Course guide
240EQ016 - 240EQ016 - Polymers and Biopolymers

Last modified: 27/05/2024

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

Degree: **Academic year:** 2024 **ECTS Credits:** 6.0
Languages: Spanish

LECTURER

Coordinating lecturer: JORGE PUIGGALI BELLALTA

Others: SEBASTIAN MUÑOZ GUERRA - MONTSERRAT GARCIA ALVAREZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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

2. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.
3. Designing products, processes, systems and services for the chemical industry as well as the optimization of other already developed technology based on various areas of chemical engineering, understanding of processes and transport phenomena, separation operations and engineering chemical reactions, nuclear, electrochemical and biochemical.
4. Easily integrate technical team and creative interdisciplinary any chemical company or research center.

Generical:
5. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.
6. Communicate and discuss proposals and conclusions in forums multilingual, skilled and unskilled, in a clear and unambiguous.
7. Ability to analyze and synthesize to the continued progress of products, processes, systems and services using criteria of safety, affordability, quality and environmental management.

TEACHING METHODOLOGY

Subject in process of extinction. There is no teaching, the students that enroll it do so only with the right to an exam.

LEARNING OBJECTIVES OF THE SUBJECT

1. To gain an understanding on the chemical structure of polymers and biopolymers, their classification and nomenclature.
2. To acquire knowledge about the basic properties of polymers and biopolymers and how they relate to chemical and physical structure.
3. To acquire acknowledge about the chemical processes involved in the production of synthetic polymers and the recovery of biopolymers.
4. To acquire a general knowledge about commercial polymeric materials, their properties and applications.
5. To acquire a knowledge on advanced polymeric materials and research strategies for their technical development.
6. To acquire an understanding of the main biopolymers with technical applications.
7. To acquire knowledge about the ecological impact of the use of plastic materials and technologies used to minimize enviromental impact.

STUDY LOAD

Type	Hours	Percentage
Hours large group	36,0	24.00
Hours small group	18,0	12.00
Self study	96,0	64.00

Total learning time: 150 h

CONTENTS

1. Polymer chemistry

Description:
Composition, constitution and configuration. Molecular weights and their distribution. Classification and nomenclature. Characterization of the chemical structure: Chromatography and FTIR and NMR spectroscopy. Polymerization methods. Polycondensation, polyaddition and others. Polymerization techniques. Chemical modification and degradation. Laboratory practice.

Specific objectives:
Know and understand the chemical structure of polymers, how it is determined and how it relates to the behavior of polymers. To have a basic understanding of the procedure used for the synthesis of polymers and how they apply to an industrial level, Knowing the degradation processes that affect the use of polymers and the exploitation and reuse.

Related activities:
Resolution of a collection of exercises that allows students to become familiar with the structure and nomenclature of polymers as well as the basic techniques of chemical chracterization (GPC chromatography, IR spectroscopy and NMR spectroscopy). To perform a laboratory practice of characterization and polymerization and the corresponding report.

Full-or-part-time: 24h
Laboratory classes: 3h
Other activities: 12h
Theory classes: 6h
Practical classes: 3h

2. Polymer physics

Description:
Solubility, diffusion and permeability of polymers. Thermodynamcs of polymer solutions. Molecular conformation. Physicochemical methods of analysis. Colligative properties. Viscosity. Light scattering. Tha amorphous state and the crystalline state. Laboratory practice. Thermal properties. Mechanical properties. Rhelogy of polymers.

Specific objectives:
Understand the physicochemical principles of the behavior of polymer solutions and apply them in the characterization of polymeric materials. To have a basic knowledge about the structure of the polymers and its influence on physical properties.

Related activities:
Solve a set of problems which include thermodynamic facts of solutions, physicochemical characterization, structural analysis and solid state properties. To perform a laboratory practice and the corresponding report.

Full-or-part-time: 30h
Other activities: 15h
Theory classes: 9h
Practical classes: 4h 30m
Laboratory classes: 1h 30m

3- Biopolymers

Description:
Natural sources. Structural characteristics. Supramolecular assemblies. Biosynthesis and biodegradation. Polysaccharides: starch, cellulose and chitin. Derivatives of industrial interest. Technological fibrous proteins: collagen, silk and keratin. Applications. Polyterpenes and microbial biopolymers. Biopolymer synthesis.

Specific objectives:
The sources and applications of biopolymers of technological interest, their use and their potential as competitive materials respect to petrochemical-based plastics.

Related activities:
Individual work on the production, properties and applications of a biopolymer or a biopolymer derivative that will be chosen by each student.

Full-or-part-time: 20h
Other activities: 9h 30m
Theory classes: 9h
Practical classes: 1h 30m

4. Commodity materials

Description:
Carbon chain thermoplastics: polyethylene, polypropylene, polystyrene, acrylic polymers, polyvinyl chloride, fluorinated polymers. Heterochain thermoplastics: polyamides, polyesters, high performance polymers. Elastomers and resins.

Specific objectives:
To have a knowledgement of the properties and applications of synthetic polymers more frequently used.

Related activities:
Individual work on the production, properties and applications of a determined polymer to be chosen by each student.

Full-or-part-time: 14h
Theory classes: 4h 30m
Practical classes: 1h 30m
Guided activities: 8h

5. Technology and processing of polymers

Description:
Fillers, plasticizers and other additives. Plastic moulding: compression, injection and extrusion. Fibres and spinning processes. Laboratory practice. Elastomer technology.

Specific objectives:
Have a knowledgement of additives and formulation of polymeric materials. Know the main technologies used in processing different types of polymeric materials.

Related activities:
Individual work explaining the ways of processing a given polymer that will be selected by each student. To perform a laboratory practice and the corresponding report.

Full-or-part-time: 9h
Other activities: 4h 30m
Theory classes: 3h
Practical classes: 1h 30m

6. Development of new materials

Description:
Liquid crystals. Nanocomposites. Advanced polymers. Biocompatible and biodegraadble polymers.

Specific objectives:
Know the progress in the design of new polymeric materials of interest in industry and in the field of both theoretical and applied research.

Related activities:
Discussion of two scientific papers to be selected according to a specific subject.

Full-or-part-time: 14h
Self study (distance learning): 8h
Theory classes: 4h 30m
Laboratory classes: 1h 30m

GRADING SYSTEM

Subject in process of extinction. There is only one final test that corresponds to 100% of the final grade of the subject.

BIBLIOGRAPHY

Basic:
- Sperling, Leslie Howard. Introduction to physical polymer science. 4th ed. New York: John Wiley & Sons, 2006. ISBN 9780471706069.

Complementary:
- Seymour, R. B. ; Carraher, C. E. Introducción a la química de los polímeros. Barcelona: Reverté, 1995. ISBN 8429179267.
- Fried J. R. Polymer science and technology. 3rd ed. Upper Saddle River: Prentice Hall, 2014. ISBN 9780137039555.
- Strobl, G. The physics of polymers [on line]. 3rd ed. Berlin: Springer, 2007 [Consultation: 22/05/2020]. Available on: http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10230258. ISBN 9783540252788.
- Reiter, G. ; Strobl, G. R. Progress in understanding of polymer crystallization [on line]. Berlin: Springer, 2007 [Consultation: 22/05/2020]. Available on: http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10171221. ISBN 9783540473053.
- Wunderlich, Bernhard. Thermal analysis of polymeric materials. Berlin: Springer, 2005. ISBN 3540236295.
- Ward, Ian Macmillan ; J. Sweeney. An introduction to the mechanical properties of solid polymers. 2nd ed. West Sussex: John Wiley & Sons Ltd, 2006. ISBN 047149626X.