Bachelor in Industrial Chemical Engineering

Course information

Year 2021-22

GENERAL SPECIFICATIONS			
English name			
Polymer Technology			
Spanish name			
Tecnología de Polímeros			
Code	**Type**		
606210301	Optional		
Time distribution			
	Total	**In class**	**Out class**
Working hours	150	60	90
ECTS: 6			

Standard group	**Small groups**			
	Classroom	**Lab**	**Practices**	**Computer classroom**
4.14		1.86	0	0

Departments	**Knowledge areas**
Chemical Engineering, Physical Chemistry and Material Science	Chemical Engineering
Year	**Semester**
4º	1º

TEACHING STAFF			
Name	**E-Mail**	**Telephone**	**Office**
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SPECIFIC INFORMATION OF THE COURSE
1. Contents description
1.1. In English:
The main objective of the course is to provide students with basic knowledge of polymer science and technology, covering physicochemical properties, characterization techniques and processing. The course is divided into four sections: SECTION I: MACROMOLECULAR STRUCTURE AND POLYMER This section includes a brief discussion of the historical development of polymers, basic definitions and concepts, and an overview of the basis for the various classifications of polymers. It also examines the requirements for polymer formation from monomers and discusses polymer structure and the section continues with a discussion of polymer solutions. SECTION II: POLYMER SYNTHESIS

The second section deals with how polymers are prepared from monomers. It starts with a discussion of the various polymer preparation methods with emphasis on reaction mechanisms and kinetics. This section continues with a discussion of polymer reaction engineering. Emphasis is on the selection of the appropriate polymerization process and reactor to obtain optimal polymer properties

SECTION III: POLYMER CHARACTERIZATION

The third section deals with the properties and applications of polymers. It provides an overview of polymer characterization test methods. The effects how processing conditions affect the ultimate properties of the finished polymer product are examined too.

BLOQUE IV: POLYMER TYPES AND POLYMER PROCESSING.
This section deals with the main conventional polymer types and their applications. The section presents a discussion of unit operations in polymer processing

1.2. In Spanish

El objetivo fundamental de la asignatura es proporcionar a los alumnos conocimientos fundamentales de las propiedades físico-químicas, técnicas de caracterización y procesado de macromoléculas.
La asignatura se dividirá en 4 grandes bloques:
BLOQUE I: ESTRUCTURA DE MACROMOLÉCULAS Y PROPIEDADES EN DISOLUCIÓN.
Este primer bloque se dedica a definir una serie de conceptos y términos que aparecerán repetidamente a lo largo de la asignatura, de importancia fundamental para la asimilación de la misma. También se estudia la estructura de macromoléculas, así como la importancia de la disolución de polímeros.
BLOQUE II: SÍNTESIS DE POLÍMEROS.
Se abordan los diferentes mecanismos por lo que pueden transcurrir las reacciones de polimerización, así como los distintos métodos de producción de polímeros empleados en la industria química.
BLOQUE III: CARACTERIZACIÓN DE POLÍMEROS.
Revisión de las distintas técnicas empleadas en la determinación de las propiedades de los polímeros, tanto en fundido o en disolución, como frecuentemente se encuentran durante su procesado, como en estado sólido, cuando el polímero ha sido ya procesado y proporciona un servicio.
BLOQUE IV: TIPOS DE POLÍMEROS Y TÉCNICAS DE PROCESADO.
Se estudian los principales tipos de polímeros en cuanto a volumen de producción e importancia de la aplicación, así como las diferentes técnicas que permiten su transformación hasta productos finales de interés comercial.

2. Background

2.1.Situation within the Degree:

The use of polymers has continued to expand for decades. In many of their applications, polymers have replaced other materials (metals, natural materials), but their development is mainly focused on new applications (microelectronics, biomedicine, communications, etc.) thanks to the wide range of properties they can exhibit.
The descriptors of this optional fourth year subject focus on providing the student with an overview of the main aspects of polymer technology, such as characterization, formulation, determination of physicochemical properties, processing and transformation of these materials. The different polymer recycling technologies are also presented. Therefore, it is a subject where basic knowledge and skills acquired in subjects such as Chemistry I and Chemistry II that are taught in the 1st year, Fluid Flow that is taught in the 2nd year and, in addition, certain knowledge of the subjects of Reactors I and II that are taught in the 3rd year must be used and applied.

2.2. Recommendations:

Basic knowledge in Organic Chemistry, Physical Chemistry, Thermodynamic and Chemical Kinetic.

3. Objectives (as result of teaching):

By the end of this course, the students acquire basic knowledge of classification, synthesis, physicochemical properties, processing and characterization of polymer.

4. Skills to be acquired

4.1. Specific Skills:

4.2. General Skills:

G04: Be able to apply knowledge in practice

G05: Work as a team

G11: Be able to communicate in the mother tongue both orally and in writing

G12: Be able to learn autonomously and comprehensively

G16: Sensitivity to environmental issues

TC1. Be completely fluent in Spanish, mastering the different styles and the specific languages required to develop and communicate the acquired knowledge in the scientific and academic environment.

TC2. Develop a critical attitude, being able to analyse and synthesize.

TC3. Develop an attitude of inquiry that permanently enables to review and deepen in the knowledge.

