Course guide
295580 - 295PB011 - Polymerisation Chemistry

Last modified: 04/06/2026

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: 2026 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: FRANCISCO ESTRANY CODA

Others:

PRIOR SKILLS

Basic knowledge of materials acquired during undergraduate studies, and especially in subjects that contain the topics "Polymers" and "Biopolymers".

LEARNING RESULTS

Knowledges:
K3. Identify the fundamentals of the processes of synthesis, manufacture, modification, use, recycling and degradation of polymers and biopolymers.
K1. Identify the molecular chemical structure of polymers and biopolymers.
K4. Apply the necessary criteria for the analysis and characterisation of macromolecular materials and for the selection of technologies required for their production and processing.

Skills:
S4. Make appropriate use of different techniques for polymerisation and transformation of polymeric materials.

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

MD.1 – Participative lecture;
MD.3 - Case studies;
MD.5 – Cooperative group work.

LEARNING OBJECTIVES OF THE SUBJECT

To know the chemical principles of the polymerization and copolymerization methods, the molecular mechanisms on which they are based and their design possibilities, and it application in the procedures available for the chemical modification of polymers to modify their properties.

STUDY LOAD

Type	Hours	Percentage
Hours large group	21,0	28.00
Self study	54,0	72.00

Total learning time: 75 h

CONTENTS

Theme 1. Introduction to the chemistry of polymerization

Description:
Polymers: Classification and nomenclature. Composition, constitution and configuration. Characterization of the chemical structure. Molecular weights and their distribution. Experimental methods for the determination of the representative parameters of the molecular weight distribution.Polymerization methods. Degradation of polymers.

Specific objectives:
Understand the chemical structure of polymers, how it is determined and how it relates to the behavior of polymers. Have basic knowledge about the procedures that are used for the synthesis of polymers and their application at the industrial level. Know the degradation processes that affect polymers in their use and their use in recycling and reuse.

Related activities:
Resolution of a series of specific exercises, application of the contents of the subject.

Full-or-part-time: 6h
Theory classes: 6h

Theme 2. Polymerization

Description:
Structure and chemical properties. Monomer and polymer. Functionality, regiochemistry and reactivity. Linear polycondensation Kinetic and thermodynamics. Molecular weights: stoichiometry and chain size. Three-dimensional polycondensation: gelling. Polyaddition Radical and ionic mechanisms. Kinetic and thermodynamics. Transaction reactions. Molecular weights: regulators and inhibitors of the chain. Living polymers. Stereochemistry of polymerization. Ziegler-Natta Polymerization. Metal • locens. Stereospecific polymerization of olefins and diens. Polymerization for opening cycles (ROP). Polymerizable cycles and ROP mechanisms. Special methods of polymerization. Hyper branched polymers and dendrimers.

Specific objectives:
To know the chemical and physicochemical principles of the polymerization methods by means of polycondensation and polyaddition mechanisms.
Know the chemical and physicochemical principles of the polymerization methods used in the synthesis of polymers through organometallic catalysts and through special mechanisms and how they apply to the preparation of polymers at both industrial and laboratory levels.

Related activities:
Resolution of practical problems and exercises of a theoretical nature that allow to deepen in the application of the concepts introduced in this subject.

Full-or-part-time: 12h
Theory classes: 12h

Theme 3. Copolymerization

Description:
Structure and properties of copolymers. Copolymerization by addition. Relative reactions of the monomers. Composition and microstructure of copolymers. Condensation copolymers. Telescope polymers. Design of copolymers with structure and specific properties. Graft copolymers.

Specific objectives:
Understand the chemical and physicochemical principles of the copolymerization methods that are used in the synthesis of copolymers through the different possible mechanisms, and how they apply to the preparation and design of copolymers, both at industrial and laboratory levels, from the properties that are required for these materials.

Related activities:
Resolution of practical problems and exercises of a theoretical nature that allow to deepen in the application of the concepts introduced in this subject.

Full-or-part-time: 4h 30m
Theory classes: 4h 30m

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**.

Midterm test (30%)
Final Exam (30%)
Project carried out in groups (30%)
Deliverable exercises (10%)

EXAMINATION RULES.

Performing specific tasks and wider tasks.
Exam: It consists of different theoretical and practical issues related to the program.

BIBLIOGRAPHY

Basic:
- Painter, Paul C.; Coleman, Michael M. Essentials of polymer science and engineering. Lancaster: DEStech Publications, cop. 2009. ISBN 9781932078756.

Complementary:
- Odian, George G. Principles of polymerization. Fourth edition. Hoboken, N. J: Wiley-Interscience, a John Wiley & Sons, Inc., Publication, 2004. ISBN 9780471274001.
- Ravve, A. Principles of polymer chemistry. 3rd ed. New York: Springer, 2012. ISBN 9781461422112.

RESOURCES

Other resources:
Notes made by students in class, notes and documentation provided by the teacher, recommended bibliography and bibliographic research directed by the teacher.