

## COURSE DESCRIPTION

### COURSE DETAILS

Title (of the course): **MACROMOLÉCULAS Y COLOIDES**

Code: 100474

Degree/Master: **GRADO DE QUÍMICA**

Year: 4

Name of the module to which it belongs: APLICADO

Field: QUÍMICA (OPTATIVA 2)

Character: OPTATIVA

Duration: FIRST TERM

ECTS Credits: 6.0

Classroom hours: 60

Face-to-face classroom percentage: 40.0%

Study hours: 90

Online platform: Moodle

### LECTURER INFORMATION

Name: GINER CASARES, JUAN JOSÉ (Coordinator)

Department: QUÍMICA FÍSICA Y TERMODINÁMICA APLICADA

Area: QUÍMICA FÍSICA

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### PREREQUISITES AND RECOMMENDATIONS

#### Prerequisites established in the study plan

The student must have passed 60 basic training credits and at least another 30 compulsory credits.

#### Recommendations

B1 English level is recommended

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### INTENDED LEARNING OUTCOMES

CB3	Oral and written communication in native language.
CB10	Capacity for independent learning for continued profesional development.
CE7	Thermondynamic principles and their applications in chemistry.
CE8	The kinetics of chemical change, including catalysis. Mechanical interpretation of chemical reactions.
CE14	The relationship between macroscopic properties and the properties of atoms and individual molecules: including macromolecules (natural and synthetic), polymers, colloids and other materials.
CE15	The structure and reactivity of the primary classes of biomolecules and the chemistry of the primary biological processes.
CE20	The study, properties and applications of the materials.
CE21	Capacity to demonstrate knowledge and comprehension of essential facts, concepts, principles and theories related to chemistry.
CE22	Capacity to apply said knowledge to the resolution of qualitative and quantitative problems according to previously developed models.
CE25	Competency to present, in both written and oral forms, scientific material and arguments to a specialised audience.
CE29	Ability to observe, follow and measure properties, events and chemical changes and to systematically and reliably record the corresponding documentation.
CE30	Ability to operate standard chemical instrumentation, such as that which is used for structural investigations and separations.
CE31	Interpretation of data arising from observations and measurements in the laboratory in terms of its meaning and the theories which underpin it.

### OBJECTIVES

- Knowledge on the fundamentals of the Physical Chemistry of Macromolecules and Colloids. This includes aspects of polymerization and applications, thermodynamics and structure of macromolecules, the study of macromolecular systems of biological interest, and knowledge of colloidal systems and types.
- Work laboratory practices and/or virtual laboratory activities that complement the knowledge of the chemistry of these systems.
- Other objectives related to the competences of the subject such as: competence to present, both in written and oral form, material and scientific argumentation to a specialized and non-specialized public.

### CONTENT

#### 1. Theory contents

1. INTRODUCTION TO MACROMOLECULES AND COLLOIDS. Introduction. Types of macromolecules. Polydispersity of macromolecules. Crystalline structure. Melting temperature and glass transition. Introduction to colloids.
2. STEP-GROWTH POLYMERIZATION. Introduction. Equivalent reactivity of functional groups. Kinetics of linear polycondensation. Distribution of molecular weights. Polycondensation.
3. RADICAL POLYMERIZATION. Introduction. Full kinetic scheme of polymerization by free radicals. Simplification of the kinetic scheme. Chain length. Transfer reactions.
4. IONIC POLYMERIZATION AND COPOLYMERS. Introduction. Cationic polymerization. Kinetics and polymerization degree. Anionic polymerization. Kinetics. Tacticity. Coordination polymerization. Composition of copolymers. Reactivity indexes. Ionic copolymerization.
5. CONFORMATIONAL STATISTICS. Introduction. Length of coil. Chain with free inner rotation. Chain with



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restricted inner rotation. Real chains. Specific interactions in polymers.

6. THERMODYNAMICS OF MACROMOLECULAR SOLUTIONS. Introduction. Configuration entropy of mixture. Theory of Flory-Huggins. Solubility of macromolecules. Phase equilibrium. Excluded volume. Theory of Flory-Krigbaum. Colligative properties. Coil expansion.

7. COLLOIDAL SYSTEMS. Physicochemistry of colloids. Colloidal dispersions. Micelles. Hydrophobic and hydrophilic colloids: HLB model. Critic micellar concentration. Electric properties: electrokinetic potential. Isoelectric point in proteins.

8. EXPERIMENTAL TECHNIQUES FOR CHARACTERIZATION OF MACROMOLECULES AND COLLOIDS. Introduction. Light scattering. Viscosity of colloidal dispersions. Kirkwood-Riseman and Flory-Fox theories. Diffusion and sedimentation. Gel permeation chromatography. MALDI spectroscopy.

9. TYPES OF COLLOIDS. Stability of lyophobic colloids. Fast and slow coagulation theories. Coalescence. DLVO theory. Gels, suspensions, emulsions, foams. Foams structure.

10. CONFORMATIONAL TRANSITIONS IN PROTEINS AND NUCLEIC ACIDS. Introduction. Conformational transitions in proteins. Cooperativity. Thermodynamic analysis. Conformational transitions in nucleic acids. DNA melting. Renaturalization.

### 2. Practical contents

- Synthesis and characterization of macromolecules. Distribution of molecular weight values.
- Crossing of polymers. Physical properties. Reversibility.
- Characterization of micelles.
- Foams. Bubbles. Plateau lines.

