COURSE DATA

DATA SUBJECT

Code: 36462
Name: Polymers and colloids
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Facultat de Química	4	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1110 - Degree in Chemistry	Physical Chemistry Applied	ELECTIVES

COORDINATION

MUÑOZ ESPI RAFAEL

SUMMARY

The course "Polymers and Colloids" is an optional subject of 6.0 ECTS credits, taught during the second semester of the 4th year in the bachelor studies. The course aims to integrate in the chemical training of the student basic concepts related to polymeric and colloidal materials.

From a didactic point of view, the contents of the course have been distributed in three blocks: polymers, colloids, and applications. The first block focuses on polymeric materials from a general point of view. The second block deals with colloidal systems, with a special emphasis on polymer colloids from a general perspective. The different didactic units of these first two blocks cover (i) the synthesis of the materials, (ii) the physico-chemical aspects related to polymer and colloid systems, and (iii) the characterization techniques. The third and last block, shorter in extension, has a single didactic unit and aims to give concrete examples of applications of polymers and colloids.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

COMPETENCES / LEARNING OUTCOMES

1110 - Degree in Chemistry

Apply metrology in chemical processes, including quality management.

At the end of the course, the student will interpret the data from observations and measurements in the laboratory in terms of their significance and the theories that support them.

At the end of the subject, the student will evaluate, interpret and synthesize the chemical data and information correctly.

Collaborate effectively in work teams, assume responsibilities and leadership roles, and contribute to collective improvement and development.

Communicate effectively both orally and in writing, adapting to the context and audience.

Comprender la empresa como una realidad sistémica e inherentemente compleja, reconociendo e identificando las dimensiones consustanciales a los sistemas de gestión empresarial y los condicionantes, externos e internos, que inciden sobre su gestión.
Ser capaces de categorizar y jerarquizar las decisiones organizativas, e interpretar los procesos de adopción de decisiones en el ámbito de los modelos teóricos. Discriminar y manejar los principales métodos y técnicas disponibles para la elaboración del diagnóstico estratégico. Poder elaborar un diagnóstico estratégico básico.

Comprender las particularidades contables que presenta la regulación jurídico-mercantil de las empresas, relacionando la legislación mercantil aplicable a los distintos tipos operaciones societarias con la contabilidad de los hechos económicos que se regulan. Aprender a relacionar las leyes mercantiles que se ocupan de los concursos de acreedores con la contabilidad, adquiriendo práctica en el manejo de determinados textos legales vigentes.

Contribute to the design, development and implementation of solutions that respond to social demands, using the Sustainable Development Goals as a reference.

Demonstrate both inductive and deductive reasoning skills.

Demonstrate critical and self-critical thinking, considering professional ethics, moral values and social implications of the different activities carried out throughout the degree.

Demonstrate the ability to analyse, synthesise and reason critically.

Describe the characteristics and behaviour of the different states of matter and the theories used to explain them.

Distinguish between the qualitative and quantitative aspects of chemical problems.

Evaluate the risks involved in the use of chemical substances and laboratory procedures.

Express ideas correctly, both orally and in writing, in any of the official languages of the Valencian Community.

Handle the instrumentation used in the different areas of chemistry.

Identify chemical processes in everyday life.

Identify the main types of chemical reactions and their associated key characteristics.

Identify the structure and reactivity of the main classes of biomolecules and the chemistry of key biological processes.

Implement sustainable and environmentally friendly methodologies.

List the principles of quantum mechanics and apply them to the description of the structure and properties of atoms and molecules.

Relate chemistry to other disciplines.

Relate theory to experimentation.

Ser capaces de analizar la influencia que sobre el diseño del sistema de información de costes, ejercen, tanto la actividad concreta desarrollada por la entidad como la tecnología utilizada, la estructura organizativa y el estilo de dirección. Calcular costes preestablecidos y relacionarlos con la planificación y el control de la actividad interna. Seleccionar aquellos indicadores de gestión que faciliten el desempeño personal, estableciendo la frecuencia y el formato en función del usuario de destino.

Ser capaces de configurar y manejar un sistema integrado para la gestión contable de la empresa. Utilizar la hoja de cálculo como herramienta de análisis de la información económica de la empresa. Saber aplicar programas de apoyo a tareas específicas de gestión.

