical properties of vegetable or animal tissues, the interaction between microorganisms and natural or synthetic materials, the production and use of bioplastics or the phase changes depending on the temperature and pressure of biological substances are some examples. This subject offers EEABB students an introduction to materials science and engineering concepts that will allow them to understand the relationship between structure, nano/microstructure, properties and applications of natural materials and materials derived from natural products. Concepts and knowledge that they have not seen before, but which may be of interest to the agri-food industry and for the processes of transformation and treatment of biological products. The subject also incorporates laboratory sessions and practical exercises to introduce students to the current techniques of synthesis, processing and characterization of materials. The objectives of the subject can be split in the following parts. A first part devoted to learn the basic concepts of materials science and engineering. Then, the subject focuses on several blocks of interest: a) the rheological properties of food products and biological fluids, b) the properties and synthesis methods of biopolymers from renewable resources and c) the behavior of biological tissues, biofilms and biomaterials. Within each block, the main innovations and the state of the art in the synthesis of new materials and the design of new applications will be shown, focusing on key innovations to improve the use of natural resources and sustainability.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours medium group	40,0	26.67
Hours small group	20,0	13.33

Total learning time: 150 h

CONTENTS

Materials properties and characterization

Description:
- Introduction to materials properties and characterization. Classification of materials. Physical, chemical, environmental and economic characteristics. Structure and microstructure. Synthesis and processing methods. Techniques of characterization.
- Bulk properties. Functional and structural properties. Surface properties. Catalysis, absorption, dissolution and bioresorbable materials. Ageing, fatigue and corrosion. Durability and reusability of materials.
- Structure and growth of natural materials. Polymers and biological macromolecules. Phase transitions in biological substances and biopolymers. Crystallization in biological substances.
- Bio-inspired materials. Surface properties and bottom-up synthesis techniques.
- How to choose the right material? Merit indices and selection of materials in engineering design. Introduction to the European Eco-design Regulation.

Full-or-part-time: 37h 30m
Theory classes: 10h
Laboratory classes: 5h
Self study : 22h 30m

Introduction to Rheology, Elasticity and Viscoelasticity

Description:
- Aggregates and suspensions.
- Elasticity of biological solids. Rheology of liquids/fluids. Non-Newtonian flow behaviors.
- Viscosity measurement of biological fluids and food substances.
- Applications to innovation of new food products and food preservation methods.

Full-or-part-time: 37h 30m
Theory classes: 10h
Laboratory classes: 5h
Self study : 22h 30m

Natural biopolymers and bioplastics

Description:
- Natural materials for engineering applications: biopolymers. Definition, classification and examples. Characterization techniques.
- Comprehensive description of PLA, PHA and other bio-based polymers. Structure, properties, and applications.
- Biocomposites. Definition and properties. Natural fibers and nanoparticles as reinforcements in biocomposites. Biocomposites production techniques and applications.
- New developments for sustainable packaging in the food industry. Food additive and contact materials regulations.
- New developments in renewable materials.

Full-or-part-time: 37h 30m
Theory classes: 10h
Laboratory classes: 5h
Self study : 22h 30m

Biological tissues, biomaterials and biofilms

Description:
- Structure and mechanical properties of living tissues. The role of collagen and elastine. Structure and main properties of bones and connective, muscle, nervous and epithelial tissues. Examples.
- Introduction to biomaterials. Toxicity, biocide and biocompatible properties. Interaction of microorganisms with biomaterials and tissues. Regulations related to biocompatibility.
- Introduction to biofilms. Biofilm formation, structure and characteristics. Biofilms and chronic infections. Examples of biofilm significance in biotechnology and bioengineering processes.

Full-or-part-time: 37h 30m
Theory classes: 10h
Laboratory classes: 5h
Self study : 22h 30m

GRADING SYSTEM

During the course, the students will carry out a search for information and analysis of possible applications of the properties and/or production method of a biomaterial. This work will be evaluated in an oral examination. The follow-up of the subject will be assessed through the delivery of reports on laboratory sessions, visits and seminars, as well as the completion of tests within the class sessions.

N1: Oral defense of the project.
N2: Laboratory reports
N3: Tests, summaries of visits and lectures.

Nfinal = 0.45 N1 +0.3 N2 + +0.25 N2