Universitat Autònoma de Barcelona

2021/2022

Biomolecular Nanoscience

Code: 103273
ECTS Credits: 6

Degree	Type	Year	Semester
2501922 Nanoscience and Nanotechnology	OT	4	0

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Marc Torrent Burgas

Prerequisites

none specific

Objectives and Contextualisation

To give the student a perspective on the characteristics of biomolecules applied to the nanoscience´s field, the methodologies used for their manipulation and study. Likewise, we get more knowledgeable about its nanomecanic 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 ones 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 ones 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. Manipulation and study of individual biomolecules. Nanometrology. Techniques of fluorescence. AFM: force spectroscopy and force-clamp spectroscopy. Optical and magnetic tweezers.
Topic 3. Nanomechanical properties of nucleic acids. Stretching DNA and RNA, chromatin, and chromosome fibers.
Topic 4. Biomolecular machines. Myosin, kinesin, and dynein. Microtubules. ATP synthase and ATPases. Bacterial flagella, DNA, and RNA polymerases. Other motors based on proteins.
Topic 5. Design of nanomaterials based on the self-associative properties of biomolecules. DNA as a construction material. Nanomaterials based on peptides, liposomes, magnetosomes, virus-like particles.
"*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents."

Methodology

The subject consists of theory master classes and classes of problems and/or practical classes and seminars. "*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities."

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.

Activities

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

Assessment

Course work evaluation 30% of the total, the other 70% of the total will be distributed between attendance/participation 20% and written examination 50%.

Assessment of work during the course: There will be expositions/works to be carried out during the course. They can be of bibliographic search, presentation of seminars, interpretation of data of works, etc. According to the teacher, they can be individual or group work to be delivered in printed form or through the virtual campus.

The minimum mark 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.
"*Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities."

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

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