COURSE DATA

Data Subject	
Code	44995
Name	Química de materiales para procesos tecnológicos
Cycle	Master's degree
ECTS Credits	5.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2249 - Master's Degree in Chemistry	Faculty of Chemistry	1	First term

Subject-matter

Degree	Subject-matter	Character
2249 - Master's Degree in Chemistry	2 - Aplicaciones de la Química Física	Obligatory

Coordination

Name	Department
PEREZ PLA, FRANCISCO	315 - Physical Chemistry

SUMMARY

The subject "Chemistry of materials applied to technological processes" is organized in three thematic blocks. The first block introduces the basic notions of photochemistry (not studied in the degree) and orients the knowledge on homogeneous and heterogeneous catalysis in a practical way towards chemical processes of industrial interest. The second block focuses on the study of polymeric and colloidal systems with technological interest. For the different systems, the relevant thermodynamic and kinetic aspects, the appropriate characterization techniques, and the most important industrial applications will be studied. Special emphasis will be given to the practical implications of the concepts learned. Finally, in the third block, the basic knowledge of electrochemistry is extended, and the processes that take place on electrodes are described, in particular the kinetics of the processes that occur on electrodes. The acquired knowledge will be applied to study the problem 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

Chemistry and mathematics knowledge acquired during the Chemistry or recommended entry degree are required.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

2249 - Master's Degree in Chemistry

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Be able to solve complex chemistry problems, whether in the academic, research or industrial application areas at a specialization or masters-level.
- Possess the necessary skills to develop multidisciplinary activities within the field of chemistry at the master's 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.
- Possess the ability to plan and manage time and resources and gain experience in decision-making.
- Have the ability to plan and to manage time and resources and gain experience in decision-making.
- Gain experience in the use of information tools and in the management of the information obtained.
- 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.
- Gain skills and knowledge in the chemical-physical processes of interest that can contribute to the development of technological processes of industrial interest.
- 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 present and defend publicly the results obtained in scientific research or as a result of work in a chemical industry.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

1. Apply the basic concepts of photochemistry and homogeneous and heterogeneous catalysis that are relevant to the chemical industry.
2. Analyze experimental kinetic data from catalytic and photochemical processes.
3. Differentiate the different types of polymeric and colloidal systems according to the criteria learned and evaluate their suitability for specific technological applications.
4. Identify the relevant thermodynamic and kinetic aspects in real polymeric and colloidal systems and select the appropriate characterization techniques in each case.
5. Describe the fundamentals of electrostatic kinetics and apply them to the study and inhibition of corrosion.
6. Knowing how to apply the knowledge acquired to contribute to the Sustainable Development Goals (SDGs), such as the sustainable management of water, raw materials and energy sources (SDGs 6 and 7) and to develop a professional work with the least environmental impact and using alternative raw materials (SDGs 11, 14 and 15)

DESCRIPTION OF CONTENTS

1. Photochemical reactions (6 h)

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 (4 h)

Basic principles. Concept of catalytist. 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 interes.

3. Heterogeneous catalysis (6 h)

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

ACTIVITY	Hours	% To be attended
Theory classes	40,00	100
Tutorials	10,00	100
Study and independent work	75,00	0
TOTAL	**125,00**	

TEACHING METHODOLOGY

The course will be taught through interactive master classes about theoretical concepts, classes with directed practical activities, seminars, and workshops in which applied practical problems will be solved in order to evaluate the understanding of the subject by the student. In addition, we will use the Virtual Classroom, an online space containing all the required information for the development of the teaching process, the control of student participation in the proposed activities, and the dynamization of the continuous assessment (discussion forums, network activities, etc).

Due to organizational reasons, during the 2022-2023 academic year, attendance has been reduced to 80%

EVALUATION

The final grade for the course will be the weighted average of the grades obtained in the final exam, in the continuous assessment tests carried out, and in the assignments delivered throughout the course. The percentages of the weighting will be the following:

(a) Final exam: 60%

(b) Continuous evaluation activities: 40%

(b.1) Continuous assessment tests: 10%

(b.2) Work done throughout the course: 30%

The evaluation system and the percentages will be identical in the second call. The grade in section (b) obtained during the course will be kept.

In both calls, a minimum grade of 4 out of 10 will be required in the final exam to be able to average with the other activities. If less than 4 points are reached in the exam, the final grade will be the one obtained in the exam. To pass the course, a grade of 5 out of 10 is required.

REFERENCES

Basic

- 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.