GENERAL CHARACTERISTICS*

Type: ☐Basic formation, ☑Compulsory, ☐Optional
☐Master Thesis, ☐External practices

Duration: Semester **Semester / s**: 1
Number of ECTS credits: 4
Languages: Catalan, Spanish, English

DESCRIPTION

BRIEF DESCRIPTION AND JUSTIFICATION

The course has been designed to be taught in the environment of a master's degree in Materials Science and Engineering. That is why the concepts are presented trying to prioritize the importance of the relationship between the structure of macromolecules and the final properties of polymers. In this sense, polymer science is a good example of the possibilities of "molecular engineering". Students are invited to consider how the structure of a polymeric chain should be and try to teach them how they can be able to obtain it from elementary notions of polymer synthesis. Finally, different real examples are presented where they show how the concepts developed in class have been materialized by different authors in front of existing problems in the industry.

COMPETENCES

- E5 - Have knowledge of the different types of polymers and composite materials, their synthesis, processing, structure, and properties, for their application in Materials Engineering, both at industrial and research level.
- E6 – Ability to establish the relationship between the structure of a polymer or composite material and its properties, as well as to select them for the manufacture of pieces by common methods of processing, including, controlling and managing such operations
- CG2 – The ability to perform a responsible practices of the profession
- CB6 - To have and understand the required knowledge that provides the basis or opportunity to be innovative in the development and/or application of ideas, often in a research context.
- CB7 – To apply their knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
- CB8 – To integrate knowledge and deal with the complexity of formulating judgments based on information which, being incomplete or limited, includes reflections on social and ethical responsibilities related to the application of their knowledge and judgments.

PREREQUISITES*

The corresponding to access master studies.

CONTENTS

1. Introduction to Polymers
2. Polymer physics
   2.1. Molecular weight
   2.2. Solubility and conformation
   2.3. Polymer rheology
   2.4. Glass transition and mechanical properties
3. Synthesis of polymers
   3.1. Polycondensation
   3.2. Radical polymerization
   3.3. Ionic polymerization
   3.4. Polymerization "ring opening"
   3.5. UV-induced polymerization
   3.6. Raft polymerization
   3.7. ATRP polymerization
4. Advanced polymer technology
   4.1. Polymeric formulations
   4.2. Compatibility of polymers
   4.3. Interpenetrated Networks (IPNs)
5. Advanced applications
   5.1. Foams (rigid and flexible)
   5.2. Thermostable
   5.3. Fibers
6. Composite materials
   6.1. Polymeric matrix composite materials
   6.2. Metal matrix composite materials
   6.3. Composite sandwich materials
   6.4. Manufacturing technology of polymer matrix composites
   6.5. Nanocomposites
   6.6. 3D printing technology in the manufacture of composite materials

METHODOLOGY

LEARNING ACTIVITIES *

Learning Activities	ECTS credits	Competences
Lectures	0,50	E5, E6, CG2, CB6, CB7, CB8, CB9
Seminars	0,07	E5, E6, CG2, CB6, CB7, CB8, CB9
Case and Problem-Solving Sessions	0,80	E5, E6, CG2
Personal study	2,33	E5, E6, CG2
Presentations	0,15	E5, E6, CG2

* Estas características no deben ser modificadas sin la aprobación de los órganos responsables de las estructuras académicas de nivel superior (materia, módulo y/o plan de estudios).

Assessment Tasks (Exams, Continuous Assessment...)	0,15	E5, E6, CG2
TOTAL	**4**	

TEACHING METHODOLOGY

The learning is based on combining theoretical classes (30%) with the discussion of real cases in class (70%), based on the study of papers from scientific journals in English. Initially, the discussion is based on the previous knowledge of the students, but the tools developed in the theoretical part are quickly used. At the same time, the student is introduced to the use of CES material selection software. When the student is already autonomous in its use, this tool is incorporated into the discussion of real cases.

Each student must present at least a scientific commentary in class. All students present the summary of the articles presented by their classmates.

The final exam is a commentary on a scientific paper.

ASSESSMENT

ASSESSMENT METHODS *

Assessment methods	Weight	competences
Final exam	50%	E5, E6, CB6, CB7, CB8
Reports and Presentations	20%	E5, E6, CG2, CB9
Follow-up activities	25%	E5, E6, CG2
Participation	5%	CG2

RESULTADOS DE APRENDIZAJE (Explicación de las realizaciones del alumno que permiten la evaluación de competencias, relacionándolos con las competencias y los métodos de evaluación.)

- The student must demonstrate knowledge of the different types of polymers and composite materials, their collection, processing, structure and properties. (E5)
- The student must be able to establish the relationship between the structure of a polymer or composite material and its properties. (E6)
- Select polymeric materials for the realization of pieces through common methods of polymer processing and understand, control and manage such operations. (E6)
- The student should know the main applications of polymer materials and composite materials. (E5)
- Be able to understand and manage recycling processes of polymers and composite materials. (CG2)
- The student must demonstrate knowledge of the properties of polymers and composites in relation to the consequences derived from their misuse. (CG2)

QUALIFICATION

The evaluation of the course will consider all aspects listed in the evaluation grid with its corresponding weight. The higher weight of the mark rests in the final examination (50%). The reports and Presentations include classroom presentations and specific monographs that students (20%) prepare. Follow-up activities include partial tests or other deliverables (15%). Participation (5%) includes attitude, attendance and initiative shown by the student in the subject.

ASSESSMENT OF THE COMPETENCES (Definir expresiones de cálculo para cada competencia en función de las actividades de evaluación correspondientes.)

For the evaluation of E5 and E6 competences it will be used as an indicator the final exam, and presentations of work and monitoring activities.

For the assessment of competence CG2 it will be used as an indicator the participation, reports and presentations and follow-up activities marks.

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For the assessment of CB6, CB7, CB8 competences will be used as an indicator the final exam.

For the evaluation of competencies CB9 the mark of the work and presentations will be used

BIBLIOGRAPHY (recomendada y accesible al alumno.)

- Recent papers in the areas of experience of the couse. They are updated every year in Moodle.
- Varios autores, Ciencia y Tecnología de Materiales Instituto de Ciencia y Tecnologia de polímeros (CSIC), Madrid 2004.
- Alexander Y. Gosberg, Alexei R. Khokhlov, Giant Molecules, here there and everywhere, World Scientific data, Singapur, 2º edición, 2011

DOCUMENT HISTORY

PREVIOUS CHANGES
September 15, 2016, Salvador Borrós
October 1, 2015, Salvador Borrós

CURRENT REVISION
February 26, 2019, Salvador Borrós