UAB
Universitat Autònoma de Barcelona

Nanomaterials for Energy and the Environment

Code: 103296
ECTS Credits: 6

2025/2026

Degree	Type	Year
Nanoscience and Nanotechnology	OT	4

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Students taking this subject must have successfully completed Chemistry of the Elements, 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 Catalan.

Objectives and Contextualisation

The subject is divided into eight topics that aim to bring the student closer to the main nanomaterials currently used in devices for (1) the generation and/or storage of energy, and (2) the preservation of the environment. The environmental impact of these nanomaterials will also be the subject of study.

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 one's 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 one's 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

Topic 1. Energy and Environmental context - Current challenges

Topic 2. Solar cells

Topic 3. Batteries

Topic 4 Production and storage of hydrogen

Topic 5. Capture and reduction of CO_2

Topic 6. Fuel cells

Topic 7. Photocatalysis

Topic 8. Adsorbents in nanofiltration

Topic 9. Environmental and health impact of nanomaterials

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Experimental Laboratory Practices	8	0.32	2, 12, 16, 29, 19, 21, 24, 26, 9, 27
In-class exercises	8	0.32	2, 12, 6, 15, 19, 20, 21, 28, 27
Master Class	38	1.52	7, 8, 10, 17, 18, 20, 23, 22, 25
Type: Supervised			
Evaluation activities	8	0.32	1, 5, 13, 15, 19, 21
Tutorials	6	0.24	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	48	1.92	12, 5, 13, 3, 29, 15, 19, 21, 9, 27, 30
Study	24	0.96	2, 12, 6, 7, 8, 13, 10, 11, 14, 15, 17, 18, 20, 24, 26, 23, 22, 25

The subject consists of:
38 hours of Master Classes + 8 hours of in-class exercicess + 8 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

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exercises and writings	30%	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, 23, 22, 25, 9, 28, 27, 30
Experimental Laboratory Practices	10%	0	0	1, 2, 6, 13, 29, 19, 9, 28, 27
Oral presentations	60%	0	0	1, 2, 12, 4, 5, 7, 8, 16, 13, 10, 11, 15, 17, 18, 19, 20, 21, 26, 23, 22, 25, 9, 30

The continuous assessment of the subject has the following fundamental objectives:

1) Monitor the teaching-learning process, allowing both students and teachers to know the degree of achievement of the skills and correct, if possible, the deviations that occur.

2) Encourage the continued effort of students.

3) Verify that the students have achieved the skills determined in the study plan.

The assessment activities will be distributed in two modules:

1. Theoretical Module (T)

1a. Exercises and written assignments

Individual and/or group written exercises and assignments will be proposed with a due date, the grade of which will determine 30% of the final grade of the subject.

1b. Oral presentations

The following will be proposed: (1) oral presentations on scientific literature related to the course syllabus, and (2) the preparation by the students of specific parts of the syllabus and the subsequent presentation and discussion in class (reverse class). These assessment activities will determine 60% of the final grade of the subject.

2. Laboratory module (L)

Laboratory practices

The remaining 10% of the grade will be determined based on the evaluation of the laboratory practices, through tests and presentation of reports. Attendance at practical sessions is mandatory for all students.

To pass the subject, you must have an overall grade equal to or higher than 5.0 and you must have obtained at least 5.0 points out of 10 in both the theoretical module (T) and the laboratory module (L). Otherwise, a make-up exam will be held. It is necessary to have completed 2/3 of the activities of the continuous assessment to be entitled to take the recovery test. 10% of the grade corresponding to the laboratory module (L) is not recoverable.

If the final continuousassessment grade does not reach 5, the student has a second chance to pass the subject by taking a remedial test through the following two face-to-face activities (day assigned by the coordinator): (1) a written exercise on any part of the subject syllabus (Topics 1-9), including the oral presentations of classmates (reverse class), and which will consist mainly of short theoretical questions (30%), and (2) a presentation oral (selected by the teaching team from those proposed during the continuous assessment) followed by a discussion of the content presented with the teaching staff (60%). The remaining 10% of the grade will correspond to the grade of the laboratory module (L), which is not recoverable.

Unique assessment

Students who have accepted the single assessment modality will have to complete a final single test which will consist of a written exercise on any part of the subject syllabus (Topics 1-9), including the oral presentations of classmates of class (reverse class), and which will consist mainly of short theoretical questions (30%). On the same day, the students will have to make an oral presentation (selected by the teaching team from among those proposed during the continuous assessment) followed by a discussion of the content presented with the teaching staff (60%). The remaining 10% of the grade will correspond to the grade of the laboratory module (L) which is compulsory attendance for all students. The student's qualification will be:

Subject grade = Grade of the written exercise (30%) + Grade of the Oral presentation (60%) + Grade of the Laboratory Module (L, 10%).

If the final mark does not reach 5, the student has another opportunity to pass the subject through an evaluation identical to the previous one that will be held on the day determined by the coordination of the degree. 10% of the grade corresponding to the laboratory module (L) is not recoverable.

Bibliography

Advanced Nanomaterials and Their Applications in Renewable Energy

Jingbo Liu, Sajid Bashir, Elsevier 2022. ISBN: Paperback ISBN: 9780323998772

eBook ISBN: 9780323917131

Advanced Nanomaterials for Electrochemical Energy Conversion and Storage.

Ed. Fen Ran, Shaowei Chen, Elsevier 2019. Paperback ISBN: 9780128145586

eBook ISBN: 978012814559

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).

Software

No

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	first semester	morning-mixed
(PLAB) Practical laboratories	1	Catalan	first semester	afternoon
(TE) Theory	1	Catalan	first semester	morning-mixed