## SUSTAINABLE DEVELOPMENT GOALS RELATED TO THE CONTENT

Good health and well-being  
Affordable and clean energy  
Responsible consumption and production

## METHODOLOGY

### General clarifications on the methodology (optional)

- Assessment activities: Exercises and case studies solved by the student in the classroom under teacher's supervision. A workbook including all the exercises solved by the student will be examined.
- Assessment activities: Discussion and oral exposition of a scientific paper. The topic will be selected among those proposed.
- Lab practice. Reports: 50% of this instrument mark.
- Assessment activities: A workbook including responses of the students to a questionnaire on the theoretical topics will be examined.
- Final exam. A writing proof in which 5 questions selected from the questionnaire will be answered by the students.

### Methodological adaptations for part-time students and students with disabilities and special educational needs

Part-time students will be interviewed in each individual case. The modifications in the methodology will be designed to better match each situation, taking into account the directives given by the coordination of the degree. The methodological strategies and evaluation system contemplated in this Teaching Guide will be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are



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required.

### Face-to-face activities

Activity	Large group	Medium group	Small group	Total
<i>Assessment activities</i>	3	-	-	3
<i>Group work (cooperative )</i>	-	15	-	15
<i>Lab practice</i>	-	-	12	12
<i>Lectures</i>	30	-	-	30
<b>Total hours:</b>	<b>33</b>	<b>15</b>	<b>12</b>	<b>60</b>

### Off-site activities

Activity	Total
<i>Exercises</i>	10
<i>Group work</i>	20
<i>Reference search</i>	10
<i>Self-study</i>	50
<b>Total hours</b>	<b>90</b>

## WORK MATERIALS FOR STUDENTS

Dossier  
Exercises and activities  
Lessons summary

## EVALUATION

Intended learning	Case study/clinical case discussion/scientific work discussion	Document Analysis	Exams	Laboratory Practice	Problem solving
<i>CB10</i>		X			
<i>CB3</i>	X		X	X	X
<i>CE14</i>	X				X
<i>CE15</i>	X				X
<i>CE20</i>	X		X	X	
<i>CE21</i>				X	

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Intended learning	Case study/clinical case discussion/scientific work discussion	Document Analysis	Exams	Laboratory Practice	Problem solving
CE22			X		X
CE25					X
CE29	X	X	X	X	X
CE30		X	X	X	
CE31		X		X	
CE7		X			X
CE8	X				X
<b>Total (100%)</b>	<b>20%</b>	<b>10%</b>	<b>30%</b>	<b>15%</b>	<b>25%</b>
<b>Minimum grade</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>

(\*)Minimum mark (out of 10) needed for the assessment tool to be weighted in the course final mark. In any case, final mark must be 5,0 or higher to pass the course.

### Method of assessment of attendance:

To pass the course, the attendance to seminars and lab practices is compulsory.

### General clarifications on instruments for evaluation:

A minimum mark of 3 points in each compulsory activity is needed. The mark will be given for each activity, with no further evaluation in case of failure. The evaluation activities will be performed during the GG sessions. Document analysis and exam are not compulsory.

### Clarifications on the methodology for part-time students and students with disabilities and special educational needs:

Part-time students will be interviewed in each individual case. The modifications in the methodology will be designed to better match each situation, taking into account the directives given by the coordination of the degree. The methodological strategies and evaluation system contemplated in this Teaching Guide will be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required.

### Clarifications on the evaluation of the extraordinary call and extra-ordinary call for completion studies:

No specific guidelines are considered.

### Qualifying criteria for obtaining honors:

"Matricula de Honor" will be given for the highest mark if equal or greater than 9.0.

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### BIBLIOGRAPHY

#### 1. Basic Bibliography

- J. Areizaga, M.M. Cortázar, J.M. Elorza, J.J. Iruin. (2002). Polímeros. Ed. Síntesis.
- R.B. Seymour, C.E. Carraher. (1995). Introducción ala Química de los Polímeros. Ed. Reverté
- I. Katime. (1994). Química Física Macromolecular. UNED.
- S.C. Walwork, D.J.W. Grant. (1987) Química Física para estudiantes de Farmacia y Biología, Cap. 12: Coloides. Ed. Alhambra.
- P.C. Hiemenz, R. Rajagopalan. (1997) Principles of Colloid and Surface Chemistry. Marcel Dekker.

#### 2. Further reading

None

### COORDINATION CRITERIA

Tasks deadlines

Tasks performance

### SCHEDULE

Period	Assessment activities	Group work (cooperative )	Lab practice	Lectures
1# Week	0,0	0,0	0,0	2,0
2# Week	0,0	0,0	0,0	3,0
3# Week	0,0	0,0	0,0	2,0
4# Week	0,0	0,0	0,0	3,0
5# Week	0,0	2,0	0,0	2,0
6# Week	0,0	1,0	0,0	2,0
7# Week	0,0	2,0	3,0	2,0
8# Week	0,0	1,0	3,0	2,0
9# Week	0,0	2,0	3,0	2,0
10# Week	0,0	1,0	3,0	2,0
11# Week	0,0	2,0	0,0	2,0
12# Week	0,0	1,0	0,0	2,0
13# Week	0,0	2,0	0,0	2,0
14# Week	3,0	1,0	0,0	2,0
<b>Total hours:</b>	<b>3,0</b>	<b>15,0</b>	<b>12,0</b>	<b>30,0</b>

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