Universitat Autònoma de Barcelona

2017/2018

Chemistry for Specific Materials of Interest to Industry and Research

Code: 42428
ECTS Credits: 6

Degree	Type	Year	Semester
4313385 Industrial Chemistry and Introduction to Chemical Research	OB	0	1

Contact

Name: Xavier Sala Roman

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Use of languages

Principal working language: english (eng)

Teachers

Roser Pleixats Rovira

Jordi Hernando Campos

Maria Jose de Montserrat Esplandiu Egido

Montserrat López Mesas

Maria del Mar Puyol Bosch

External teachers

Inhar Imaz

Mónica Lira

Prerequisites

Teaching, including teaching materials handed over to students, will be in English, hence good communication skills in English are necessary.

The course assumes that the student has a solid chemical background (that typically shown by graduate students in Chemistry).

Objectives and Contextualisation

This focus of this subject is the study of the chemical properties of specific materials that are currently of interest for either research or Industry. The couse will cover selected examples of molecular, supramolecular, nanostructured and bulk materials, their corresponding applications in different fields and relevant techniques for their characterization.

Skills

- Apply materials and biomolecules to innovative fields of chemical industry and research.

- Correctly apply new information capture and organisation technologies to solve problems in professional activity.
- Define specialised concepts, principles, theories and facts in the different areas of Chemistry.
- Evaluate the human, economic, legal and ethical dimension of professional practice, as well as the environmental implications of one's work.
- Foster innovation and entrepreneurship in chemical industry and research.
- Identify information in the scientific literature using the appropriate channels and integrating said information to approach and contextualise a research issue.
- Innovate in chemical synthesis and analysis methods related with different areas of Chemistry.
- Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context
- Student should possess an ability to learn that enables them to continue studying in a manner which is largely self-supervised or independent
- Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
- Use scientific terminology in the English language to defend experimental results in the context of the chemistry profession.

Learning outcomes

1. Analyse biomaterials and apply them.
2. Correctly apply new information capture and organisation technologies to solve problems in professional activity.
3. Define the properties of specific materials.
4. Describe the properties of liquid interphases and their applications.
5. Encourage innovation in the field of materials and their applications.
6. Evaluate the human, economic, legal and ethical dimension of professional practice, as well as the environmental implications of one's work.
7. Identify information in the scientific literature using the appropriate channels and integrating said information to approach and contextualise a research issue.
8. Innovate in the synthesis and analysis methods of specific materials.
9. Interpret the properties of gels and identify their applications.
10. Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context
11. Propose advanced applications for supra-molecular materials and nanomaterials.
12. Student should possess an ability to learn that enables them to continue studying in a manner which is largely self-supervised or independent
13. Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
14. Use scientific terminology in the English language to defend experimental results in the context of the chemistry profession.

Content

- Supramolecular devices and materials: molecular recognition and self-assembly; supramolecular photophysics and photochemistry; molecular devices and machines; supramolecular materials (monolayers, films, vesicles, gels). (8 h) **Jordi Hernando**.

- Metal nanoparticles, quantum dots, nanotubes, graphenes, fullerenes, liquid crystals. **Mª José Esplandiu** (7 h).

- Metal-Organic Frameworks: from molecules and metal ions to crystals and superstructures; The course will be dedicated to the structural description of the different networks (secondary building approach), the different synthetic strategies and the properties related to the porosity of these materials (gas storage, gas separation, catalysis among others). We will focus on some theoretical aspects of the adsorption phenomena in porous materials. **Inhar Imaz** (4 h).

- Synchrotron; Interaction Radiation-Matter; Synchrotron Radiation; Into a Synchrotron; Synchrotron Techniques: spectroscopy, scattering and imaging. **Montserrat López-Mesas** (5 h)

- Membranes: Introduction to Membranes; Advances in Membranes Membranes. **Montserrat López-Mesas** (2 h)

- Materials and microfabrication technologies for miniaturized systems: Micrototal analysis systems (μTAS)/Lab on a Chip technology; Silicon and glass; Microelectronics Micromachining; Polymers; Low Temperature Cofired Ceramics (LTCC); Paper. **Maria del Mar Puyol** (7 h).

- Applications of metal nanoparticles in catalysis. **Roser Pleixats** (4 h)

- Materials for Sustainable Energy: **(a) Xavier Sala** (4h), sustainable energy; solar fuels; artificial photosynthesis; water splitting; water oxidation; water reduction; CO_2 reduction. (**b) Monica Lira** (2h),Nanostructured Materials for Photovoltaic Energy: Emerging photovoltaic technologies vs. comercial Silicon-base solar cells; Perovskite solar cells.

Methodology

Theory Lectures

The lecturer will explain the syllabus to the classroom using blackboard and multimedia material, which will be made available to the students in the "Campus Virtual" in Moodle environment. These expositive sessions will conform most of the theory lecturing of the syllabus.

Personal Study

Personal work by the student is a very important, almost indispensible aspect of the students' attitude towards passing the topic. Besides the most obvious areas (like readying and studying notes and books, preparing exercises, etc.) specific, well delimited areas of the theory syllabus will be left to the students to work out by themselves. In these cases, personal consultation hours will be made available to help coalescing the knowledge gained by the students.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Theory Lectures	43	1.72	1, 3, 4, 5, 7, 8, 9, 11
Type: Autonomous			
Personal Work and Study	87	3.48	2, 7, 14

Evaluation

- Every professor decides the number and typology of evaluation activities: oral presentations, written exams, delivery of discussed articles, small tests...
- The final mark of the module will be the sum of the mark of every professor multiplied by the percentage of his classes in the total teaching of the module.
- The marks of the written exams must be above 4 in order to average with other marks of the professor and/or the module.
- There will be a period in January to repeat written exams with marks under 5. In the case of exams under 4 will be mandatory to the student, in case of exams between 4 and 5 would be optional to the student.

- In the case that a student will not arrive to a 4 mark after the retaking exam in January, the coordinator of the module could decide to average this mark with the rest of the module. However, this option can only be considered for two written exams in the whole master.
- The marks of other evaluations activities (i. e. oral presentations) will average with the rest of the marks of the professor/module independently of the value. There will not be option of repeating these other evaluation activities.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Oral Presentations	20%	4	0.16	2, 6, 13, 14
Turned-In Exercises	30%	6	0.24	2, 5, 6, 7, 10, 11, 12, 13, 14
Written Exams	50%	10	0.4	1, 3, 4, 8, 9, 11, 14

Bibliography

Every lecturer will provide the students with a list of appropriate references (scientific papers, books, links, etc...) for each part of the syllabus.