

## COURSE GUIDE

2023/24

**Faculty** 215 - Faculty of Chemistry

**Cycle** .

**Degree** GQUIMI20 - Bachelor's Degree in Chemistry

**Year** Fourth year

## COURSE

26118 - Macromolecular Materials I: Properties and Applications

**Credits, ECTS:** 6

## COURSE DESCRIPTION

This subject aims to introduce students to the main families of industrial polymers for general purpose, as well as those employed in adhesive and coating technologies. The main objective is to learn the main characteristics of each of them and especially to understand the relationship between its structure, its properties and its applications. The subject includes, in addition to a general description of the polymeric materials, the introduction to the main methods for characterization and testing of polymeric materials. Also, concepts about the effect that polymeric materials can have on the environment, will be studied.

## COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The subject is part of the specialty of Macromolecules; it is classified inside the Advanced Module, thus sharing the cross-competencies assigned to it. Among them, the following competencies will be treated and evaluated:

M03CM17: Demonstrate observation, analysis and synthesis skills with a capacity for criticism and self-criticism.

M03CM18: Demonstrate a capacity for learning and for autonomous work for professional development.

M03CM20: Relate chemistry with other disciplines and understand its impact on the industrial and technological society and the importance of the industrial chemical sector.

The specific competencies evaluated are:

M03CM03: Possess the ability to understand and use the experimental methods of analysis and characterisation of the most representative properties of macromolecular substances and interpret the results returned in terms of the relationship between structure and properties.

M03CM04: Possess adequate knowledge of the main families of industrial polymers, their production, properties and most typical applications.

M03CM11: Be able to design, programme and carry out experimental processes and use adequate instrumental techniques for different types of chemical problems.

## CONTENIDOS TEÓRICO-PRÁCTICOS

The subject is comprised by three different parts, of different extension:

- Description of polymeric materials (15 master hours)
  - Amorphous and crystalline polymers.
  - Elastomers
  - Thermosetting polymers
  - Adhesives
  - Coatings/Paints
  - Additives for polymers
  - Polymer blends and composites
- Properties of macromolecular materials (20 master hours)
  - Mechanical properties: tensile tests, impact test, other
  - Electrical properties
  - Thermal properties
- Macromolecular materials and environment (5 master hours)
  - Environmental problems of polymers
  - Types of recycling
  - Biodegradable polymers

The following laboratory practices will be carried out:

- 1) Tensile tests: Structure-Mechanical Properties relationship for different polymeric materials,
- 2) Impact tests, and
- 3) Measuring thermal properties of polymers: MFI and Vicat softening temperature determination.

## TEACHING METHODS

Theoretical-practical (TP) activities and experimental (EX) works will be the main activities of the subject.

The theoretical-practical activities will consist of lectures in which the teacher will explain each of the topics that make up the subject, relying on Power Point presentations, which will be previously available to students. There will also be a series of seminars, in which the work of the students will be prominent, and in which some of the topics seen in the lectures will be deepened, especially those studied in the first two parts of the course. Another activity to be developed in the seminars will consist in the preparation by the students, divided into groups of three or four people, of a topic of "Macromolecular materials and environment", and that they will have to present to the rest of the students during the last days of the course.

On the other hand, the experimental activities will consist of three sessions of laboratory practices to be performed at the laboratory premises in the afternoon.

The attendance to the Seminars and Laboratory Sessions is compulsory and inexcusable.

## TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	40	10		10					
Horas de Actividad No Presencial del Alumno/a	60	20		10					

**Legend:** M: Lecture-based S: Seminar GA: Applied classroom-based groups  
GL: Applied laboratory-based groups GO: Applied computer-based groups GCL: Applied clinical-based groups  
TA: Workshop TI: Industrial workshop GCA: Applied fieldwork groups

## Evaluation methods

- Continuous evaluation
- End-of-course evaluation

## Evaluation tools and percentages of final mark

- Written test, open questions 40%
- Exercises, cases or problem sets 15%
- Individual assignments 5%
- Oral presentation of assigned tasks, Reading 10%
- Three partial exams: 1st partial exam, Descriptive of polymeric materials: 12.5%; 2nd partial exam, Mechanical properties: 12.5%; 3rd partial exam, Electrical and thermal properties: 5%.  
30%

## ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Evaluation methodology: Continuous assessment, to evaluate the theoretical-practical (TP) and experimental (EX) activities. The final grade will be obtained by averaging the grades obtained in the TP (85%) and EX (15%) parts.

a) Assessment of TP part: 3 partial exams and a final exam. Partial exams will have a pass mark of 7. Each partial exam will represent 12.5, 12.5 and 5% of the final mark, respectively, and the final exam 40%. Written tests will represent 70% of the final mark. The activities carried out during seminars (compulsory attendance) will also be scored: on one hand, the participation in the proposed activities will represent 5% of the final mark and, on the other hand, the oral exposition of the work will be worth a total of 10% of the total score. The competencies M03CM03, M03CM04, M03CM18, and M03CM20 will be evaluated.

b) Evaluation of the EX part: In laboratory work, the following items will be evaluated: the quality of the results obtained, the reports presented, the laboratory notebook and the work within the group. Attendance at laboratory practices is compulsory. The competencies M03CM11 and M03CM17 will be evaluated

In the ordinary evaluation, the grade "No-show" will only be given to students who do not attend any continuous assessment test (no exam, seminar, or laboratory practice session).

