COURSE DATA

Data Subject	
Code	36462
Name	Polímeros y Coloides
Cycle	Grade
ECTS Credits	6.0
Academic year	2018 - 2019

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
GOMEZ CLARI, CLARA M	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. 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

OUTCOMES

1110 - Degree in Chemistry

- Develop capacity for analysis, synthesis and critical thinking.
- Show inductive and deductive reasoning ability.
- Solve problems effectively.
- Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate.
- 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 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

Unit 1

- Define polymer or macromolecule.
- Define the size of a polymer and differentiate the characteristic average molecular masses of macromolecular systems.
- Differentiate the characteristic temperatures of a polymer.
- Explain the variation of the state of a polymer as a function of temperature.

Unit 2

- Describe the types of polymerization reactions.
- Describe the polymerization kinetics.
- Explain the preparation of a polymer by chain polymerization method.
- Compare the polymerization techniques.
- Explain the preparation of a polymer by the step-polymerization method.

Unit 3

- Define glass transition temperature.
- Explain which factors the glass transition temperature depends on.
- Explain polymer crystallization.
- List which factors affect the crystallization.
- Define melting temperature.
- Cite which factors affect the melting temperature.
- Explain the variation of the state of a polymer as a function of temperature.
- Explain the behavior of a polymer under a strain as a function of temperature.

Unit 4

- Characterize polymers in solution.
- Determine average molecular weights
- Characterize polymers in solid and molten states.
- Evaluate the properties as a function of temperature.
- Evaluate the behavior based on applied force.
- Evaluate the properties of structure and morphology in polymers.

Unit 5

- Differentiate colloidal and non-colloidal systems according to the IUPAC definition
- Classify colloidal systems according to the different possible criteria.
- List and describe the different methods of colloid preparation.
- Explain the techniques of preparation of inorganic colloids.
- Describe the main aspects of the processes of nucleation and growth in colloids.

Unit 6

- Explain the fundamental thermodynamic aspects of interfaces in colloidal systems.
- Describe the double layer models for charged interfaces applied to colloidal systems.
- Explain processes of interaction between particles, taking into account the concepts of electrostatic and steric stabilization.
- Explain and apply the DVLO theory in the evaluation of colloidal stability.
- Define the concept of surfactant and classify the different types.
- Explain the adsorption of surfactants in interfaces using thermodynamic concepts.
- Define the concepts of micelle and critical micellar concentration.
- Describe the concept of number of aggregation and relate it to the possible aggregation structures in colloidal systems.
- Evaluate the suitability of a surfactant as an emulsifier of a given system according to its HLB index value.

Unit 7

- Differentiate the types of emulsion (emulsion, miniemulsion and microemulsion) according to their thermodynamic and kinetic characteristics.
- List the most common methods of homogenization in emulsions and describe the fundamental aspects of each one.
- Differentiate the types of polymerization in heterophase systems and describe the main characteristics of each.
- Cite examples of polymerization in systems with spontaneous emulsification.
- Explain the technique of preparing polymer colloids by solvent evaporation.

Unit 8

- Describe and evaluate the limitations of the usual techniques of characterization of particle size in colloidal systems.
- Describe and evaluate the limitations of the usual characterization techniques of morphological and structural characterization of colloidal systems
- Predict the stability of a colloidal system according to zeta potential values and evaluate the limitations of the prediction.
- Demonstrate ability to select the appropriate method to the type of chemical problem and know the expected errors.

Unit 9

- Demonstrate the ability to correlate the knowledge acquired in chemistry and through bibliographic information to the physicochemical processes that occur in the laboratory and at industrial level.
- Demonstrate capacity, based on the application of physicochemical knowledge, to innovate in productive processes.
- Demonstrate the ability to solve real problems that require a multidisciplinary and theoretical practical study, combining several physicochemical techniques.
- Demonstrate the ability to explain through physicochemical theoretical phenomena real situations that take place during the synthesis and characterization of materials, both in the laboratory and in

industrial processes.

