# Biomolecular Nanoscience

Code: 103273
ECTS Credits: 6

2024/2025

| Degree | Type | Year |
|---|---|---|
| 2501922 Nanoscience and Nanotechnology | OT | 4 |

## Contact

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## Teachers

Sebastián Martin Tanco

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## Teaching groups languages

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

## Prerequisites

none specific

## Objectives and Contextualisation

To give the students a perspective on the characteristics of biomolecules applied to the nanoscience field, and the methodologies used for their manipulation and study. Likewise, we get more knowledgeable about its nanomechanical properties and in the design of nanomaterials based on its self-associative properties.

## 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.

- Interpret the data obtained by means of experimental measures, including the use of computer tools, identify and understand their meanings in relation to appropriate chemical, physical or biological theories.
- 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.
- Perform correct evaluations of the environmental and socioeconomic impact of chemicals and nanomaterials.
- Propose creative ideas and solutions.
- Reason in a critical manner
- 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 motivation for quality.
- Show sensitivity for environmental issues.
- Work correctly with the formulas, chemical equations and magnitudes used in chemistry.

## Learning Outcomes

1. Acquire knowledge of the nanomechanics of biomolecules and the use of their self-assembling properties for the building of nanomaterials.
2. Adapt to new situations.
3. Be ethically committed.
4. Communicate clearly in English.
5. Communicate orally and in writing in one's own language.
6. Correctly use the necessary computer tools to interpret and expose the results obtained.
7. Draft reports on biology and bionanotechnology in English.
8. Evaluate the risks for the human health of nanomaterials used in bionanotechnology.
9. Interpret scientific studies performed with techniques for analysis of individual molecules and make calculations of nanomechanics.
10. Learn autonomously.
11. Manage the organisation and planning of tasks.
12. Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
13. Operate with a certain degree of autonomy.
14. Present brief reports on biology and bionanotechnology in English.
15. Propose creative ideas and solutions.
16. Reason in a critical manner
17. Recognise systems for manipulation and study of individual biomolecules.
18. Recognise the English terms employed in biochemistry, molecular biology, microbiology, immunology and in subjects related with nanoscience and nanotechnology.
19. Resolve problems and make decisions.
20. Show motivation for quality.
21. Show sensitivity for environmental issues.
22. Understand texts and bibliographies in English on biochemistry, molecular biology, microbiology, immunology and in subjects related with nanoscience and nanotechnology.
23. Work correctly with the formulas, chemical equations and magnitudes used in chemistry.

## Content

Topic 1. Introduction. Characteristics of biological molecules and biological machines. Biological motors.

Topic 2. Introduction to synthetic molecular machines and their comparison with biological ones.

Topic 3. Nanomechanical properties of nucleic acids. Ribosomes as cellular synthetic machines.

Topic 4. Biomolecular machines. Myosin, kinesin, and dynein. Microtubules. ATP synthases and ATPases. Bacterial flagella. DNA and RNA polymerases. Other protein-based motors such as efflux pumps.

Topic 5. Design of nanomaterials based on the self-associative properties of biomolecules. DNA as a construction material: DNA Origami. Nanomaterials based on proteins, peptides, liposomes, magnetosomes, virus-like particles.

## Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Classes of problems or practices | 18 | 0.72 | 1, 10, 5, 20, 11, 9, 13, 15, 16, 17, 7, 19, 23 |
| Theory classes | 34 | 1.36 | 1, 22, 5, 9, 3, 15, 16, 18, 17, 7, 6 |
| Type: Supervised | | | |
| Tutorial | 8 | 0.32 | 10, 22, 13, 16, 18, 6 |
| Type: Autonomous | | | |
| Resolution of practical cases and problems | 22.5 | 0.9 | 5, 9, 16, 7, 19, 23, 6 |
| Study | 61.5 | 2.46 | 1, 22, 11, 9, 12, 13, 16, 17, 19 |

The subject consists of theory master classes and classes of problems and/or practical classes and seminars. 15 minutes of class will be devoted to answering the UAB institutional surveys.

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 |
|---|---|---|---|---|
| Submission works | 30 | 2 | 0.08 | 2, 10, 8, 4, 5, 20, 14, 11, 9, 21, 12, 13, 15, 16, 7, 19, 23, 6 |
| Writen Tests | 70 | 4 | 0.16 | 1, 22, 5, 20, 11, 9, 3, 13, 16, 18, 17 |

Continued evaluation:

Evaluation of course work 30% of the total, the other 70% of the total will be divided between attendance/participation 20% and written exam 50%.

Assessment of work during the course: There will be two assignments to be done during the course. They can be bibliographic research, presentation of seminars, interpretation of work data, etc. According to the teacher, they can be individual or group work to be delivered in printed form, through the virtual campus, or through presentations in the classroom.

The minimum grade to pass will be 5 out of 10.

To participate in the retake (final) exam, the students must have been previously evaluated in a set of activities whose weight equals a minimum of two-thirds of the total grade of the subject or module, and they must have a mark of at least 3,5.
The final exam will include the theoretical contents and that will be worth up to 70% of the final grade.

Unique assessment:

There will be an Exam that will include Theory and the content of the classroom practice sessions and the contents of the seminars held on the subject. The test will consist of topic-type questions to be developed. The grade obtained in this test will represent 70% of the final grade of the subject, 50% corresponding to the theory, and the other 20% corresponding to the contents of the classroom practices and seminars.

The delivery of the activities carried out during the course will follow the same procedure as the continuous assessment: There will be two assignments to be done during the course. They can be bibliographic research, presentation of seminars, interpretation of work data, etc. According to the teacher, they can be individual or group work to be delivered in printed form, through the virtual campus, or through presentations in the classroom. The delivery will be on the same date that the exam. The grade obtained in this test will account for 30% of the final grade of the subject.

To participate in the retake (final) exam, the students must have a mark of at least 3,5.
The final exam will include the theoretical contents and that will be worth up to 70% of the final grade.

## Bibliography

1- Nanochemistry: A Chemical Approach to Nanomaterials. RSC Publishing. 2008.

2- Molecular Machines . Benoit Roux Ed. 2011.

3- Motor proteins and Molecular Motors. CRC Press 2020.

## Software

None

## Language list

| Name | Group | Language | Semester | Turn |
|---|---|---|---|---|
| (PAUL) Classroom practices | 1 | Catalan/Spanish | second semester | morning-mixed |
| (TE) Theory | 1 | Catalan/Spanish | second semester | morning-mixed |