Universitat Autònoma de Barcelona

2019/2020

Nanomaterials for Energy and the Environment

Code: 103296
ECTS Credits: 6

Degree	Type	Year	Semester
2501922 Nanoscience and Nanotechnology	OT	4	0

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Prerequisites

Students taking this subject must have successfully completed Electronic Devices, Solid State, Physics and Chemistry of Surfaces and Synthesis and Structure of Crystalline and Amorphous Materials.
A good level of English is recommended because the main bibliographical sources are written in this language.

This subject requires a native or near-native level of Spanish.

Objectives and Contextualisation

The subject is divided into two modules.
The first presents the main materials used in devices used for energy generation and/or storage, with special emphasis on its key properties as well as alternative processing methods.
The second module studies the relationship of nanomaterials with the environment under two complementary approaches: the use of nanomaterials for pollution remediation, and, the threats that may pose the dispersion of certain nanomaterials in the environment.

Competences

- Adapt to new situations.
- Apply the concepts, principles, theories and fundamental facts of nanoscience and nanotechnology to solve problems of a quantitative or qualitative nature in the field of nanoscience and nanotechnology.
- Be ethically committed.
- Communicate clearly in English.
- Communicate orally and in writing in ones own language.
- Demonstrate knowledge of the concepts, principles, theories and fundamental facts related with nanoscience and nanotechnology.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
- Operate with a certain degree of autonomy.
- Propose creative ideas and solutions.
- Reason in a critical manner

- Recognise and analyse physical, chemical and biological problems in the field of nanoscience and nanotechnology and propose answers or suitable studies for their resolution, including when necessary the use of bibliographic sources.
- Recognise the terms used in the fields of physics, chemistry, biology, nanoscience and nanotechnology in the English language and use English effectively in writing and orally in all areas of work.
- Resolve problems and make decisions.
- Show sensitivity for environmental issues.
- Work correctly with the formulas, chemical equations and magnitudes used in chemistry.

Learning Outcomes

1. Adapt to new situations.
2. Apply the acquired theoretical contents to the explanation of experimental phenomena.
3. Be ethically committed.
4. Communicate clearly in English.
5. Communicate orally and in writing in ones own language.
6. Critically evaluate experimental results and deduce their meaning.
7. Describe material and nanomaterials with energy saving properties.
8. Describe processes that use nanomaterials to eliminate pollutants from the environment.
9. Draft and present reports on the subject in English.
10. Identify the impact of nanomaterials on the environment.
11. Interpret texts in English on aspects related with the physics and chemistry of nanoscience and nanotechnology.
12. Learn autonomously.
13. Manage the organisation and planning of tasks.
14. Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
15. Operate with a certain degree of autonomy.
16. Perform bibliographic searches for scientific documents.
17. Predict the applications of a material or of a nanomaterial in solar cells, in fuel batteries and electrical energy storage and transport processes.
18. Predict the possible applications and effects on the environment of an advanced material or nanomaterial
19. Propose creative ideas and solutions.
20. Propose materials and nanomaterials for processes and devices related with energy
21. Reason in a critical manner
22. Recognise the application of nanomaterials to energy capture in photovoltaic cells, in the transport of electrical energy and in the generation and storage of hydrogen.
23. Recognise the potentiality of thermoelectric nanomaterials to improve energy efficiency.
24. Recognise the risks for the health and environment associated with the manipulation of chemicals and material compounds in general.
25. Recognise the sources and uses of energy in modern-day society.
26. Recognise the terms of micro and nanosystems and of nanophotonics, nanoelectronics and spintronics.
27. Resolve problems and make decisions.
28. Resolve problems with the help of the provided complementary bibliography.
29. Show sensitivity for environmental issues.
30. Work correctly with the formulas, chemical equations and magnitudes used in chemistry.

Content

Module 0. Review of the main types of nanostructured materials andmain methods of synthesis.

Module 1. Nanomaterials for the production, storage and efficient use of Energy.

Solar cells
Fuel cells
Thermoelectrics

Batteries
Hydrogen production and storage
CO_2 reduction.
Nanomaterials for efficient energy use.

Module 2. Nanomaterials and Environment.

Adsorbents
Photocatalysts
Nanofiltration
Environmental impact of nanomaterials

Methodology

The subject consists of:
34 hours of Master Classes + 6 hours of in-class exercicess + 12 hours of experimental laboratory practices.

Master Classes
They will be carried out by combining the use of computer equipment and the slate.

In-class exercicess
It will consist of seminars that will delve into some specific aspects of the analysis of documents from the scientific literature. Attendance is mandatory.

Experimental Laboratory practices
They will consist of the preparation and execution of various experimental laboratory practices related to the content of the subject. Attendance is mandatory

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Experimental Laboratory Practices	12	0.48	2, 12, 16, 29, 19, 21, 24, 26, 9, 27
In-class exercises	6	0.24	2, 6, 15, 19, 20, 21, 28, 27
Master Class	34	1.36	7, 8, 10, 17, 18, 20, 22, 23, 25
Type: Supervised			
Evaluation activities	8	0.32	1, 5, 13, 15, 19, 21
Tutorials	5	0.2	5, 13, 21, 27
Type: Autonomous			
Ploblem solving and bibliografic search	10	0.4	2, 12, 13, 19, 21, 28, 27, 30
Prepare individual or group presentations/reports	24	0.96	12, 5, 13, 3, 29, 15, 19, 21, 9, 27, 30
Study	48	1.92	2, 12, 6, 7, 8, 13, 10, 11, 14, 15, 17, 18, 20, 24, 26, 22, 23, 25

Assessment

The evaluation will be done on an ongoing basis. Two partials shall be proposed, the note of which will determine 50% of the final qualification.

Exercises, written works and oral, individual and/or group presentations with delivery date will be proposed, the note of which will determine another 40% of the final qualification.

The remaining 10% of the qualification shall be determined on the basis of the evaluation of laboratory practices, by means of tests and reporting.

To pass the course, you must obtain an overall grade of 5.0 or more and at least 5.0 points out of 10 give the average of the two partial exams. For students who do not pass this grade, there will be a recovery exam. It is necessary to have done 2/3 parts of the activities of the continuous evaluation and the partial examinations in order to be entitled to the recovery test.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exercises, writings and oral presentations	40%	0	0	1, 2, 12, 6, 4, 5, 7, 8, 16, 13, 10, 11, 3, 29, 14, 15, 17, 18, 19, 20, 21, 24, 26, 22, 23, 25, 9, 28, 27, 30
Experimental Laboratory Practices	10%	0	0	1, 2, 6, 13, 29, 19, 9, 28, 27
Written exam	50%	3	0.12	2, 12, 6, 5, 7, 8, 10, 15, 17, 18, 19, 20, 26, 22, 23, 25, 28

Bibliography

Environmental Nanotechnology: Applications and Impacts of Nanomaterials

Ed. Mark R. Wiesner, P.E. Jean-Yves Bottero, McGraw-Hill 2007.

Energy Storage. Robert A. Huggins, Springer 2010.

Solar Hydrogen Generation: Towarda Renewable Energy Future.

Ed. K. Rajeshwar, R. McConnell and S. Licht, Springer 2008.

Extensive use review articles will also be made (accessible form UAB).