DESCRIPTION OF CONTENTS

1. Polymers and polymer systems

1.1. Historical development
1.2. Basic concepts and definitions

2. Polymerization reactions

2.1. Introduction
2.2. Chain polymerization
2.2.1. Radical polymerization
2.2.2. Anionic polymerization
2.2.3. Cationic polymerization
2.3. Step polymerization
2.4. Polymerization techniques

3. Properties of polymers in solid state

3.1. General characteristics
3.2. Vitreous transition
3.3. Crystallization
3.4. Fusion
3.5. Mechanical behavior
3.6. Dynamomechanical behavior

4. Polymer characterization

4.1. Characterization of polymers in solution. Determination of molecular weights and dimensions
4.2. Characterization of polymers in solid state
4.2.1. Thermal analysis
4.2.1.1. Differential scanning calorimetry
4.2.1.2. Temperature-modulated differential scanning calorimetry
4.2.1.3. Thermogravimetric analysis
4.2.2. Characterization of the dynamomechanical behavior
4.3. Characterization of the mechanical behavior
4.3. Rheology of molten polymers and solutions
4.4. Other characterization techniques: spectroscopic techniques (FTIR, UV-Vis, Raman, NMR), X-ray techniques, microscopy techniques (SEM, TEM, AFM), conductivity measurements

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. Methods of preparation of colloidal systems
5.5 Inorganic colloids
5.6. Nucleation and growth

6. Interfaces in colloid systems

6.1. Thermodynamics of the interface in colloidal systems
6.2. Chrage in colloidal systems
6.2.1. Model of the double layer
6.2.2. Interaction between particles
6.3. Stabilization of colloids
6.3.1. Electrostatic stabilization
6.3.2. Steric stabilization
6.3.3. DLVO theory
6.4. Surfactants
6.4.1. Definition and classification
6.4.2. Adsorption of surfactants and thermodynamic aspects
6.4.3. Formation of micelles and other aggregation structures
6.4.4. Practical criteria for choosing surfactants: hydrophiliclipophilic balance (HLB)

7. Polymer colloids and heterophase polymerization

7.1. Emulsion, miniemulsion, and microemulsion
7.1.1. Emulsification methods in emulsions
7.2. Polymerizations in heterophase systems
7.3. Polymerizations in systems with spontaneous emulsification
7.4. Preparation of polymer colloids by 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 material 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, seminars are planned for deepening of aspects of certain topics, highlighted by their interest or actuality. The seminars may be taught or moderated by the teacher or by other professionals relevant to the topic covered and involve the participation of the students by completion of critical exercises, debates, or presentations.

EVALUATION

The evaluation of the student’s learning will take into account all aspects exposed in the methodology section of this teaching guide. The evaluation will be carried out via two modalities: a continuous-assessment modality and a only-exam modality. In principle, all students remain assigned to the continuous-assestment modality, but they may request the change to the only-exam modality in written form to the teacher(s) of the subject within the first 30 days from the beginning of the course.

Continuous-assessment modality. This modality takes into account the student's **continuous assessment**, which will weigh **40%**in the final grade. Delivery of activities, active participation in tutorials and seminars, and continuous assessment tests will be taken into account in the continuous evaluation. The participation of the student in the sessions of group tutorials and seminars is mandatory. The remaining **60%**of the grade will be the result of a final exam with theoretical and/or practical exercicises. To pass the subject the student must obtain a total grade equal to or greater than 5 (over 10). It will also be necessary to reach a minimum score of 40% of the total of the section in each of the sections considered in the evaluation.

Only-exam modality. In the only-exam modality, the final grade corresponds to the exam. The exam for students choosing this evaluation type will have two parts: (i) a first part with a weight of 60% of the grade, which will be identical to the exam of students who follow the continuous-assessment modality, and (ii) a second part with exercises related to a proposed case study, weighing 40%. The second part of the exam will only be offered to those students who have requested in writen form within the deadline (during the first 30 days from the beginning of the course) the change to the only-exam modality.To pass the subject the student must obtain a total grade equal to or greater than 5 (over 10).

The evaluation system will be the same in the two calls. If applicable, the continuous assessment grade is maintained for the second call.

REFERENCES

Basic

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Additional

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  3. Hans-Dieter Dörfler. Grenzflächen und kolloid-disperse. Systeme. Physik und Chemie. Springer: Berlin, 2002.
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