COURSE DATA

Data Subject	
Code	36462
Name	Polymers and colloids
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Faculty of Chemistry	4	Second term

Subject-matter

Degree	Subject-matter	Character
1110 - Degree in Chemistry	15 - Physical Chemistry Applied	Optional

Coordination

Name	Department
MUÑOZ ESPI, RAFAEL	315 - Physical Chemistry

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

1110 - Degree in Chemistry

- Develop capacity for analysis, synthesis and critical thinking.
- Show inductive and deductive reasoning ability.
- Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation.
- Solve problems effectively.
- Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.
- Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate.
- Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional.
- Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.
- Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units.
- Demonstrate knowledge of the characteristics and behaviour of the different states of matter and the theories used to describe them.
- Demonstrate knowledge of the main types of chemical reaction and their main characteristics.
- Show knowledge of the metrology of chemical processes including quality management.
- Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.
- Show knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Solve qualitative and quantitative problems following previously developed models.

- Evaluate, interpret and synthesise chemical data and information.
- Handle the instrumentation used in the different areas of chemistry.
- Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them.
- Relate theory and experimentation.
- Recognise and evaluate chemical processes in daily life.
- Understand the qualitative and quantitative aspects of chemical problems.
- Develop sustainable and environmentally friendly methods.
- Relate chemistry with other disciplines.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.
- Have basic skills in the use of information and communication technology and properly manage the information obtained.

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

DESCRIPTION OF CONTENTS

1. Polymers and polymer 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. Polymerization reactions

2.1. Introduction: classification of polymerization reactions
2.2. Chain-growth 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-growth and step-growth polymerization
2.5. Polymerization methods

3. Properties of polymers in solid state

3.1. Polymers in the solid state: amorphous and crystalline states
3.2. Glass transition temperature and melting temperature
3.3. Amorphous polymers
3.4. Semicrystalline polymers: polymer crystallization

4. Polymer characterization

4.1. Characterization of polymers in solution: determination of molecular weights and dimensions
4.2. Characterization of polymers in the solid state: thermal analysis
4.2.1. Thermogravimetric analysis (TGA)
4.2.1. Differential scanning calorimetry (DSC)
4.2.1. Dynamic mechanical analysis (DMA)
4.3. Characterization of mechanical properties
4.4. Other useful techniques for polymer characterization

5. Colloid Systems

5.1. Definition of colloid
5.2. Historical aspects of the development of the colloid and interface science
5.3. Classification of colloidal systems
5.4. Particles in dispersion
5.5. Emulsions
5.6. Inorganic colloids
5.7. Precipitation reactions and particle formation: nucleation and growth
5.8. Sol-gel processes
5.9. Microemulsion and miniemulsion for the formation of inorganic nanoparticles

6. Interfaces in colloidal systems and colloidal stability

6.1. Surfactants
6.1.1. Definition and classification
6.1.2. Adsorption of surfactants and thermodynamic aspects
6.1.3. Formation of micelles and other aggregation structures
6.1.4. Practical criteria for choosing surfactants: hydrophiliclipophilic balance (HLB)
6.1.5. Detergency
6.2. Physical stability of colloids
6.2.1. Stability in colloids and stabilization strategies
6.2.2. Sedimentation
6.2.3. Interaction between particles: aggregation and flocculation
6.2.4. DLVO theory and electrostatic stabilization
6.2.5. Steric stabilization
6.2.6. Ostwald ripening
6.2.7. Coalescence

7. Polymer colloids and heterophase polymerization

7.1. Types of emulsions and homogenization methods in emulsions
7.2. Polymerization in heterophase systems
7.3. Preparation of polymer colloids by spontaneous emulsification
7.4. Preparation of polymer colloids by emulsion-solvent evaporation techniques

8. Colloid characterization

8.1. Size characterization
8.2. Morphological and structural characterization
8.3. Characterization of the stability of colloidal systems
8.4. Characterization of other physical parameters

9. Applications of colloid and polymer systems

9.1. Examples of current applications of polymers
9.2. Examples of current applications of colloidal systems

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	51,00	100
Tutorials	9,00	100
Development of individual work	30,00	0
Study and independent work	32,00	0
Preparing lectures	14,00	0
Preparation of practical classes and problem	14,00	0
TOTAL	**150,00**	

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 non-continuous assessment modality. By default, all students remain assigned to the 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 non-continuous assessment 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.

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 non-continuous assessment modality. In the non-continuous modality, the final grade is the weighted average of the following two exercises:

A) Final exam (80%)

B) Oral presentation of a topic to choose between three proposed (20%). The topic proposal will be provided to the student within 30 calendar days following the acceptance of the non-continuous assessment modality. The presentation will have a maximum duration of 15 minutes, followed by a discussion with the teachers for a maximum time of 20 minutes. The oral presentation will be 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 allow it, within the four following working days. If the teaching staff authorizes it, by mutual agreement, this test may be taken on an alternative date.

To pass the subject in the non-continuous exceptional assessment, it will be necessary to obtain an average grade equal to or greater than 5. In addition, it will be necessary to achieve a minimum grade of 4 in each of the two exercices.

The evaluation system will be the same in both calls. If applicable, the grade of the continuous evaluation is maintained for the second call. In the non-continuous exceptional evaluation modality, as a general rule, the two exercises have to be taken, even if one of them was passed on the first call. The topic of the oral presentation will be the same for both calls.

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*".

REFERENCES

Basic

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