5. Training Activities and Teaching Methods

5.1. Training Activities:

- Lectures sessions (G12, TC2, TC3)
- Problem solving sessions (G04, G05, G11, G12, TC2, TC3)
- Laboratory sessions (G04, G05, G12, TC2, TC3)
- Topics covered in lessons will be reviewed through exercises, seminars, tutorials, text analysis, oral presentations of project work, and individual tests. Students will receive guidance from the professor (G04, G05, G11, G12, G16, TC2, TC3)

5.2. Teaching Methods:

- Lectures
- Laboratory
- Seminars and tutorials
- Group work
- Problem-based learning
- Examinations and assessments

5.3. Development and Justification:

Lectures will be interactive with student participation and the professor will guide the student along the problem solving sections. Some sessions will be reserved for solving exercises in small groups. There will also be laboratory sessions where small groups of students will take measurements and perform experiments which illustrate the basic concepts explained in the classroom and a visit to a polymer manufacturing and processing industry (15 hours).

6. Detailed Contents:

SECTION I: MACROMOLECULAR STRUCTURE AND POLYMER

UNIT 1. INTRODUCTION
1.1. Basic Concepts
1.2. Classification of Polymers
1.3. Nomenclature
1.4. History of Polymers and Plastics
1.5. Molecular Weight

UNIT 2. MACROMOLECULAR STRUCTURE
2.1. Introduction
2.2. Polymer Structure
2.3. The Amorphous and Crystalline State
2.4. Thermal Transitions
2.5. Structure- Property relationship

UNIT 3. POLYMER SOLUTIONS
3.1. Introduction
3.2. Polymer solubility
3.3. Thermodynamics of polymer solutions
3.4. Polymer- polymer blends

SECTION II: POLYMER SYNTHESIS

UNIT 4. POLYMERIZATION
4.1. Introduction
4.2. Chain Growth Polymerization
4.3. Step Growth Polymerization

UNIT 5. INDUSTRIAL POLYMERIZATION PROCESSES
5.1. Introduction
5.2. Bulk polymerization
5.3. Solution polymerization
5.4. Suspension polymerization
5.5. Emulsion polymerization
SECTION III: POLYMER CHARACTERIZATION

UNIT 6. POLYMER RHEOLOGY
6.1. Why Rheology?
6.2. Fundamental Rheology Concepts and Parameters
6.3. Viscosity and Steady Shear Testing
6.4. Viscoelasticity and Time Dependence
6.5. Fundamental Rheometry Concepts

UNIT 7. POLYMER TESTING
7.1. Introduction
7.2. Mechanical properties
7.3. Physical properties
7.4. Thermal properties

7.5. Environmental properties

SECTION IV: POLYMER TYPES AND POLYMER PROCESSING

UNIT 8. PLASTICS
UNIT 9. RUBBERS
UNIT 10. FIBERS
UNIT 11. POLYMER RECYCLING

7. Bibliography

7.1. Basic Bibliography

-PLASTIC TECHNOLOGY HANDBOOK. Chanda, M. y Roy, S.K. Marcel Dekker, New York, 1998

-AN INTRODUCTION TO POLYMER SCIENCE. Hans-Georg, E. VCH, New York, 1997

-PRINCIPLES OF POLYMERISATION. Odian, G. Ed. Willey, 1991

-THE ELEMENTS OF POLYMER SCIENCE AND ENGINEERING. Rudin, A. Ed. Academic Press, 1998

-POLYMER RECYCLING: SCIENCE, TECHNOLOGY AND APPLICATIONS. Schiers, J. John Wiley & Sons, Cichester, 1998

-POLYMER CHEMISTRY AND INTRODUCTION. Stevens, M P. Ed. Oxford University Press, 1999

-PROPERTIES OF POLYMERS. Van Krevelent, D.W. Ed. Cartoné- 2009.

-POLYMER SCIENCE AND TECHNOLOGY. Robert O. Ebewele. CRC Press LLC, 2000

7.2. Additional Bibliography:

- http://www.uhu.es/biblioteca/recursose/biblioelectr.html

8. Systems and Assessment Criteria

8.1. System for Assessment:

Exams
Presentations, group projects, reports, essays, problem-solving.
Active classroom participation.

The student may choose among the two different methods of assessment proposed below:
A. Continuous assessment
1) Writing Exam (45%). G11, G12, G16, CT1, CT2, CT3
2) Active participation. Class Continuous Assessment (20%). G11, G12, G16, CT1, CT2, CT3
3) Presentation of works and written reports (35%). G11, G12, G16, CT1, CT2, CT3, G04, G05

B. Final assessment:
1) Written Exam (100%). G11, G12, G16, CT1, CT2, CT3, G04

An overall total mark of 50% for continuous assessment or final assessment would be required to pass the course.

8.2. Assessment Criteria and Marks:

Final results will be given in terms of a numerical scale between 0 and 10 (including tenths),

with the corresponding qualitative ratings below:

- ≤4.9: Fail (D)
- 5.0 - 6.9: Pass (C)
- 7.0 - 8.9: Pass with Merit (B)
- 9.0 - 10: Distinction (A)

The total number of distinctions cannot exceed 5% of the students enrolled in the subject in the academic year (unless the number of students enrolled is lower to 20, in which case one distinction can be awarded)

The grading system is subject to the Bachelor's Degree Exam Regulations of the University of Huelva (Normativa de Evaluación para las Titulaciones de Grado de la Universidad de Huelva). Please refer to:
http://www.uhu.es/sec.general/Normativa/Textos_Pagina_Normativa/Normativa_2019/Rgto_evaluacion_grado_mofs_ccgg_19_03_13.pdf.
In particular, please note that make-up exams and other special circumstances will be subject to article 19 of these regulations.'

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