VNIVERSITAT DE VALÈNCIA

Course Guide
44995 Chemistry of Materials for Technological Processes

COURSE DATA

DATA SUBJECT

Code: 44995
Name: Chemistry of Materials for Technological Processes
Cycle: Master's Degree
ECTS Credits: 5
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
2249 - Master's Degree in Chemistry	Facultat de Química	1	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2249 - Master's Degree in Chemistry	Aplicaciones de la Química Física	COMPULSORY

COORDINATION

PEREZ PLA FRANCISCO

SUMMARY

The course, "Chemistry of Materials for Technological Processes" is organized into three thematic units. The first block introduces basic photochemical concepts (not covered in the bachelor's program) and applies knowledge of homogeneous and heterogeneous catalysis to practical chemical processes of industrial interest. The second block focuses on polymeric and colloidal systems of technological interest. Students will examine the relevant thermodynamic and kinetic aspects, characterization techniques, and industrial applications of each system. Special emphasis will be placed on the practical implications of the learned concepts. In the third module, students will expand their basic knowledge of electrochemistry and describe the processes taking place at electrodes, particularly the kinetics of these processes. This knowledge will be applied to the study of electrochemical corrosion.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

It is recommended to have the chemistry and mathematics knowledge acquired during the Chemistry or other recommended entry degree.

COMPETENCES / LEARNING OUTCOMES

2249 - Master's Degree in Chemistry

Apply the advanced theoretical and practical knowledge gained in the different specialties of chemistry to R&D and innovation.

Be able to conduct any type of research in the field of chemistry and/or the chemical industry, as a specialist.

Be able to defend positions in debates and colloquia in a rigorous and reasoned manner.

Be able to design, conduct, analyse and interpret complex experiments and data, as a specialist.

Be able to present and defend publicly the results obtained in scientific research or as a result of work in a chemical industry.

Be able to solve complex chemistry problems, whether in the academic, research or industrial application areas at a specialization or masters-level.

Fomentar, en contextos académicos y profesionales del ámbito de la política económica,
el avance tecnológico, social o cultural dentro de una sociedad basada en el conocimiento y en el respeto a: a) los derechos fundamentales y de igualdad de oportunidades entre hombres y mujeres, b) los principios de igualdad de oportunidades y accesibilidad universal de las personas con discapacidad y c) los valores propios de una cultura de paz y valores democrático.

Gain experience in the use of information tools and in the management of the information obtained.

Gain skills and knowledge in the chemical-physical processes of interest that can contribute to the development of technological processes of industrial interest.

Have the ability to plan and to manage time and resources and gain experience in decision-making.

Know how to apply acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.

Know how to communicate your conclusions (and the underlying knowledge and reasons) to both specialist and non-specialist audiences in a clear and unambiguous way.

Possess the ability to plan and manage time and resources and gain experience in decision-making.

Possess the learning skills that will allow them to continue studying in a way that will be largely self-directed or autonomous.

Possess the necessary skills to develop multidisciplinary activities within the field of chemistry at the master's level.