Solve problems effectively.

Understand and analyse, from the perspective of the degree programme, social inequalities based on sex and gender; integrate gender-sensitive approaches into problem-solving and solution design.

Use chemical terminology, nomenclature, conventions and units correctly.

DESCRIPTION OF CONTENTS

1. Macromolecules and Polymeric Systems
1.1. General aspects and historical development of macromolecular chemistry
1.2. Classification of polymers and copolymers
1.3. Molecular weight distributions
1.4. Conformation, configuration, and polymers in solution
1.5. Polymer nomenclature

2. Polymer Synthesis: Polymerization Reactions
2.1. Introduction: classification of polymerization reactions
2.2. Chain polymerization
2.2.1. Radical polymerization
2.2.2. Anionic polymerization
2.2.3. Cationic polymerization
2.3. Step-growth polymerization
2.4. Differences between chain and step-growth polymerization
2.5. Polymerization methods

3. Sustainability in Polymers: Bio-based Polymers and Recycling
3.1. General aspects of sustainability and circular economy in polymers
3.2. Biopolymers and bio-based polymers
3.3. Biodegradability
3.4. Plastic recycling

4. Properties of Polymers in the Solid State
4.1. Polymers in the solid state: amorphous and crystalline states
4.2. Glass transition and melting temperatures
4.3. Amorphous polymers
4.4. Semicrystalline polymers: polymer crystallization

5. Polymer Characterization
5.1. Characterization in solution: molecular weights and dimensions
5.2. Solid-state characterization: thermal analysis
5.2.1. Thermogravimetric analysis (TGA)
5.2.2. Differential scanning calorimetry (DSC)
5.2.3. Dynamic mechanical analysis (DMA)
5.3. Mechanical property characterization
5.4. Other useful polymer characterization techniques

6. General Aspects of Colloidal Systems
6.1. Definition of colloid
6.2. Historical aspects of colloid and interface science
6.3. Classification of colloidal systems
6.4. Dispersed particles
6.5. Emulsions: types and homogenization methods
6.6. Particle formation: nucleation and growth

7. Interfaces in Colloidal Systems and Surfactants
7.1. Surfactants: definition and classification
7.2. Surfactant adsorption and thermodynamic aspects
7.3. Micelle formation and other aggregation structures
7.4. Practical criteria for surfactant selection: hydrophilic-lipophilic balance (HLB)
7.5. Detergency

8. Colloid Synthesis

8.1. Inorganic colloids
8.1.1. Precipitation reactions
8.1.2. Sol-gel processes
8.1.3. Microemulsion and miniemulsion for inorganic nanoparticle formation
8.2. Polymeric colloids
8.2.1. Polymerizations in heterophase systems
8.2.2. Preparation via spontaneous emulsification
8.2.3. Emulsion-solvent evaporation techniques

9. Colloidal Stability
9.1. Stability and stabilization strategies
9.2. Sedimentation
9.3. Particle interactions: aggregation and flocculation
9.4. DLVO theory and electrostatic stabilization
9.5. Steric stabilization
9.6. Ostwald ripening
9.7. Coalescence

10. Colloid Characterization
10.1. Size characterization
10.2. Morphological and structural characterization
10.3. Stability characterization of colloidal systems
10.4. Characterization of other physical parameters

11. Applications of Polymeric and Colloidal Systems
11.1. Examples of current polymer applications
11.2. Examples of current colloidal system applications

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	9,00
Theory	51,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	30,00
Independent study and work	32,00
Preparation of lessons	28,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00

Total hours	**90,00**

TEACHING METHODOLOGY

The development of the subject is done through three types of on-site teaching sessions: theory classes, tutorials, and seminars.

In the theory classes, the fundamental concepts of each unit of the teaching guide will be explained, indicating the relevant literature for the consolidation of the topic. In addition, students will have teaching materials provided by the teaching team, which can serve as a starting point for the student's work, but never as the only study material. After exposing the theoretical concepts, practical activities corresponding to the theme will be carried out.

