Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2025/26

Faculty 215 - Faculty of Chemistry **Cycle** .

Degree GQUIMI20 - Bachelor's Degree in Chemistry **Year** Fourth year

COURSE

26119 - Macromolecular Materials II: Processing **Credits, ECTS:** 6

COURSE DESCRIPTION

The subject begins with an introduction to Rheology, locating the particular features of macromolecular materials and their behaviour between elastic solids and Newtonian liquids. Rheological knowledge is the basis for the later study of methods to process or convert these materials into useful products. The objectives are: provide students with the theoretical knowledge and practical experience needed to understand the behaviour of polymer flows, and use the main industrial techniques for processing these materials in the context of correlations between structure, rheology, processing and properties.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

This subject is included in the minor called "Macromolecules", located in the Advanced Module of the Degree and so, its transversal competencies will be evaluated. Among them, the following will be worked:

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 of this subject are:

M03CM05: Acquire knowledge and develop skills to use the main methods for transforming macromolecular materials into useful products. Possess basic knowledge of the rheological foundations on which said transformations are based.

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

M03CM12: Possess knowledge of the network tools and services that enable searches for information in the field of chemistry and similar fields.

The coordination of this subject with the others included in the same module is up to the Undergraduate Degree Coordination Comission.

Theoretical and Practical Contents

1) Introduction to Rheology: Polymer flow. Definition and basic concepts. Non-newtonian liquids. Flow description. Physical origin of non-linear behavior. Modelling and factors that affect the viscosity curve
2) Introduction to Viscoelasticity. Viscoelastic behaviors in flow. Measurement of viscoelasticity. Oscillatory Flows: Dynamic Measurements. Types of dynamic measurements
3) Rheology and polymer processing. Influence of the processing variables. Theory of the activated flow. Flow distortions. Slip and Plug Flow. Physicochemical processes, degradation and crystallization.
4) Operations before processing: Drying of polymers and blending in macromolecular materials (mixing and additive addition).
5) Continous processing techniques: Extrusion. Calendering. Applications.
6) Cyclic processing techniques: Injection molding. Blow molding. Thermoforming. Molding of thermoset materials. Other cyclic processing techniques. Applications.
7) Additive Manufacturing

TEACHING METHODS

The methodology in this course will be divided into master classes, seminars and laboratory practices.
The theoretical content will be taught in the classroom through master classes. To carry them out, PowerPoint presentations will be used as the main resource, which will be previously available to the students.
During the seminar hours, group activity and discussion will be encouraged. The development of topics proposed by the teacher and their presentation and discussion in groups of 2-3 people are contemplated.
The laboratory practices will be divided into different sessions, in the afternoon. In the practices, both rheology and processing contents will be worked on. The practical scripts will be delivered that will include the tasks to be completed, the instructions for the use of the equipment and the experimental conditions to perform the proposed practices. The students, divided into groups of 3-4 people, will carry out the experimental work, recording and analyzing the data obtained and contrasting them with the possible incidents. Finally, each group will reflect the work done, as well as the

results and their discussion, in a written report.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	40	5		15					
Horas de Actividad No Presencial del Alumno/a	60	10		20					

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 55%
- Exercises, cases or problem sets 25%
- Oral presentation of assigned tasks, Reading¿ 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The acquisition of skills will be assessed continuously throughout the course, according to the following rating system.
1) The evaluation of the theoretical-practical contents presented in the master classes will count for 55% of the total grade and will be evaluated by means of an evaluation test and a written exam. The evaluation tests will be carried out at the end of each topic using interactive applications. The evaluation of each of the 3 first tests will contribute 5% to the theoretical-practical qualification. On the other hand, the evaluation of the rest of tests may partially replace sections of the final exam.
2) The evaluation of the work developed in the seminars will be carried out through oral presentations. This evaluation will count for 20% of the final grade and is mandatory for the student who opts for continuous evaluation.
3) The evaluation of the laboratory practices will be based both on direct observation in the laboratory and on the reports of the work carried out. This evaluation will count 25% of the final grade. Attendance at laboratory practices will be a compulsory essential condition to pass the subject.

Conditions to pass the subject:
- Qualification ≥ 4.0 in all sections: theoretical-practical, seminar activities and laboratory practices.
- Average rating ≥ 5.0.

The criteria for opting for evaluation by final test are those established in chapter 2, article 8 of the regulations governing the evaluation of students of EHU undergraduate degrees.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary evaluation, a student may request that his/her marks are calculated in the percentages referred to in sections 2) and 3) of the ordinary evaluation rules (only if they have passed them). In this case, the student may only do the written exam in section 1), with its corresponding percentage value (55%).

If a student opts for evaluation through a single exam, or has not passed section 2) and 3) of the ordinary evaluation, he/she will take a single exam of a theoretical-practical nature, representing 100% of the final mark. This exam will be used to evaluate all the competences of the subject.

MANDATORY MATERIALS

There is no compulsary material.

BIBLIOGRAPHY

Basic bibliography

J. M. Dealy. Rheometers for Molten Plastics. Van Nostrand Reinhold, 1982.
J. Ferguson, Z. Kembloswsky. Applied Fluid Rheology. Elsevier Applied Science, 1991.
A. A.Collier. Thechniques in Rheological Measurements. Chapman and Hall, 1993.
G. Schramm. A Practical Approach to Rheology and Rheometry. Haake, 1994.
C. D. Han. Rheology in Polymer Processing. Academic Press, 1976.
J. M. Dealy, K. F. Wissbrun. Melt Rheology and its Role in Plastics Processing: Theory and Applications. Van Nostrand Reinhold, 1990.
A. Santamaría, M. E. Muñoz. Curso de Reología Aplicada. UPV/EHU, 2009.

A. Santamaria, E.Unzueta. Erreologia: Teoria eta Praktika. UEU, 1994.
M. L. Berins, Editor. Plastics Engineering Handbook. Van Nostrand Reinhold, 1991.
W. Michaeli. Plastics Processing, An Introduction. Hanser, 1995.
T. L. Richardson. Industrial Plastics. Delmar Publishers Inc., 1989.
J. M. Charrier. Polymeric Materials and Processing. Hanser, 1991.
W. Michaeli, H. Kaufmann, H. Greif. F. J. Vosseburger. Training in Plastics Technology. Hanser, 1995.
A. W. Birley, B. Hawort, J. Batchelor. Physics of Plastics. Processing, Properties and Materials Engineering. Hanser Publishers, 1991.

Detailed bibliography

J. D. Ferry. Viscoelastic Properties of Polymers. Wiley, 1980.
W. W. Graessley. Polymeric Liquids and Networks: Dynamics and Rheology. Garland Science, 2008.
I. I. Rubin (ed.). Handbook of Plastics Materials and Technology. Wiley Interscience, 1990.
C. A. Harper (ed.). Handbook of Plastic Processes. Wiley, 2006.

Journals

Polymer
Journal of Rheology
Rheologica Acta
Applied Rheology
Macromolecular Materials and Engineering
Polymer Engineering and Science
International Polymer Processing
European Polymer Journal
Journal of Applied Polymer Science

Web sites of interest

http://www.rheology.org/
http://www.bsr.org.uk
http://rrc.engr.wisc.edu/
http://www.strictly-extrusion.com
http://www.ferris.edu/htmls/academics/course.offerings/hillm
http://www.polymer-age.co.uk
http://www.matweb.com
http://www.plastics.com
http://www.empirewest.com/academy/index.html
http://www.mdacomposites.org
http://www.plastunivers.es
http://www.mixers.com
http://www.apme.org

OBSERVATIONS