Universitat Autònoma de Barcelona

2018/2019

Polymeric Materials and Biomaterials

Code: 102510
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	OT	4	1

Contact

Name: Carles Jaime Cardiel
Email: Carlos.Jaime@uab.cat

Use of languages

Principal working language: english (eng)
Some groups entirely in English: Yes
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Teachers

Jordi Marquet Cortés

Prerequisites

It is advisable to have passed the subjects "Chemical Bonding and Structure of Matter" and "Structure and Reactivity of Organic Compounds".

The subject is taught entirely in English, thus it is almost essential to have a good knowledge of that language.

Objectives and Contextualisation

In "Polymeric materials and biomaterials" we will study the properties, both physical and chemical, and the preparation methods of the most important polymers, as well as their main uses. Also, basic ideas about different analytical methods will be given.

The objectives of the course are:

1 Identify the synthetic polymers.

2 Know the main methods of preparation and characterization of the polymeric materials and biomaterials.

3 Determine and represent the structure of organic polymers and biomaterials.

4 Find out the properties of polymeric materials depending on their structure.

5 Knowing the main applications of polymeric materials and biomaterials based on its structure.

Skills

- "Interpret data obtained by means of experimental measures, including the use of IT tools; identify their meaning and relate the data with appropriate chemistry, physics or biology theories."
- Apply knowledge of chemistry to problem solving of a quantitative or qualitative nature in familiar and professional fields.

- Be ethically committed.
- Communicate clearly in English.
- Communicate orally and in writing in ones own language.
- Develop synthesis and analyses studies in chemistry from previously established procedures.
- Evaluate the health risks and environmental and socioeconomic impact associated to chemical substances and the chemistry industry.
- Handle chemical products safely.
- Handle standard instruments and material in analytic and synthetic chemical laboratories.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Manage, analyse and synthesise information.
- Obtain information, including by digital means.
- Propose creative ideas and solutions.
- Reason in a critical manner
- Resolve problems and make decisions.
- Show an understanding of the basic concepts, principles, theories and facts of the different areas of chemistry.
- Show initiative and an enterprising spirit.
- Show motivation for quality.
- Show sensitivity for environmental issues.
- Use IT to treat and present information.
- Use the English language properly in the field of chemistry.
- Work in a team and show concern for interpersonal relations at work.

Learning outcomes

1. Analyse the influence of catalyst-substrate interactions in the reaction speed of heterogeneous catalytic processes using suitable kinetic models.
2. Analyse the influence of the steric and electronic effects of ligands on the properties of a complex metal that acts as a catalyst.
3. Be ethically committed.
4. Communicate clearly in English.
5. Communicate orally and in writing in ones own language.
6. Describe some of the most important catalytic processes in homogenous or heterogeneous phase and in biocatalysis, and analyse the applications and limitations.
7. Distinguish the models of chemical bonding in solids and relate them with the physical and chemical properties of the same.
8. Identify the environmental impact of the use of polymeric materials and recycling demands.
9. Interpret and rationalise the mechanisms established for the previous processes and relate them with the nature of the catalysts used in their activity and selectivity.
10. Justify the results obtained in the laboratory from processes of synthesising and characterising solid, soft and nano materials on the basis of knowledge of their structure and properties.
11. Learn autonomously.
12. Manage the organisation and planning of tasks.
13. Manage, analyse and synthesise information.
14. Obtain information, including by digital means.
15. Predict the product formed in polymerisation reactions.
16. Prepare and characterise nanomaterials.
17. Prepare and characterise polymeric materials and other types of soft matter.
18. Properly handle the chemical products required to prepare solid, soft and nano materials.
19. Properly use the required material and instruments to prepare and characterise solid, soft and nano materials.
20. Propose creative ideas and solutions.
21. Read, analyse and extract information from texts in the English language on the different areas of the field of material chemistry.
22. Reason in a critical manner
23. Recognise the English names of terms in the field of material science.

24. Recognise the English names used in the field of preparing and characterising solid and soft materials, as well as in nanochemistry and nanomaterials.
25. Resolve problems and make decisions.
26. Show initiative and an enterprising spirit.
27. Show motivation for quality.
28. Show sensitivity for environmental issues.
29. Synthesise and characterise solid materials with electrical, magnetic or optical properties, and measure said properties.
30. Use IT to treat and present information.
31. Work in a team and show concern for interpersonal relations at work.

Content

1. Composition and structure of polymers: classification and nomenclature, structure (introduction, composition and structure of polymer chains and types of isomers, copolymers, dendrimers, intermolecular forces) characterization techniques (IR, Raman, NMR, XRD), solubility and viscosity, molecular weight.