DESCRIPTION OF CONTENTS

1. **Photochemical reactions.** Concept of photochemical reaction. Principles of photochemistry. Rate of light absorption. Quantum yield. Primary and secondary photochemical processes. Bimolecular deactivation. Primary and secondary photochemical reactions. Chemiluminescence. Photochemical reactors. Study of photochemical reactions of industrial interest.
2. **Homogeneous catalysis.** Basic principles. Concept of catalyst. Mechanism of catalysis. Classification of catalytic processes. Catalyst activity and selectivity. Autocatalysis. The kinetic study of a catalytic reaction. Homogeneous catalysis. Acid base catalysis. Metal complex catalysis. Ligand exchange. Oxidative additions. Reductive eliminations. Migration and insertion reactions. Nucleophilic attack on coordinated substrates. Steric effects. Electronic effects. Asymmetric catalysis. Examples of industrial interest.
3. **Heterogeneous catalysis.** Classification of heterogeneous catalytic processes. Concept of active sites. Model catalytic systems. Real catalysts: promoters, modifiers and poisons. Preparation of solid catalysts: sludge precipitation. Co-precipitation. Impregnation of solid supports. Hydrothermal synthesis. Drying, calcination and activation of solid catalysts. Characterization of catalysts: surface characterization techniques, thermogravimetric methods, surface spectroscopy, surface microscopy. Examples of industrial interest.
4. **Colloid chemistry.** Colloidal systems: kinetic and thermodynamic aspects. Colloidal stability: van der Waals forces and electrostatic interactions. Steric stabilization with polymers. Surfactants and detergency. Association colloids. Emulsions, foams, and particle dispersions. Characterization of colloidal systems. Technological applications.
5. **Polymeric materials.** Basic concepts of polymers in solutions. Polymers in the solid state: amorphous and partially crystalline polymers. Polymerization methods. Industrially relevant polymerization processes. Characterization techniques for polymers in solution and in the solid state. Examples of polymer materials with technological interest.
6. **Electrode kinetics.** The electrochemical cell. Simple equivalent circuits. Mass transport in electrochemical cells. The Butler-Volmer equation. Electrochemical techniques: chronoamperometry, voltammetry, electrochemical impedance. Polarization curves. Tafel curves.
7. **Corrosion and its prevention.** Definition of corrosion. Corrosion and environment. Corrosion rate and economy. Characterization techniques for the corrosion rate. Protection against corrosion.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	10,00
Theory	40,00
Total hours	**50,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	75,00
Preparation of lessons	0,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**75,00**

TEACHING METHODOLOGY

The course will be taught in synchronous/asynchronous online mode. The training activities will include the resolution of applied practical problems aimed at assessing the students' understanding of the subject. In addition, use will be made of the Virtual Classroom, an online space where all the information considered appropriate for the development of teaching, the control of student participation in the proposed activities and the dynamisation of continuous assessment (discussion forums, online activities, etc.) will be deposited.

EVALUATION

Taking into account that the course is taught in a synchronous/asynchronous teaching mode, the final grade for the subject will be the weighted average of the grades obtained in the final presential exam, the continuous assessment tests taken, and the assignments submitted throughout the course. The weighting percentages will be as follows: 60% for the final presential exam and 40% for the continuous assessment activities (broken down into 15% for the continuous assessment tests and 25% for the assignments carried out throughout the course). In both calls, a minimum score of 4.0 out of 10 in the final presential exam will be required to be able to average with the other activities. If the 4.0 points are not reached, the final grade will be the one obtained in the exam. To pass the subject, a minimum overall grade of 5.0 out of 10 is required. In the second call, the only recoverable element will be the final presential exam (60%). The grades corresponding to the continuous assessment activities and assignments (40%) will be kept for the second call, maintaining the ones obtained during the course as they are non-recoverable activities.

REFERENCES

- ROTHENBERG, G. Catalysis. Concepts and Green Applications. Wiley-VCH, Weinheim. 2008
- MASEL, R.I. Chemical Kinetics and Catalysis. Wiley-Interscience, 2001
- GATES, B.C. Catalytic Chemistry. Wiley, New York, 1992.
- KONTOGEORGIS, G.M.; KIIL, S. Introduction to Applied Colloid and Surface Chemistry. Wiley, 2016.
- HIEMENZ, P. C.; RAJAGOPALAN, R. Principles of Colloid and Surface Chemistry. 3rd ed. Marcel Dekker, New York, 1997.
- Koltzenburg, S.; Maskos, M.; Nuyken, O. Polymer Chemistry. Springer, 2017.
- YOUNG, R. J.; LOVELL, P. A. Introduction to Polymers. 2nd ed, Chapman & Hall, London, 1991.
- BARD, A. J.; FAULKNER, A.R.N. Electrochemical Methods: Fundamentals and Applications. Wiley, 1980.
- BAGOTSKY, V. S. Fundamentals of Electrochemistry, John Wiley & Sons, Hoboken, New Jersey, 2006.