Those parts (theory, seminars and/or laboratory practices) with an score lower than 4.0, or those parts scored equal to or higher than 4.0 but lower than 5.0, but being the average of all of them lower than 5.0, will be reassessed in the extraordinary assessment.

Students who have chosen continuous assessment, may waive the call (opt-out) within a period of up to 4 weeks before the ending of the teaching period of the subject. This resignation must be submitted by writing a letter to the teacher responsible for the subject. On approval of the application, the student will be qualified as "No-show".

Students have the right to be evaluated through the final evaluation system (single test), regardless of whether or not they

have participated in the continuous assessment system. To do this, students must submit, within a period of 9 weeks from the beginning of the course, a letter to the teacher responsible for the subject, declining the continuous assessment.

The application will declare the way in which the knowledge and competences inherent to the subject will be achieved, especially the practical skills.

In both calls (ordinary and extraordinary) the single test will be made of several parts: 1) a written examination of all the theoretical-practical content of the subject, 2) the realization of a practical laboratory exam (realization of a laboratory practice sorted out among those contemplated in the program, and writing the corresponding report), and 3) an oral dissertation with the help of multimedia resources of a topic chosen among those developed in the seminars, selected by the examiners at least 10 days before the examination, followed by a discussion with the examiners. Competencies M03CM03, M03CM04, M03CM11, M03CM17, M03CM18 y M03CM20 will be assessed.

Students who had opted by the evaluation through a single test, but not shown to the exam, will be granted "No-show", which means the automatic waiver of the call.

### EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Evaluation methodology: A single test in which the parts graded no-pass/failed in the ordinary call (theoretical part, seminars and/or laboratory practices) will be assessed, according to the aforementioned final evaluation system (single test).

There will be a written exam for the assessment of the theoretical content, an oral examination consisting of the presentation of a subject among those treated in the seminars, for those students who have failed this activity, and an experimental exam of laboratory practices for those who failed the laboratory work. The written laboratory reports of all the practices will also be required.

The score of the extraordinary call will be the weighted average of the mark gotten in the exam, and of the marks gotten in the parts granted pass saved in the ordinary call.

"No-show" in the extraordinary call will be granted to anyone not attending the exam, which means the automatic waiver of the call.

### MANDATORY MATERIALS

There is no compulsory material.

### BIBLIOGRAFÍA

#### Basic bibliography

- 1) J.A. Brydson. Plastics Materials (7th Edition), Butterworth-Heinemann, 1999.
- 2) J.A. Brydson. Materiales Plásticos. Instituto de Plásticos y Caucho, 1975.
- 3) Z. W. Wicks Jr., F. N. Jones, S. P. Peppas. Organic Coatings: Science and Technology. Wiley Interscience, 1999.
- 4) W. Brockmann. Adhesive bonding: Materials, Applications and Technology. Wiley-VCH, 2008
- 5) L.E. Nielsen and R.F. Landel. Mechanical Properties of Polymer and Composites: Second Edition. Marcel Dekker, 1994.
- 6) V. Shah. Handbook of Plastics Testing and Failure Analysis: Third Edition. John Wiley & Sons, Inc., 2007.

#### Detailed bibliography

- 1) J. Royo. Manual de Tecnología del Caucho. Ed. Consorcio Nacional de Industriales del Caucho, 1989.
- 2) J. Areizaga, M. Cortázar, J. M. Elorza, J. Iruin. Polímeros. Editorial Síntesis, 2002
- 3) A.A. Tracton. Coatings Technology: Fundamentals, Testing, and Processing Techniques. CRC Press, 2007.
- 4) A.A. Tracton. Coatings Materials and Surface Coatings. CRC Press, 2007.
- 5) R. Brown. Physical Testing of Rubber, 3rd edition. Chapman & Hall, 1996.
- 6) R. Blythe. Electrical Properties of Polymers. Cambridge University Press, 1979.
- 7) D. Hull. An introduction to Composite Materials. Cambridge University Press, 1981.

#### Journals

Macromolecules  
 Polymer  
 Polymer Engineering and Science  
 Journal of Applied Polymer Science  
 Composites Science and Technology

Polymer Testing  
Revista de Plásticos Modernos

**Web sites of interest**

<http://pslc.ws/spanish/index.htm>

<http://www.plastics.com>

<http://www.plastunivers.es>

<http://www.matweb.com>

**OBSERVATIONS**

If the student gets a final grade of "no pass/failed", the parts graded as "pass" (TP or EX) will not be saved for the following course, and will be examined again.