2. Rheology and macroscopic properties of polymers: macroscopic properties, rheology and mechanical properties.
3. Synthesis and applications of polymers: classification of polymerization reactions (polymerization stages, polymerization chain polymerization, polymer curing and other reactions), inorganic-organic polymers and carbon polymers.
4. Formulation, processing and environmental aspects: composites, fillers and additives, polymerization and environmental aspects, polymer technology.
5. Biomaterials and natural polymers: introduction, biomedical materials, main tissues and polymers as construction biomaterials; natural polymers from plants and animals.
6. Soft Matter: definition, colloids (sols, gels, foams, emulsions), surfactants and liquid crystals.

Laboratory practices
Synthesis and characterization of polymers.
Analysis and determination of polymer properties.

WARNING ON SECURITY IN THE LABORATORY
Any student seen involved in an incident that may have serious security consequences may be expelled from the laboratory and fail the course.

Methodology

Students have to develop different types of activities throughout this course:

a) **Addressed activities**: In the class room, lectures on the contents of the subject will be given. In addition, questions and exercises will be resolved once the subject has advanced enough. Moreover, students also carry out lab exercises, consisting on the synthesis and characterization of macromolecular and polymeric materials. These practices are part of the compulsory practices of the Chemistry of Materials itinerary (mention). Therefore, if a student completes the mention later, he/she will carry out the itinerary practices in that academic year.
b) **Supervised Activities**: There will be tutorials to monitor the progress of students with different aspects of the subject.
c) **Autonomous activities**: Students will study the contents of the course and solving exercises by theirselves. They will also read related texts and practice recipes and they will write reports on their laboratory results.

Activities

Title	Hours	ECTS	Learning outcomes

Type: Directed			
Lectures	34	1.36	1, 4, 5, 26, 27, 2, 7, 6, 21, 3, 28, 15, 9, 20, 23, 24
Practical exercises	18	0.72	1, 4, 27, 2, 17, 12, 13, 6, 8, 10, 18, 19, 28, 22, 23, 24, 29, 31
Type: Supervised			
Tutoring	4	0.16	11, 4, 26, 27, 21, 28, 20, 22, 23, 24
Type: Autonomous			
Reading of texts and recipes, and writing reports	23	0.92	4, 12, 13, 10, 21, 14, 22, 23, 24, 31, 30
Studying and exercises solving	64	2.56	1, 11, 5, 26, 27, 2, 7, 13, 6, 21, 28, 14, 15, 9, 20, 23, 24, 25, 30

Evaluation

There will be a skills assessment that will include a practical module and written tests.

The evaluation system is organized in modules, each of which will be assigned a specific weight in the final grade:

Practical module: The lab will be evaluated based on the ability and commitment demonstrated during the stay in the laboratory (30%), in the correctness of the laboratory notebook (10%), and in the contents of a brief report (60%) to be submitted electronically in English on the date indicated by the lab supervisors. The mark obtained in this practical module is equivalent to 20% of the final grade for the course.
If, for organizational reasons, some students do not carry out these practices, they will be asked to make only one report related to the subject, written in English and that should be presented orally; this report will be also equivalent to 20% of the finalgrade.
This lab is mandatory for students following the Materials Chemistry itinerary (mention). If a student completes the mention later, and he/she had not made these practices, the/she will need to carry out them at that course.

Written test module: it will consist on two partial tests with a weight of 40% each. The subject is considered passed when the average of the modules grades is equal to or greater than 5 points out of 10, provided they have obtained a minimum of 4 out of 10 in each of the two written tests and have attended the lab sessions (or replacement work has been done in the cases indicated).

Recovery exam: *To undertaken the recovery exam, the student has to be previously evaluated in continous evaluation activities covering 2/3 of the final qualification, i.e., he/she has to be taken the two written exams and has to be attending the loboratory sessions (just one written exam and the laboratory do not achieve the 2/3 of the final qualification).*

Students who do not pass the minimum scoring in the first and/or second written test and those with an average of less than 5 points can make a recovery exam after the second written test. The completion of this test involves giving up the qualification was obtained in the test or tests originals, but will keep the note and the weight of the practical module (20%).

From the second enrollment for the course, students who have achieved the skills of the practical module in previous years (get a rating equal to or greater than 5 out of 10) they do not need to do that again.

When the number of assessment activities carried out is less than 50% of the planned for the course (the practical module and two written tests), the grade will be "**Not attended**".

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Laboratory module	20%	1	0.04	1, 4, 26, 27, 2, 17, 16, 13, 6, 8, 10, 18, 19, 28, 20, 23, 24, 29, 31
Writing exams module	80%	6	0.24	11, 4, 5, 26, 27, 2, 7, 12, 13, 6, 8, 21, 3, 28, 14, 15, 9, 20, 22, 23, 24, 25, 30

Bibliography

Polymer Chemistry, Carraher, C. E., Jr. Eight edition, CRC **2011**

Introduction to Soft Matter: Synthetic and Biological Self-Assembling Materials, Hamley, I. W., Wiley **2007**