

## Course guide

### 295579 - 295PB022 - Biopolymers and Bioplastics

**Last modified:** 02/10/2025

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 713 - EQ - Department of Chemical Engineering.

**Degree:** MASTER'S DEGREE IN POLYMERS AND BIOPLASTICS (Syllabus 2024). (Compulsory subject).

**Academic year:** 2025    **ECTS Credits:** 6.0    **Languages:** Catalan, Spanish, English

#### LECTURER

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**Coordinating lecturer:**

**Others:**

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Generical:**

CGMUEQ-06. Have the capacity to analyze and synthesize the continuous progress of products, processes, systems and services using safety, economic viability, quality and environmental management criteria

CGMUEQ-10. Adapt to changes, being able to apply new and advanced technologies and other relevant developments, with initiative and entrepreneurial spirit

**Transversal:**

02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.

03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

#### LEARNING RESULTS

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**Knowledges:**

K1. Identify the molecular chemical structure of polymers and biopolymers.

K5. Relate the structure and properties of polymers and biopolymers in order to predict their behaviour and to obtain materials with new functionalities.

**Skills:**

S3. Interpret the results of polymer analysis and characterisation techniques.

**Competences:**

C3. Apply acquired knowledge and problem-solving skills both in discipline-specific environments and in new or unfamiliar environments in broader (or multidisciplinary) contexts related to the field of study.

C2. Apply appropriate methods of analysis, production and management in the field of polymers and biopolymers.

C4. Make effective use of information resources, managing the acquisition, structuring, analysis and visualisation of data and information within the field of specialisation and critically evaluating the results of this process.

#### TEACHING METHODOLOGY

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Exhibition classes and presentation of works

## LEARNING OBJECTIVES OF THE SUBJECT

Specific:

CEMQ1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, with critical reasoning to establish economically viable solutions to technical problems.

CEMQ9. Manage Research, Development and Technological Innovation, taking into account the transfer of technology and property and patent rights.

CEMQ13. Realization, presentation and defense, once all the credits of the syllabus have been obtained, from an original exercise carried out individually before a university court, consisting of a comprehensive project of Chemical Engineering of a professional nature in which the competences acquired in the teachings are synthesized. .

Generic:

CGMQ4. Carry out the appropriate research, undertake the design and lead the development of engineering solutions, in new or unfamiliar environments, relating creativity, originality, innovation and technology transfer.

CGMQ6. Be able to analyze and synthesize the continuous progress of products, processes, systems and services using criteria of safety, economic viability, quality and environmental management.

CGMQ11. Possess the skills of autonomous learning to maintain and improve the skills of chemical engineering that allow the continuous development of the profession

Transversal:

CT3. TEAMWORK: Being able to work as a member of an interdisciplinary team, either as a member or performing management tasks, in order to contribute to develop projects with pragmatism and sense of responsibility, assuming commitments taking into account the resources available

## STUDY LOAD

Type	Hours	Percentage
Self study	108,0	72.00
Hours large group	21,0	14.00
Hours small group	21,0	14.00

**Total learning time:** 150 h

## CONTENTS

### 1. Biopolymers and bioplastics

**Description:**

Introduction to biopolymers and bioplastics. Carbohydrates, lipids, proteins and nucleic acids. Polymeric biomaterials.

**Full-or-part-time:** 2h

Theory classes: 2h

### 2. Biomaterials and biocompatibility

**Description:**

Biomaterials: classification. Biocompatibility and hemocompatibility. Response of living beings. Regulations and biocompatibility tests. Modification of surfaces. Analysis of surfaces. Sterilization Biomaterials: classification.

**Full-or-part-time:** 2h

Theory classes: 2h

### 3. Biostenibilidad and biodegradability

**Description:**

Sustainable development. Green chemistry: the atomic economy. The parameters of sustainability. Analysis of biological cycles. Toxicity. Biodegradability Mechanisms of biodegradation and evaluation methods. Regulation of sustainability. Bioplastics.

**Full-or-part-time:** 5h

Theory classes: 5h

### 4. Sustainable monomers

**Description:**

Traditional monomers of natural origin. Chemical and biotechnological processes of production. Green catálisis. Sustainable ethylene: bioethanol. Sustainable additives: green plasticizers. Lignin as a source of monomers.

**Full-or-part-time:** 3h

Theory classes: 3h

### 5. Sustainable polymers and bioplastics

**Description:**

Impact of the manufacture and use of polymers. New synthesis strategies Sustainable polymerization methods. Substitution of traditional toxic monomers: new alternatives. New bioplastics from carbohydrates and natural oils. Polylactic acid Contribution of recycling techniques.

**Full-or-part-time:** 5h

Theory classes: 5h

### 6. Nanostructured polymers and copolymers

**Description:**

Biopolymers of technological interest: starch and cellulose. Protein biopolymers. Modifications and industrial applications. Bacterial polymers: polyesters and polysaccharides. Industrial applications Economic aspects.

**Full-or-part-time:** 3h

Theory classes: 3h

### 7. Polymeric biomaterials

**Description:**

Surgical sutures. Adhesives Polymeric cements Dental restorations and implants. Hydrogels Contact lenses. Artificial skin Polymers in pharmaceutical tablets. Controlled release of drugs.

**Full-or-part-time:** 6h

Theory classes: 6h

### 8. Advanced bioplastics

**Description:**

New biocomposites based on bioplastics. Flexible and low migration bioplastics. Hybrid bioplastics. Sustainable coatings based on bioplastics: paints and plastic coatings.

**Full-or-part-time:** 5h

Theory classes: 5h

### 9. Bioplastics based on peptides and polypeptides

**Description:**

Bioplastics based on polypeptides. Bioplastics obtained from self-assembly of peptides: Peptide materials. Conjugated bioplastics.

**Full-or-part-time:** 5h

Theory classes: 5h

### 10. Processing of biopolymers and bioplastics

**Description:**

Processing of biopolymers and bioplastics. Additives Plasticizers. Extrusion. Injection. Micro and nanoprocessed.

**Full-or-part-time:** 6h

Theory classes: 6h

## GRADING SYSTEM

$$NC = (NP1 + NP2 + NP3) / 3$$

Where NC is the course grade and NP1-NP3 are the marks of the three parts in which the subject is divided.

## EXAMINATION RULES.

Exam: It consists of different theoretical and practical questions related to the content of the subject.

## BIBLIOGRAPHY

**Basic:**

- Lendlein, Andreas; Sisson, Adam L. Handbook of biodegradable polymers : synthesis, characterization and applications [on line]. Weinheim, Germany: Wiley-VCH, cop. 2011 [Consultation: 06/05/2020]. Available on: <https://onlinelibrary.wiley.com/doi/book/10.1002/9783527635818>. ISBN 9783527635825.

- Bastioli, Catia [ed.]. Handbook of biodegradable polymers. 2nd ed. Shrewsbury: Smithers Rapra Technology, 2014. ISBN 9781847355270.

- Alemán, Carlos; Bianco, Alberto; Venanzi, Mariano. Peptide materials : from nanostructures to applications [on line]. Chichester: John Wiley & Sons, 2013 [Consultation: 06/05/2020]. Available on: <https://onlinelibrary.wiley.com/doi/book/10.1002/9781118592403>. ISBN 9781118592403.