In the tutorial sessions, the students will work on practical activities proposed by the teacher, a part of them available in advance to allow their autonomous resolution and facilitate the active participation. The tutorials will be interactive to allow the resolution of the doubts of the students.

Finally, at the seminars, the students will make oral presentations on relevant topics related to macromolecular and colloidal systems. In these seminars, they will work on both specific aspects of the subject and some transversal competences (oral and written communication, bibliographic search and management, teamwork). The exact dates of the seminars, within the scheduled hours of the subject, will be announced by the teachers during the first days of the course.

EVALUATION

The evaluation of the student's learning will take into account all the aspects exposed in the methodology section of this teaching guide. In general, the evaluation will be trough continuous assessment in the classroom. Exceptionally, for students that cannot attend classes because of justified reasons (for example, an employment contract that implies working during class hours), we offer a remote learning modality. By default, all students remain assigned to the general continuous assessment modality, unless that a written application is submitted to professors of the subject, including the reasons and documents that justify the impossibility to attend the normal lectures. This application has to be submitted within the first 30 calendar days from the beginning of the course. If the remote learning modality is not requested and the face-to-face sessions have not been attended, the continuous assessment will not be passed and the subject will be automatically considered as failed.

General continuous assessment modality. This modality takes into account the student's continuous assessment, which will have a weight of 40% in the final grade. The continuous assessment is distributed in the following sections:

A) Active participation in tutorials and seminars (16 hours in total), evaluation of the corresponding compulsory activities, and evaluation of off-site tasks (OSTs): 15% of the final grade.

B) Continuous assessment tests (CATs), which will be carried out during tutorial sessions and seminars: 10% of the final grade.

C) Oral presentation of a subject related to macromolecular and colloidal systems, in accordance with the guidelines indicated by the teachers at the beginning of the course: 15% of the final grade.

Student participation in group tutorial sessions and seminars is mandatory. To compensate for the non-attendance of a mandatory session for duly justified exceptional reasons, teachers may propose carrying out an alternative activity. In any case, continuous assessment tests carried out in tutorials and seminars cannot be retaken. Missing 5 or more hours of tutorials and seminars will automatically imply the grade "not passed" in the continuous assessment with 0% and, consequently, the subject will be failed.

The remaining 60% of the grade will be the result of a final assessment test (FAT) with theoretical or theoretical-practical exercises, which will take place on the day scheduled by the academic calendar for the final exam. To pass the subject a total grade equal to or greater than 5 (out of 10) has to be obtained. It will also be necessary to reach a minimum score of 4 out of 10 in both the continuous assessment and the FAT.

Exceptional Remote Learning Assessment Method. In the remote learning method, the final grade is the weighted average of the following three parts:

A) Written paper on a topic chosen from three proposed topics (10%). The proposed topics will be provided to the student within 15 calendar days following the acceptance of the the remote learning method. The paper will be completed during the course and must be submitted by the date indicated by the professors, prior to the exam date. The extension of the paper will be between 10 and 15 pages.

B) Oral presentation of the written paper topic (15%). The presentation will have a maximum duration of 15 minutes, followed by a discussion with the professors for a maximum of 20 minutes. The oral presentation will take place on the same day scheduled in the academic calendar for the final exam (in an alternative time slot) or, if time and the number of students do not permit, within the following four school days. If authorized by the professors, by mutual agreement, this test can be conducted on an alternative date.

C) Final exam (75%).

To pass the subject through the exceptional remote learning method, it is necessary to obtain a weighted average grade of 5 or higher. Additionally, it is required to achieve a minimum grade of 4 in each of the three parts.

The evaluation system will be the same in both calls. If applicable, the continuous assessment grade is maintained for the second call. In the exceptional remote learning method, the grades for parts A and B, which cannot be retaken, will be maintained. In the second call, only the final exam will be conducted.

Final warning

Copying or plagiarism of any assignment that is part of the evaluation will make it impossible to pass the course, and the student will be subject to the appropriate disciplinary procedures.

Please note that, according to Article 13 d) of the University Student Statute (RD 1791/2010, December 30), "*it is the duty of a student to refrain from using or cooperating in fraudulent procedures in evaluation tests, in the work performed or in official University documents*".

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